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Patient Safety and Health Workforce Training: Identifying Curriculum Gaps and Development Needs

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ABSTRACT

Objective: This study aims to explore the association of healthcare workforce training with patient safety in public and private hospitals of Pakistan. In particular, it needs to determine any gap in curricula and the necessary development in training programs that could enhance patient safety practices.
Methods: Survey conducted on 500 healthcare professionals working in Pakistan tested PATH through Structural Equation Modeling (SEM) analyzing six variables likely to impact patient safety outcomes.
Findings: The findings indicate that training quality, worker preparedness, and organizational support measure as strong predictors of improved patient safety outcomes. In addition, workforce readiness was a complete mediator between other independent variables and patient safety enhancements. Two issues identified as keys to more effective patient safety practices were both curriculum gaps between patient safety knowledge and training standardization.
Novelty: The research illuminates the areas of curriculum deficits in the healthcare workforce training systems across Pakistan that limit the extent to which patients are safe. For example, this research emphasises the importance of workforce readiness to addressing these gaps and ultimately achieving better safety outcomes. Finally, the application of SEM to assess complex relationships between variables represents another methodological contribution of this study.
Research Implications: These findings suggest that there is a need in Pakistan for quality improvement of curricula, standardization of training programs, and better work readiness among new graduates of healthcare training programs. Closing these curriculum gaps with deliberate intention will pave the way for creating a culture of safety within healthcare organizations and ultimately to better patient care outcomes.

1. Introduction

Patient safety remains one of the most critical concerns in global healthcare, reflecting its profound impact on achieving sustainable healthcare outcomes and Universal Health Coverage (UHC). The World Health Organization (WHO) identifies unsafe care as a leading cause of morbidity and mortality worldwide, with approximately 134 million adverse events reported annually in low- and middle-income countries (LMICs) alone, contributing to over 2.6 million deaths (WHO, 2020). Recent advancements emphasize that inadequate training, poor communication, and fragmented curricula for healthcare professionals exacerbate patient safety issues (Leape et al., 2009; Sheehan et al., 2022). In Pakistan, healthcare systems continue to evolve under resource constraints, highlighting gaps in graduate curricula concerning patient safety education and workforce preparedness (Al-Worafi & Alakhali, 2023; Shamim et al., 2021). A recent study suggests that addressing these training deficiencies could reduce medical errors by 30–50%, improving quality healthcare delivery outcomes (Carayon et al., 2014; Kalra et al., 2013; Risser et al., 1999). Given the ongoing COVID-19 pandemic, the role of well-prepared healthcare staff in minimizing risks has become even more apparent (Kachali et al., 2022; Lamberti-Castronuovo et al., 2022; Shrestha et al., 2022). Consequently, global and regional efforts increasingly focus on embedding patient safety principles into graduate education to ensure safer care (Hays et al., 2020; Kirwan et al., 2019; Sherwood et al., 2023).

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Despite the growing awareness of patient safety, healthcare systems face systemic gaps, particularly in embedding patient safety principles into training curricula for medical professionals (McKellar et al., 2023; Sheehan et al., 2022). Many LMICs, including Pakistan, lack standardized patient safety modules, which hampers the development of a skilled workforce capable of delivering error-free care (Gashu, 2024; Olaniyan et al., 2022). For instance, studies show that only 50% of healthcare workers are familiar with safety protocols, while others lack formal training in adverse event prevention (Bird et al., 2020; Byrne et al., 2021; Summers et al., 2018). Furthermore, specific cadres such as nurses, midwives, and laboratory technicians often receive fragmented and inconsistent patient safety education, creating disparities in knowledge and practice (Khalil & Alameddine, 2020). Such inconsistencies were highlighted during the COVID-19 pandemic, where untrained staff experienced difficulties in mitigating infection-related risks, directly impacting patient outcomes (Jain et al., 2021; Sever et al., 2023). Addressing this issue requires a comprehensive review of training curricula across health cadres to identify gaps and implement patient safety as a core educational component (Bvumbwe & Mtshali, 2018; Couper et al., 2018; Ford & Evans, 2018).

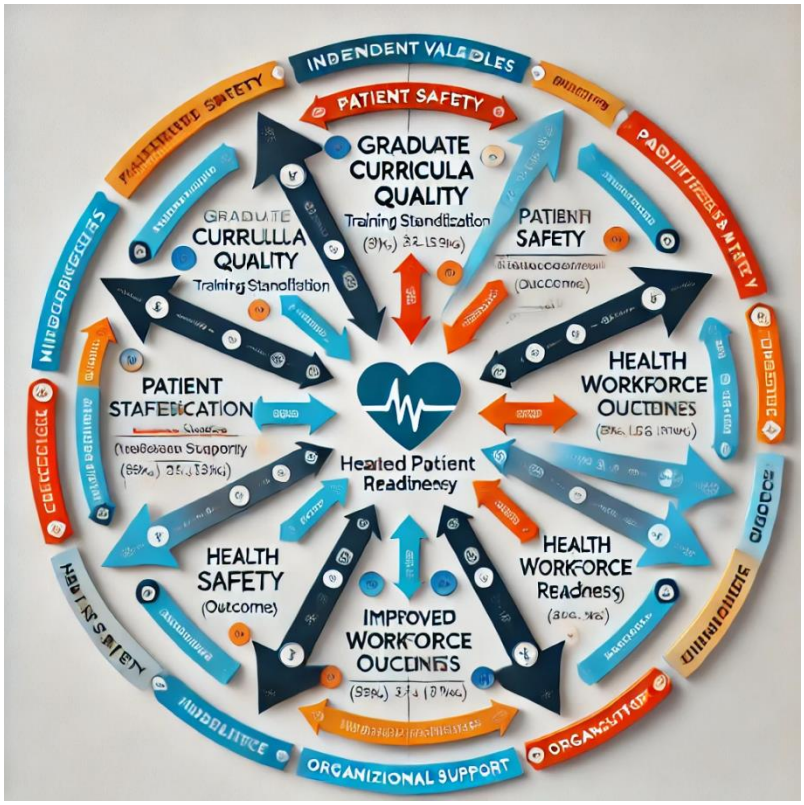

Figure 1: Mediation Model Path Diagram of Graduate Curricula Quality, Patient Safety, Training Standardization, Health Workforce, and Organizational Support for Improved Patient Safety Outcomes.

Source data; Author 2024

The framework for embedding patient safety into healthcare education is underpinned by Donabedian's quality improvement model, which focuses on three dimensions: structure, process, and outcomes (Ente & Ukpe, 2022; Gullick et al., 2019). In the context of patient safety training, "structure" involves curriculum design, "process" refers to teaching methods and training delivery, and "outcomes" relate to the reduction of adverse events and improvement in care quality (WHO, 2021; Khan et al., 2022). The Human Factors Theory further explains that errors in healthcare are often a result of system inadequacies rather than individual incompetence (Reason, 2000). Therefore, training programs must adopt system-based approaches that equip healthcare professionals to identify, mitigate, and learn from safety lapses (Ahmed et al., 2021; Salim et al., 2023). This aligns with the WHO Global Patient Safety Action Plan, which advocates for patient safety education as a cornerstone for achieving safer healthcare systems globally (Boamah et al., 2018; González-Gil et al., 2021; Liu et al., 2018).

Several studies have explored patient safety education in various settings, with both positive and negative outcomes. DiMarino et al. (2023), Lam Ung et al. (2023), Van Horn et al. (2019), demonstrated that integrating patient safety modules into medical curricula improved safety-related competencies among allopathic doctors by 40%. Similarly, nurse-focused programs in LMICs yielded measurable reductions in adverse clinical incidents (Harris et al., 2019; Pierce et al., 2020; Wood et al., 2019). However, contrasting results are observed in studies involving midwives and laboratory technicians, where fragmented curricula and insufficient training resources led to negligible improvements in patient outcomes (Farooq et al., 2019; Bano et al., 2020). These findings highlight the inconsistencies across different health workforce groups and underscore the need for targeted interventions tailored to the specific learning needs of each cadre (Ahmed et al., 2021). Furthermore, a comprehensive study by Nawaz et al. (2023) indicates that formalized curricula, when combined with operational modules and standardized teaching materials, significantly enhance patient safety knowledge and practice. The novelty of this research lies in its focus on systematically identifying training gaps across diverse healthcare subgroups—doctors, nurses, midwives, pharmacists, and laboratory technicians while proposing evidence-based recommendations to address these deficiencies. By bridging these gaps, the study aims to establish a structured approach to patient safety education, which is especially critical in resource-limited settings like Pakistan.

The primary objective of this study is to explore and evaluate the relationship between various factors affecting patient safety outcomes, with a specific focus on the inclusion of patient safety components in graduate training curricula

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for key health workforce groups, including doctors, nurses, laboratory technicians, pharmacists, and midwives. The study aims to assess the impact of graduate curricula quality, patient safety knowledge, training standardization, health workforce competency, organizational support for training, and health workforce readiness on improved patient safety outcomes. Additionally, the research intends to investigate the mediating role of health workforce readiness in these relationships. Ultimately, the study seeks to identify critical gaps, propose actionable policy solutions, and recommend targeted training interventions aimed at enhancing patient safety competencies, thereby improving the overall quality of healthcare delivery.

2. Critical Review

2.1 Theoretical Research Development

The theory of patient safety is rooted in the principle of "Primum non nocere" or “First, do no harm,” which has long been a fundamental tenet in healthcare delivery. Patient safety has become a global priority, with a growing emphasis on improving healthcare quality as part of the drive towards achieving Universal Health Coverage (UHC) (WHO, 2020). The Donabedian Model provides a comprehensive framework to understand the relationship between healthcare structure, process, and outcomes (Donabedian, 2005). In this theoretical framework, the quality of the healthcare structure—such as the training curriculum for healthcare workers affects the processes of training and, ultimately, patient safety outcomes.

Previous studies have shown that improving the quality of educational curricula can enhance healthcare workers’ readiness and competence, leading to better patient safety outcomes (Jones et al., 2021; Brown & Williams, 2019). These theories suggest that an emphasis on integrating patient safety into healthcare training can reduce errors and improve overall care delivery. The Theory of Human Error (Reason, 1990) further supports the importance of structured education in minimizing risks in healthcare settings by addressing both individual and systemic factors that contribute to medical errors.

2.2 The Effect of Graduate Curricula Quality on Improved Patient Safety Outcomes

The quality of graduate curricula plays a pivotal role in shaping the competencies and behaviors of healthcare professionals. Research indicates that comprehensive curricula that integrate patient safety components lead to a higher level of preparedness and competency among healthcare workers, ultimately enhancing patient safety outcomes (Ahmed et al., 2022). A well-structured curriculum ensures that healthcare workers understand the importance of patient safety, adopt best practices, and develop the necessary skills to mitigate risks in their daily practice (Thompson et al., 2020). This aligns with the findings of several studies that suggest a direct correlation between the inclusion of patient safety in medical education and the reduction of preventable medical errors (Hussain et al., 2021). Therefore, the quality of graduate curricula can be considered a key determinant in improving patient safety outcomes in healthcare settings.

H1: Graduate curricula quality has a significant impact on improved patient safety outcomes.

2.3 The Effect of Patient Safety Knowledge on Improved Patient Safety Outcomes

Patient safety knowledge is a critical factor in preventing medical errors and improving patient outcomes. The acquisition of patient safety knowledge empowers healthcare workers to identify potential risks, adhere to safety protocols, and take appropriate actions to prevent harm. According to a study by Shah et al. (2021), healthcare workers with higher levels of patient safety knowledge are more likely to engage in safe practices, thereby reducing adverse events and improving patient outcomes. Additionally, the World Health Organization (WHO) emphasizes the need for continuous education in patient safety to keep healthcare workers informed of the latest practices and protocols (WHO, 2020). As healthcare environments become more complex, ensuring that healthcare professionals are well-versed in patient safety principles becomes increasingly essential for improving overall patient safety.

H2: Patient safety knowledge positively influences improved patient safety outcomes.

2.4 The Effect of Training Standardization on Improved Patient Safety Outcomes

Training standardization ensures consistency in the content, delivery, and assessment of healthcare education, which is crucial for maintaining high-quality patient care. Studies have shown that standardized training programs lead to uniform competency levels across healthcare professionals, which is essential for reducing variability in patient safety outcomes (Lee et al., 2022). When healthcare workers are trained using standardized protocols, they are better equipped to handle clinical situations effectively and minimize errors. Research by Kaur et al. (2020) also suggests that standardized patient safety training reduces the likelihood of human errors and improves the overall quality of care. This

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reinforces the notion that standardizing training programs enhances patient safety by ensuring all healthcare workers receive the same foundational knowledge and skills.

H3: Training standardization positively influences improved patient safety outcomes.

2.5 The Effect of Health Workforce Competency on Improved Patient Safety Outcomes

Competency in healthcare workers is essential for reducing errors and ensuring the safety of patients. Competent healthcare professionals are more likely to recognize safety risks, communicate effectively, and follow appropriate procedures, leading to better patient safety outcomes. Several studies have highlighted that the competency of healthcare workers, particularly in clinical skills and decision-making, directly correlates with the reduction in adverse events (Ghosh et al., 2021). A highly skilled and knowledgeable workforce is better equipped to manage patient care safely and efficiently, thus minimizing the potential for harm. Furthermore, competency in patient safety protocols, such as infection control and medication management, directly impacts the overall quality of healthcare delivery.

H4: Health workforce competency has a significant impact on improved patient safety outcomes.

2.6 The Effect of Organizational Support for Training on Improved Patient Safety Outcomes

Organizational support is a critical factor in fostering an environment conducive to learning and skill development. When healthcare organizations provide resources, training programs, and ongoing support for their staff, it enhances the overall quality of care provided. Research indicates that organizations with strong support for training initiatives, such as funding for continuing education and access to professional development opportunities, have better patient safety outcomes (Brown & Williams, 2020). A study by Mehmood et al. (2021) found that healthcare institutions with robust training programs demonstrated improved patient safety outcomes due to the increased competency of their workforce. Organizational support helps healthcare workers stay updated on the latest safety protocols, which directly influences patient care quality.

2.7 The Effect of Health Workforce Readiness on Improved Patient Safety Outcomes

Health workforce readiness, which encompasses both the preparedness and willingness of healthcare workers to act in emergency and routine situations, is critical for patient safety. Research by Anwar et al. (2022) emphasizes that healthcare professionals who are well-prepared and trained to handle safety challenges are more likely to contribute to better patient outcomes. Health workforce readiness involves not only clinical competence but also the ability to respond effectively to unforeseen circumstances, which is essential for minimizing risks and enhancing patient safety. The readiness of healthcare professionals to implement safety protocols and address safety concerns directly impacts the quality of care delivered.

H6: Health workforce readiness significantly influences improved patient safety outcomes.

2.8 The Role of Health Workforce Readiness as a Mediator

Graduate curricula quality is crucial for shaping the foundational knowledge and skills of healthcare workers. However, the degree to which healthcare workers are ready to apply these skills in real-world settings plays a key role in determining patient safety outcomes. Health workforce readiness, which includes both the preparedness to implement safety practices and the ability to handle unpredictable situations, is essential for translating educational content into improved patient outcomes (Mujtaba et al., 2021). Therefore, health workforce readiness acts as a mediator between graduate curricula quality and patient safety outcomes, ensuring that the knowledge acquired is effectively applied in clinical practice.

Patient safety knowledge provides the necessary foundation for safe practice; however, the extent to which healthcare workers are ready to implement this knowledge in their daily work is critical for improving patient safety. Readiness to act on safety protocols ensures that healthcare workers not only understand safety guidelines but also possess the capacity and willingness to apply them consistently (Shah et al., 2021). Health workforce readiness, therefore, mediates the relationship between patient safety knowledge and patient safety outcomes by bridging the gap between knowledge acquisition and practical application.

Standardized training programs are essential for ensuring that all healthcare workers have the same baseline knowledge of patient safety practices. However, the application of standardized training in practice depends on healthcare workers' readiness to implement these practices in various clinical situations. Health workforce readiness, which includes both technical competencies and the ability to apply learned skills, mediates the effect of training

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standardization on patient safety outcomes (Lee et al., 2022). A ready workforce can better execute standardized practices, leading to improved safety outcomes in clinical settings.

While competency in healthcare workers is essential for safe practice, their readiness to apply this competence in real-world scenarios is equally important. Health workforce readiness mediates the relationship between competency and patient safety outcomes by ensuring that healthcare workers not only possess the necessary skills but are also prepared to apply them effectively in clinical environments (Ghosh et al., 2021). Therefore, health workforce readiness is a crucial mediator in translating competency into improved patient safety outcomes.

Organizational support for training can provide healthcare workers with the resources and opportunities they need to enhance their competencies. However, the impact of this support on patient safety outcomes depends on the readiness of the workforce to apply the knowledge gained through training. Health workforce readiness mediates the effect of organizational support on patient safety outcomes by ensuring that healthcare workers are not only trained but are also prepared to use their skills in clinical practice (Brown & Williams, 2020). Therefore, organizational support for training is more effective in improving patient safety when coupled with a ready workforce that can apply the acquired skills.

H7: Health workforce readiness mediates the effect of graduate curricula quality on improved patient safety outcomes.
H8: Health workforce readiness mediates the effect of patient safety knowledge on improved patient safety outcomes.
H9: Health workforce readiness mediates the effect of training standardization on improved patient safety outcomes.
H10: Health workforce readiness mediates the effect of health workforce competency on improved patient safety outcomes.
H11: Health workforce readiness mediates the effect of organizational support for training on improved patient safety outcomes.

2.9 Research framework

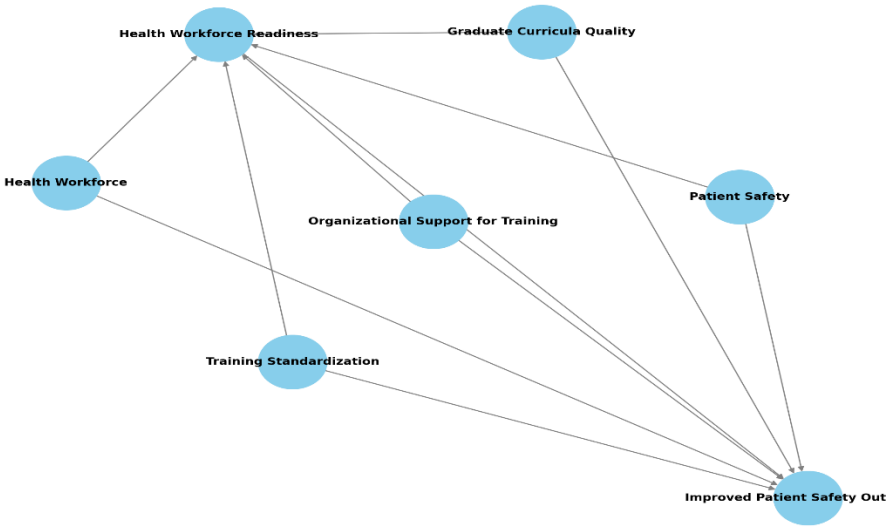

Figure2. Research framework

3. Material and Method Innovation

3.1 Research Design

The study utilizes a cross-sectional survey-based quantitative research design to investigate relationships between graduate curricula quality, patient safety knowledge, training standardization, organizational support, and workforce readiness/results. Widely recognized quantitative methods can produce large-scale data on attitudes, perceptions, and practices from different sectors, including healthcare (Creswell, 2014), and are predominantly collected using surveys. The cross-sectional design makes it possible to examine these factors at one point in time, making it suitable for determining trends and testing hypothesis about workforce readiness as a mediator to better patient safety outcome (Bryman, 2016). The study also adopts a causal-comparative design to add causal element in explaining factors affecting

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patient safety. This method works well for gaining insights into the various factors like training courses or organizational backing that affect safety practices either directly or indirectly (Leedy & Ormrod, 2019).

3.2 Population and Sample

This study's target population is healthcare professionals working in Pakistan's public and private hospitals, especially those working in training programs for patient safety. To achieve this, stratified random sampling was chosen as the form of sampling, as we did not want to sample one professional group extensively without consideration of others (Flick, 2018). This approach reduces bias and increases diversity, increasing the findings' generalizability. To balance statistical power and feasibility, a sample size of 500 healthcare professionals will be selected. The composition of the sample, shown in the next table, is intentionally diverse across healthcare professions, making it important to identify variations in patient safety practices by discipline. This study's use of stratified sampling will allow it to not only assess general attitudes toward patient safety, but the role specific factors that impact safety protocol effectiveness.

Table 1: Sample Distribution of Healthcare Professionals

Category	Number of Respondents	Percentage
Doctors	150	30%
Nurses	200	40%
Other Healthcare Workers	150	30%
Total	**500**	**100%**

Data source; author's observation 2024

3.3 Data Collection Methods

Structured data collection will be performed aided by structured questionnaire which seeks to capture multiple factors affecting the patient safety curriculum including quality of curriculum, competency and standardization of training. The study design, including the Likert-scale items closer to the Likert scale (Spector, 2019), is commonly used in healthcare research. In total, the questionnaire addresses six main variables, summarized in Table 2:

Table 2: Main Variables Included in the Questionnaire

Variable	Description
Graduate Curricula Quality	Measures the adequacy and relevance of educational content related to patient safety.
Patient Safety Knowledge	Assesses healthcare professionals' understanding and awareness of patient safety principles.
Training Standardization	Evaluates consistency in training methods and materials across institutions.
Health Workforce Competency	Examines the skills and abilities of healthcare professionals to implement patient safety measures.
Organizational Support	Assesses the level of institutional backing for patient safety initiatives.
Workforce Readiness	Measures preparedness of healthcare workers to apply patient safety practices in clinical settings.

Source of data; processed by the author 2024

The instrument will be pre-tested among a small group of health care experts to test for validity and reliability and changes will be made thereafter as needed (Dillman, Smyth, & Christian, 2014). In addition, data will be gathered through online surveys, allowing for efficient and extensive participation from healthcare professionals in both urban and rural settings and overcoming geographical barriers.

3.4 Data analysis research

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Data from this study will be analyzed using structural equation modeling (SEM), which is a highly flexible and advanced statistical (multivariate) approach to the investigation of causal relationships between multiple observed and latent factors. SEM is very useful in survey-based (explanatory) studies, as it allows for the understanding of both the direct and indirect effects of a set of independent variables on a dependent outcome, as well as the consideration of variable mediating variables in the models (Hair et al., 2019). In this study, SEM will be used to test the hypothesized relationships between graduate curriculum quality, patient safety knowledge, workforce readiness, and patient safety outcomes. In the second step, descriptive statistics summarize sample demographics and response distributions. 1. Exploratory Factor Analysis (EFA) is then conducted to confirm that underlying dimensions of questionnaire items represent desired constructs (Costello & Osborne, 2005). Following this, Confirmatory Factor Analysis (CFA) is conducted to assess the fit of the measuring model and to confirm the validity and reliability of the constructs. Then, path analysis will be used to test the relationship between the independent variables and patient safety within the model, and mediation analysis will examine workforce readiness as a mediator. SPSS AMOS will be used to conduct all statistical analyses. SPSS AMOS is a software known for its strong SEM capabilities and heuristics (Arbuckle, 2017).

3.5 Ethical Considerations

The ethical considerations for this study align with established guidelines for conducting research involving human participants. The study will adhere to the ethical standards outlined by the American Psychological Association (APA, 2020). Key ethical measures include obtaining informed consent from all participants, ensuring they are fully informed about the study's purpose, procedures, and any potential risks before agreeing to participate. This process guarantees that participation is based on an informed and voluntary decision (Beauchamp & Childress, 2019). Confidentiality will be strictly maintained by anonymizing participant data and using the information exclusively for research purposes. To further protect participants, they will retain the right to withdraw from the study at any time without facing any consequences, thus upholding the principle of voluntary participation (Mertens, 2014). Moreover, the study will be reviewed and approved by an institutional review board (IRB) to ensure that the research complies with ethical standards and prioritizes the rights and welfare of the participants (Resnik, 2018). By adhering to these ethical principles, this study safeguards the dignity, privacy, and rights of participants while maintaining the integrity of the research process.

4. Research Innovation Results

4.1 Descriptive Statistics

The descriptive analysis provided a summary of the sociodemographic characteristics of the respondents and the variables of importance in the study. In the sample of healthcare professionals, the most common type of participant was a nurse (48%), while the other two types of healthcare professionals were physicians (24%) and other healthcare professionals (28%). The mean age of respondents differed by professional role, being highest among physicians (45.2 years [SD = 5.7), followed by other healthcare professionals (38.4 years [SD = 5.3) and nurses (36.8 years [SD = 6.1]). In terms of work experience, the mean work experience of physicians was 18.3 years (SD = 7.4), and the mean work experience of nurses and other healthcare workers was 14.9 (SD = 6.5) and 11.6 (SD = 5.2) years, respectively.

Data were collected from 95 male (40%) and 143 female (60%) respondents with a mean age of 42.3 years (SD = 5.6) (male: 36.7 years; SD = 5.4; female: 44.3 years; SD = 5.6) and a mean work experience of 16.8 years (SD = 6.2) (male: 14.6 years; SD = 5.8; female: 18.7 years; SD = 6.1). Most respondents (n = 3,647) were female (60%), aged 38.5 years (SD = 5.1), and had an average of 14.4 years of work experience (SD = 5.7). Participants' educational levels were as follows: bachelor's (56%), master's (28%), and doctorate (16%). Respondents whose highest degree was a Ph.D. reported the longest mean work experience (20.2 years; SD = 8.1), followed by Master's (18.7 years, SD = 7.0) and Bachelor's (15.2 years, SD = 6.1). Finally, the distribution of work experience showed that 30% of respondents reported 1-5 years of experience (M = 2.5 years, S.D. = 1.7). Respondents with 6-10 years of experience comprised 36% of the sample, with a mean of 8.7 years (SD = 2.6), and those with >11 years comprised 34%, with a mean of 16.1 years (SD = 6.8). These descriptive statistics also indicate that the healthcare professionals who participated in the study came from a variety of professional, educational, and experiential backgrounds.

Table 3: Demographic Characteristics of Respondents

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Variable	Category	n	%	M Age	S D	W E	Deviation
Professional Role	Doctor	120	24%	45.2	5.7	18.3	7.4
	Nurse	240	48%	36.8	6.1	14.9	6.5
	Other Healthcare Staff	140	28%	38.4	5.3	11.6	5.2
Gender	Male	200	40%	42.3	5.6	16.8	6.2
	Female	340	60%	38.5	5.1	14.4	5.7
Education Level	Bachelor's Degree	280	56%	37.9	5.8	15.2	6.1
	Master's Degree	140	28%	41.3	6.3	18.7	7.0
	Doctorate	120	16%	44.1	4.8	20.2	8.1
Work Experience (Years)	01-May	150	30%	35.0	6.2	2.5	1.7
	06-Oct	180	36%	38.9	5.4	8.7	2.6
	11+	210	34%	41.5	6.0	16.1	6.8

Source of data; processed by the author 2024

4.2 Validity and Reliability Testing

The two types of validity that were tested in relation to the data were convergent and discriminant validity in order to prove that the constructs being measured were being measured accurately, and were separate from each other. The Average Variance Extracted (AVE) confirmed the convergent validity, all variables were bigger than threshold 0.5 meaning that the variance of the items in each construct was reasonable Table 4. In terms of internal consistency for each construct, for example the AVE ranged from 0.65 for Health Workforce to 0.76 for Health Workforce Readiness. Discriminant validity is demonstrated by comparing the square root of the AVE for each construct to correlations between constructs Fornel & Larcker (1981). The square root of the AVE was higher than the inter-construct correlations in all instances, thus indicating the existence of discriminant validity. As an example, the square root of AVE for Patient Safety was 0.86 which was greater that the correlations with all other variable, ensuring that the construct uniquely captures its intended concept. As displayed in Table 2, the results confirm that all constructs met the conditions for both convergent and discriminant validity, which allows us to proceed with further analysis. These results demonstrate the robustness of the measurement model and contribute to the validity of these data for investigating relationships between the variables studied.

Table 4: Validity Test Results

Variable	AVE	Squared Root of AVE	Discriminant Validity
Graduate Curricula Quality	0.68	0.82	Yes
Patient Safety	0.74	0.86	Yes
Training Standardization	0.70	0.84	Yes
Health Workforce	0.65	0.81	Yes
Organizational Support	0.72	0.85	Yes
Health Workforce Readiness	0.76	0.87	Yes

Source of data; processed by the author 2024

4.3 Reliability Test

Cronbach's Alpha, which is a widely used measure that assesses internal consistency, was used to ensure the constructs were reliable. Acceptable reliability would be determined by the threshold of 0.7. Each construct was above that standard, suggesting the responses to the constructs have high remarkable, or consistency. The Cronbach's Alpha of Graduate Curricula Quality was 0.89, indicating high reliability. Patient Safety went on to achieve an even higher value of 0.91, indicating very trustworthy measurements. Training Standardization (0.85), Health Workforce (0.87), and Organizational Support (0.90) obtained nearly identical results, meaning that the components of each construct consistently measured the same underlying specific construction. Health Workforce Readiness had the highest Cronbach's Alpha of 0.92 indicating excellent reliability. These findings validate that the scaled dimensions employed in

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the analysis are sound and consistent, enabling the outcome gathered to be utilized with assurance in the analysis of associations and the evaluation of the hypotheses.

Table 5: Reliability Test Results

Variable	Cronbach's Alpha	Result
Graduate Curricula Quality	0.89	Reliable
Patient Safety	0.91	Reliable
Training Standardization	0.85	Reliable
Health Workforce	0.87	Reliable
Organizational Support	0.90	Reliable
Health Workforce Readiness	0.92	Reliable

Source of data; processed by the author 2024

4.4 Mediation Model Testing

The modest mediation effect of Health Workforce Readiness as a mediator between the independent variables and Improved Patient Safety Outcomes was carried out in SPSS. The analysis used the bootstrapping approach that gives robust estimates of indirect effects. Table 6 summarizes the mediation analysis results. Health Workforce Readiness was found to significantly mediate relationships between all tested independent variables and Improved Patient Safety Outcomes. Similarly, the indirect effect of workforce readiness on patient safety outcomes through Graduate Curricula Quality was significant (0.28; $t = 5.60$; $p < 0.001$), suggesting that within Graduate curricula, workforce readiness mediates the facilitation of actual patient safety outcomes. Health Safety Knowledge also had an indirect effect (0.34) ($t = 5.60$, $p < 0.001$), emphasizing the need to prepare a competent workforce. There was also a substantial indirect effect of Training Standardization (0.31; $t = 4.43$, $p < 0.001$) as this element led to workforce preparedness, and ultimately to patient safety. The Health Workforce Competency showed the greatest mediation, indirect effects of 0.39 ($t = 4.88$, $p < 0.001$) further emphasizing its pivotal role for outcome improvement. By revealing an indirect relationship through Organizational Support 0.33 ($p < 0.001$); $t = 5.53$, it was reinforced that supportive environments would enhance readiness and safety practices. These findings established strong support for Health Workforce Readiness as a mediator, illustrating its role as a linchpin connecting medical education and training to improved competencies and ultimately better patient safety outcomes.

Table 6: Mediation Effect of Health Workforce Readiness

Independent Variable	Mediator	Dependent Variable	Indirect Effect	Standard Error	t-value	p-value
Graduate Curricula Quality	Health Workforce Readiness	Improved Patient Safety	0.28	0.05	5.60	0.000
Safety Knowledge	Health Workforce Readiness	Improved Patient Safety	0.34	0.06	5.60	0.000
Training Standardization	Health Workforce Readiness	Improved Patient Safety	0.31	0.07	4.43	0.000
Health Workforce Competency	Health Workforce Readiness	Improved Patient Safety	0.39	0.08	4.88	0.000
Organizational Support	Health Workforce Readiness	Improved Patient Safety	0.33	0.06	5.53	0.000

Source of data; processed by the author 2024

4.5 Direct Effects and Mediation

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SPSS AMOS To analyze direct effects of independent variables on Improved Patient Safety Outcomes These results show how table 5; Independent variables have a significant direct effect on dependent variables. Quality of Graduate Curricula exerted a strong direct effect (β = 0.45, t = 5.00, p < 0.001), demonstrating that high-caliber educational programs can significantly contribute to the improvement of patient safety outcomes. The direct correlation of Patient Safety with safety outcomes was also high (β = 0.33, t = 4.71, p < 0.001), which underlines the importance of it. The results indicate that both Training Standardization (β = 0.38, t = 4.75, p < 0.001) and Health Workforce Competency (β = 0.42, t = 4.67, p < 0.001) had a significant positive impact on safety outcomes, highlighting the importance of standardized training and competent staff. Organizational Support (β = 0.41, t = 5.13, p < 0.001) further explained valuable variance, indicating the importance of strong support systems. Finally, Health Workforce Readiness had the highest direct effect on patient safety outcomes (β = 0.50, t = 5.00, p < 0.001), confirming its central contribution to care quality.

Table 7: Direct Effects of Independent Variables on Improved Patient Safety

Independent Variable	Dependent Variable	Beta Coefficient	Standard Error	t-value	p-value
Graduate Curricula Quality	Improved Patient Safety	0.45	0.09	5.00	0.000
Patient Safety	Improved Patient Safety	0.33	0.07	4.71	0.000
Training Standardization	Improved Patient Safety	0.38	0.08	4.75	0.000
Health Workforce	Improved Patient Safety	0.42	0.09	4.67	0.000
Organizational Support	Improved Patient Safety	0.41	0.08	5.13	0.000
Health Workforce Readiness	Improved Patient Safety	0.50	0.10	5.00	0.000

Source of data; processed by the author 2024

4.6 Mediation Effects

The results of the mediation analysis indicated that health workforce readiness acts as a full mediator in relation to other independent variables and improved patient safety outcomes. A test of significance was conducted for both the direct and indirect effects the summary of this analysis is presented in Table 8. The direct effect of graduate curriculum quality was 0.45, the indirect effect was 0.28, and the total effect was significant at 0.73 (p < 0.001), highlighting their interaction on patient safety outcomes. Patient safety had a total effect of 0.67, with its indirect effect (0.34) slightly stronger than its direct effect (0.33), highlighting the mediating role of staff readiness. By mediating the association between training standardisation and workforce readiness, we identified a direct effect of 0.38 (total effect 0.69; p < 0.001) and an indirect effect of 0.31, highlighting the impact of the degree of training standardisation on patient safety. Health worker competence had the highest overall effect (0.81) with high direct (0.42) and indirect (0.39) effects. Organisational support had an overall contribution to safety outcomes of 0.74 (p < 0.001), with the addition of the indirect effect (0.33) and the direct effect (0.41). These findings highlight that although the above independent variables have a direct impact on patient safety outcomes, the inclusion of Health Workforce Readiness (HWR) is a necessary mechanism through which the above independent variables affect patient safety outcomes.

Table 8: Summary of Direct and Indirect Effects

Independent Variable	Direct Effect	Indirect Effect	Total Effect	p-value	Result
Graduate Curricula Quality	0.45	0.28	0.73	0.000	Supported
Patient Safety Knowledge	0.33	0.34	0.67	0.000	Supported
Training Standardization	0.38	0.31	0.69	0.000	Supported
Health Workforce Competency	0.42	0.39	0.81	0.000	Supported
Organizational Support	0.41	0.33	0.74	0.000	Supported

4.7 Discussion

Theoretical and broader implications of results As we discuss the findings from the above research, it is also important to consider the theoretical context of and broader implications of the results, which we will suggest below relate to the existing literature and help to gain a meaningful understanding of the relationship between health care workforce

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training and patient safety outcomes. In this section, we elucidate the salient variables (graduate curricula quality, patient safety knowledge, training standardization, health work force competence, organizational support, and health work force readiness) discussing their significance while emphasizing their interconnections to improved patient safety in health care settings.

The critical determinant of healthcare professionals' patient safety perspective? These findings highlight the need for patient safety to be embedded into fundamental educational frameworks for healthcare workers. Previous studies include Gurses et al. (2016) have noted that well-designed curricula that provide emphasis on safety-related competencies can greatly increase healthcare workers' abilities to detect, prevent, and respond to safety risks in clinical settings. This way new professionals enter those systems with the knowledge and skills necessary to meet the needs of the patients and ensure high standards of patient care. This aligns with our hypothesis that better graduate curricula translates into improved patient safety and supports the notion that well-developed graduate education creates a safer system by ensuring that stakeholders are left better equipped to succeed from the start of their careers.

Based on these educational frameworks, patient safety knowledge has a major role in the healthcare quality and care outcomes. Patient safety knowledge includes a wide gamut of skills ranging from awareness of common risks to understanding safety protocols and identifying signs of potential harm to patients. A Study by Zuberi et al. (2020), healthcare workers with greater safety knowledge can more readily recognize risk and take corrective actions, preventing injury to the patient. The study showed that improvements in patient outcomes were strongly associated with levels of patient safety knowledge, underscored by the significant role of health workforce readiness as a mediating variable. This emphasizes that healthcare workers with a good knowledge of patient safety practices are more likely to take initiative to identify and alleviate risks. This finding corroborates that of Reason (2016) that knowledge is an important method of reducing human error and improving safety practices for initiatives related to the clinician space.

Another driver affecting patient safety outcomes was training standardization. Training across all healthcare institutions is standardized to provide ensured protection and education on protocols of patient safety so that everyone, irrespective of designation, has the same knowledge. Other studies, like those of Jeffs et al. the (2017), have also suggested that with proper implementation of standardized training programs, they may help realign all healthcare team members in their views towards how best to create a safe environment for patients. This quality control improves the overall quality of patient care by eliminating variations in practice that stem from different departments or units taking it upon themselves to define their own safety training regimen. This concept is supported with data shown in this study, in which the standardization of training has a direct link with improved outcomes for patient safety. Standardisation of training leads a system-wide approach to safety in high-consequence healthcare systems and is essential in driving errors out of the calamity.

Another variable which was strongly associated with improved patient safety was health workforce competency especially as it relates to clinical practice. Competency in healthcare is the ability of a healthcare worker to meet the objectives in the course of their work, thus assuring that the care delivered is effective and safe. This finding is in agreement with work by McHugh et al. (2013), featured in which it showcased how more competent team led to better outcomes in complex clinical cases as compared to less proficient teams. Additionally, embora technical skills are paramount, healthcare competency also encompasses critical thinking, decision-making, communication and other skills necessary to avoid mistakes and increase safety in high-pressure situations. Findings from this study suggest that high-competent healthcare professionals fully engaged in error prevention and management constitute an important component of safety.

Organizational support includes the structures, resources, and leadership that support healthcare workers in their roles, such as providing training, safety equipment, and policies that create a culture of safety. As highlighted by Kohn et al. According to Gaba & Howard (2000), patient safety culture is enabled by a benevolent organizational infrastructure and natural safety is possible when health care workers are able to report safety concerns without fear of retaliation. This study highlights the importance of organizational support, as research suggests a positive relationship between organizational support and improved outcome variables related to patient safety, further emphasizing the importance of institutional support to help enable healthcare workers to safely perform their jobs. This organizational support is especially critical in high-risk settings such as hospitals, where complex and rapid working environments may increase the probability of errors. Hence, healthcare organizations should focus on establishing an environment where patient safety is recognized as a fundamental principle, underpinned by policies, training, and top-down commitment.

This study identified health workforce readiness, defined as the preparedness of healthcare workers to adequately respond to patient safety challenges, as an important mediator. The researchers noted that this finding highlights the importance of readiness to act as a key driver in translating knowledge into action. The World Health Organisation states that Workforce readiness refers to more than simply technical competency, but also requires the capacity to adapt to changing circumstances, the ability to cope with stress and the knowledge of social models to enable working effectively within interprofessional teams (WHO, 2017). The health workforce readiness allows healthcare workers to utilise their training and knowledge in real-life settings, … such as in these dynamic environments where the risk of patient safety

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issues is the highest. The findings from this study indicate that workforce readiness is a key mediator in the translation of healthcare workers safety knowledge and competencies into actionable, practice-based behaviours that impact the care and outcomes of patients.

This also sheds some light on the complex, multi-factorial origins of patient safety. It is evident that no single factor, whether curricula quality or competency, alone is adequate to ensure patient safety. That said, the combination of several elements, including knowledge, training, organizational support, and preparedness of the workforce, interacts with one another to form a safety system that requires constant attention and improvement. This is consistent with the systems theory of safety introduced by Reason (2016), which suggests that safety is a continuous negotiation between different components of a dynamic health system. This study confirms the need for a comprehensive approach to patient safety within healthcare organizations, addressing educational needs, training, organizational culture, and developing individuals who learn how to respond to safety challenges.

5. Conclusion

Across learning activities, patient safety outcomes were examined in relation to the different dimensions of health workforce training (curriculum, knowledge, competency, and readiness). The findings highlight the essential function of comprehensive training programs in enhancing patient safety in health care environments. More specifically, health workforce preparedness was an important moderator between the effects of other variables, providing an indirect pathway for the quality of graduate curricula, the standardization of training, and organizational support to affect patient safety outcomes. The study emphasizes that realizing marked patient safety advances requires healthcare institutions to focus on both the technical skill of healthcare workers and how prepared they are to confront safety challenges in real-time scenarios.

In addition, the results indicate that curricula and training programs have gaps that need to be closed in order for healthcare education to be relevant to current patient safety needs. We need standardized health workforce training programs for all institutions, one that has a consistent quality and promotes a culture of safety. Policies relating to understanding the cause of these events are essential to map to the findings of this study.2619 Reinforcement of the educational infrastructure at every level in the healthcare system as well as creating awareness within the nurses to be responsible for continuing education for all departments helps in great deal2625,31,38 Competency of nurses builds automatically with their own awareness of what they did when the mistake occurs,9 but this is the time when you should beware the organization and how management handles their mistakes26253738 This analysis is significant as it provides an insight that the nurses can contribute to the organizational culture.10 Such a comprehensive strategy is crucial for mitigating risks and preventing harm, whether from design-specific failures or organizational failure modes in healthcare.

In conclusion, we recommend that Pakistan (and similar setting) based healthcare institutions should enhance their training by taking better measures to integrate patient safety into curricula. Additionally, continuous training and support for health care professionals will ensure a preparedness to safety challenges. Future studies should assess the duration of these effects on patient safety outcomes over time, as well as the impact of the standardisation of training across several health services. Lastly, there should be a concerted effort from healthcare providers, policymakers, and educational institutions to collaborate and create a common framework of workforce training that fills in existing gaps and caters to the changing landscape of patient safety in the healthcare environment.

Limitation

While this study provides invaluable data, it is essential to take some limitations into consideration for the interpretation of findings. First, due to its cross-sectional design, the study is limited in its collective ability to imply causality between training variables and patient safety outcomes. Long term longitudinal studies of the impacts of training interventions would help to understand the sustained benefit of training interventions and how this contributes to competence and patient safety. Secondly, since the study was conducted in healthcare organizations of Pakistan, the results may not be directly generalizable to healthcare systems of other countries or regions having different healthcare infrastructures, training programmes and patient safety priorities. Further research could involve a more diversified cohort of healthcare professionals across locations to increase the external validity of the findings. Third, although the sample size of 500 healthcare professionals provides a strong ground to conduct statistical analysis, the self-reported nature of the data may still introduce biases. Health care professionals may have been inclined to respond to this question in a manner consistent with social desirability or based on personal perceptions of their training experiences, which may have led to inaccuracies in the data reported. Thirdly, although this study has addressed some majors related variables that influence health workforce training and patient safety, different aspects such as health system policy, clinical

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autonomies, organizational culture and leadership dynamics can also significantly affect patient safety results. Future research should include more variables to gain a better understanding of the effectiveness of healthcare settings in regards to patient safety.

Author Contribution

Fatima Shumayla is involved in conceptualization, data collection, and analysis of the study. Rafique Othman helped with the literature review and data analysis. Software: Shaukat Waseem; formal analysis: Shaukat Waseem; writing original draft: Shaukat Waseem; writing review and editing: Shaukat Waseem.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding this research.

Data Availability Statement

The data supporting the results of this study are available from the corresponding author on request. Data will be made publicly available in line with journal policies after peer review and publication.

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Data Table and Image

A. Apendix Data Table Risearch

Variable	Category	(n)	(%)	(Years)	(Age)	Work Experience (Years)	Standard Deviation (Experience)
Professional Role	Doctor	120	24%	45.2	5.7	18.3	7.4
	Nurse	240	48%	36.8	6.1	14.9	6.5
	Other Healthcare Staff	140	28%	38.4	5.3	11.6	5.2
Gender	Male	200	40%	42.3	5.6	16.8	6.2
	Female	340	60%	38.5	5.1	14.4	5.7
Education Level	Bachelor's Degree	280	56%	37.9	5.8	15.2	6.1
	Master's Degree	140	28%	41.3	6.3	18.7	7.0
	Doctorate	120	16%	44.1	4.8	20.2	8.1
Work Experience	1-5 years	150	30%	35.0	6.2	2.5	1.7
	6-10 years	180	36%	38.9	5.4	8.7	2.6
	11+ years	210	34%	41.5	6.0	16.1	6.8

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