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THE INFLUENCE OF INTERNAL AND EXTERNAL FACTORS ON RADIOGRAPHER COMPLIANCE AND ITS IMPACT ON THE IMPLEMENTATION OF RADIATION SAFETY SOPS AT CLINIC X, MECCA, KSA

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Wahyu HANANI[1], Erislan ERISLAN[2], Tatan SUKWIKA[3]
[1,2,3] Faculty of Management, Occupational Health and Safety and Environment, Sahid University, Indonesia
Corresponding author: Wahyu Hanani
Email: Hananiwahyu776@gmail.com

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Abstract:
This study examines the problem of the influence of internal factors (knowledge, attitude, and work experience) on radiographer compliance and implementation of radiation safety SOPs, the influence of external factors (condition of equipment and facilities and work safety culture) on radiographer compliance and implementation of radiation safety SOPs, the influence of radiographer compliance on the implementation of radiation safety SOPs, and the influence of internal and external factors on the implementation of radiation safety SOPs through radiographer compliance. The data collection method used a questionnaire with a Likert scale. Data analysis methods include descriptive statistical analysis, SEM-PLS analysis with outer model testing, inner model testing and hypothesis testing. The results of this study indicate that internal factors (knowledge, attitude, and work experience) have a positive and significant effect on radiographer compliance and implementation of radiation safety SOPs at the Radiology Unit of Clinic X, Mecca, KSA. External factors (condition of equipment and facilities and work safety culture) have a positive and significant effect on radiographer compliance and implementation of radiation safety SOPs at the Radiology Unit of Clinic X, Mecca, KSA. Radiographer compliance has a negative and significant effect on the implementation of radiation safety SOPs at the Radiology Unit of Clinic X, Mecca, KSA. Internal and external factors have a significant influence on the implementation of radiation safety SOPs through radiographer compliance at the Radiology Unit of Clinic X, Mecca, KSA.
Keywords: Internal, External Factors, Compliance, Radiation Safety

INTRODUCTION

Occupational health and safety are efforts made to maintain physical, mental and social health by promoting and maintaining health for workers who are at risk of work accidents that can threaten their lives (Antunes-Raposo et al., 2022).

The implementation of quality K3 can also directly or indirectly affect the quality of service and provide satisfaction for all parties (Sari and Mentari, 2021). One category of health service support offered by Clinic X Mecca is radiology services. Radiology services must focus on radiation safety aspects because this procedure uses various forms of ionizing and non-ionizing radiation to help doctors diagnose patients. However, although this service is useful, it also poses risks to radiation personnel (radiologists), the general public, and the environment around the facility where the radiation device is used (Shaari and Puad, 2023). Therefore, radiologists working in the radiology department at Clinic X Mecca must strive to minimize radiation exposure by adhering to established guidelines. Failure to adequately address this issue can have a negative impact on the health and safety of radiologists, which in turn can affect the quality of health services provided in the radiology department. (Alquraini et al., 2022). This is because the radiology unit is a workspace that can be at

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risk of work accidents. After all, it is often exposed to radiation. However, the impact is not felt by the body directly; in the long term, with high intensity and continuous, radiographers are very vulnerable to radiation exposure (Paul et al., 2022).

The reasons for choosing Clinic X Mecca, Kingdom of Saudi Arabia (KSA), as the context of this study have several strategic reasons and significant relevance. First, Mecca is an important religious center and has a high flow of international visitors, making it a unique location to study safety practices in radiology in an intensive and diverse environment. Thus, this study can provide insight into how safety compliance is managed in situations with large patient volumes and different cultural variables. Second, the health system in Saudi Arabia is undergoing transformation and quality improvement, including in aspects of occupational safety and radiation risk management. Clinic X Mecca, as part of that health system, offers an opportunity to evaluate the implementation and compliance with safety standards that may differ from practices in other countries. By analyzing the factors that influence compliance at Clinic X Mecca, this study can make an important contribution to the development of better safety policies that are adapted to the local context. Based on this study, the main problem faced in this study is the low level of worker compliance with the use of personal protective equipment (PPE), which has the potential to increase occupational safety risks. Based on behavioral theory, compliance with the use of PPE is influenced by various motivational and environmental factors. One relevant theory is Maslow's Hierarchy of Needs, which states that individuals will prioritize safety needs if the threat to their safety is perceived as significant. In this context, compliance with PPE can increase if the need for safety is internalized. In addition, Herzberg's Two-Factor theory suggests that compliance can be driven by hygiene factors, such as the availability and comfort of PPE, and motivator factors, such as providing incentives or rewards to workers who comply with safety rules.

Based on a preliminary study conducted by researchers at the Radiology Unit of Clinic X Mecca, data was obtained that the number of radiographers was 30 people. When researchers held initial discussions with the head of the room and two radiographers, it was revealed that both professionals reported regularly facing problems such as hair loss and having dry and red skin while working. The staff in the radiology department at Clinic X Mecca is still inadequate, with 75% of the current personnel working there, and there is still a shortage of available medical physicists. During the previous year, from January to December 2023, the Radiology Unit of Clinic X Mecca handled a total of 10,368 patients, including inpatients and outpatients. The two radiographers interviewed shared that they were responsible for daily X-ray procedures, averaging between 25 to 30 patients each day. This indicates that radiographers often operate indoors to conduct radiological assessments.

Furthermore, it was revealed that the radiation protection equipment, or Personal Protective Equipment (PPE) used in the Radiology Unit of Clinic X Mecca, was not fully adequate, such as the lack of complete monitoring equipment, such as TLD checks for radiographers. In addition to the lack of PPE equipment in the Radiology Unit of Clinic X Mecca, it was also found that out of 30 radiographers, 55% of them were less compliant in using PPE when conducting examinations because PPE tends only to be used when there are problems with patients in the radiology room. In addition, the researcher argued that the management of the Radiology Unit of Clinic X paid less attention to the work safety culture for radiographers because the clinic did not yet have K3 staff in the radiology unit, and there was no routine training practice to improve the performance of the radiology unit. In fact, many potential dangers can threaten radiographers in their work. In addition, no previous researchers have conducted research on radiographer compliance and safety at the Radiology Unit of Clinic X, Mecca. This research activity is based on the inconsistency of the results

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of several previous studies on similar variables, as explained above. However, the current study seeks to develop these previous studies, especially those conducted by Mardiansyah et al. (2022), Nurmalia et al. (2022), and Handayani (2022). The motivation for the current study is to analyze the influence of internal and external factors on radiographer compliance, as well as its impact on the implementation of radiation safety SOPs. Still, it is quite different from the research conducted by previous researchers because the status of the radiographer compliance variable in the current study is a mediating variable. The novelty of the current study includes the researcher adding internal factor variables (work attitude and experience), external factors (condition of equipment and facilities, work safety culture), and radiation safety, where all of these variables were not analyzed in the previous studies. Furthermore, in this study, the researcher used SEM-PLS analysis because the aim was to test the direct, indirect, and overall impacts between exogenous and endogenous variables.

METHODS

The quantitative approach aims to test theories, build facts, show relationships between variables, provide statistical descriptions, and estimate and predict the results (Arikunto, 2018). The method used in this study is associative quantitative, namely a research method that aims to find out numbers that indicate the direction and strength of the influence of two or more variables. The direction is expressed in the form of a positive or negative influence, and the strength of the influence is expressed in the regression coefficient (Sugiyono, 2019). This research method is used to determine the influence of internal factors (knowledge, attitude, work experience) and external (condition of equipment and facilities, work safety culture) on radiographer compliance and its impact on the implementation of radiation safety SOPs.

The hypothesis is a temporary answer to the formulation of the problem referring to theoretical and empirical studies (Sugiyono, 2018). Based on the theoretical relationship between variables and the framework of thought above, the research hypothesis is formulated as follows:

- H1: Knowledge influences radiographer compliance. H2: Attitude influences radiographer compliance.
- H3: Work experience influences radiographer compliance.
- H4: The condition of equipment and facilities affects radiographer compliance.
- H5: Workplace safety culture affects radiographer compliance.
- H6: Knowledge affects radiation safety. H7: Attitude affects radiation safety.
- H8: Work experience affects radiation safety.
- H9: The condition of equipment and facilities affects radiation safety.
- H10: Workplace safety culture affects radiation safety. H11: Radiographer compliance affects radiation safety.

The conceptual framework explains the concept of the relationship between variables in this study, as described below:

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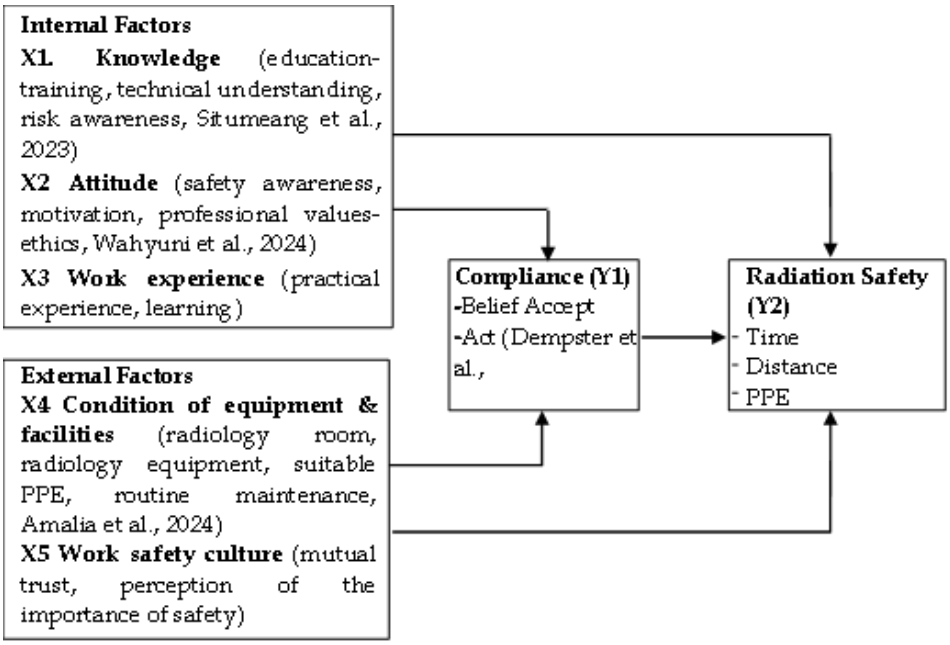

Figure 1. Conceptual Framework

The concept of the relationship between exogenous variables, mediating variables, and endogenous variables so that the conceptual framework above can describe the influence of internal factors (knowledge, attitude, work experience) and external (condition of tools and facilities, work safety culture) on radiographer compliance, and its impact on the implementation of radiation safety SOPs. Exogenous variables in the conceptual framework above include KnowledgeKnowledge (X1.), attitude (X2), work experience (X3), condition of tools and facilities (X4), and work safety culture (X5). The mediating Variable is radiographer compliance (Y1), while the endogenous Variable is the implementation of radiation safety SOPs (Y2).

Data Analysis Tools. This research strategy is used to assess the impact of internal factors such as knowledge, attitude, and work experience, along with external elements such as equipment and facility status and work safety culture, on radiographer compliance and its influence on the implementation of radiation safety standard operating procedures. In this study, the population consisted of staff (radiologists) from the Radiology Unit at Clinic X in Mecca, KSA, as of 2024, totaling 30 people. Referring to the formulation of the problem as explained in the previous chapter, the focus of this study is to analyze the associative relationships or relationships between objects, as follows:

1. Internal factors consist of knowledge (X1.), attitude (X2), and work experience (X3).
2. External factors consist of equipment and facility conditions (X4) and work safety culture (X5).
3. Radiographer compliance in using PPE (Y1)
4. Implementation of SOP on radiation safety (Y2)

The method used in this study is associative quantitative, namely a research method that aims to determine the numbers that indicate the direction and strength of the influence of two or more variables. The direction is expressed in the form of a positive or negative influence, and the strength of the influence is expressed in the regression coefficient (Sugiyono, 2019). The analysis approach used in this study is a descriptive statistical technique, which focuses on data analysis to determine the distribution of participant responses by calculating the average value, standard deviation, and

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inferential statistics using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) to investigate the relationship between variables. The software used for SEM PLS analysis is the Smart PLS version 4 application.

The Likert scale is a psychometric scale that is commonly used in questionnaires and is the most widely used scale in research in the form of surveys. The scores given to the answers obtained in this questionnaire are ordinal so that they can be analyzed and calculated using a 5-level Likert scale, namely 1 to 5. The scoring details for each answer are:

- Answering 'SS' (Strongly Agree) score 5
- Answering 'S' (Agree) score 4
- Answering 'R' (Undecided) score 3
- Answering 'TS' (Disagree) score 2
- Answering 'STS' (Strongly Disagree) score 1

RESULT AND DISCUSSION

The respondents in this study were employees (radiographers) of the Radiology Unit at Clinic X Mecca, KSA, in 2024, totaling 30 people. The respondents of this study can be categorized into several characteristics, namely based on gender, age range, final education, and length of service.

Table 1. Research Respondents

No.	Gender	Age Range	Education	Work Period as Radiographer
1	Male	36-45 years	Bachelor	6-10 years
2	Male	36-45 years	Bachelor	11-15 years
3	Male	26-35 years	Bachelor	1-5 years
4	Male	46-55 years	Master	11-15 years
5	Female	26-35 years	Bachelor	1-5 years
6	Male	36-45 years	Bachelor	11-15 years
7	Female	56-65 years	Master	More than 20 years
8	Male	46-55 years	Bachelor	11-15 years
9	Female	36-45 years	Bachelor	11-15 years
10	Male	26-35 years	Bachelor	1-5 years
11	Female	17-25 years	Bachelor	Less than 1 year
12	Male	36-45 years	Bachelor	11-15 years
13	Female	36-45 years	Bachelor	11-15 years
14	Male	56-65 years	Master	More than 20 years
15	Female	26-35 years	Bachelor	1-5 years
16	Male	36-45 years	Bachelor	11-15 years
17	Female	46-55 years	Master	6-10 years
18	Male	36-45 years	Bachelor	11-15 years
19	Female	46-55 years	Bachelor	6-10 years
20	Male	56-65 years	Doctor	More than 20 years
21	Female	36-45 years	Bachelor	6-10 years
22	Male	46-55 years	Bachelor	6-10 years
23	Female	46-55 years	Master	6-10 years
24	Male	36-45 years	Bachelor	6-10 years
25	Female	36-45 years	Bachelor	6-10 years
26	Male	26-35 years	Master	11-15 years
27	Female	46-55 years	Bachelor	1-5 years
28	Male	17-25 years	Bachelor	11-15 years

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No.	Gender	Age Range	Education	Work Period as Radiographer
29	Female	46-55 years	Bachelor	Less than 1 year
30	Female	36-45 years	Bachelor	6-10 years

The questionnaires of these variables were distributed or given to all respondents with the aim of being answered so that information was obtained regarding internal factors (knowledge, attitude, work experience), external factors (condition of equipment and facilities, work safety culture), radiographer compliance, and implementation of radiation safety SOPs. The following is a description of the respondents' assessment of each of the research variable items obtained by calculating using SMART PLS, where you can see several measurements such as the average value (mean), standard deviation, median, minimum scale, maximum scale, kurtosis and skewness of a questionnaire data. Kurtosis and skewness are used to see the distribution of data and whether the data distribution is normal or not.

In general, whether the data is normally distributed or not if the kurtosis and skewness values lie between -2 < kurtosis <2 and -2 < skewness <2 or can be seen from the value of 1.96 at alpha 5% and 2.58 at alpha 1%. The following is a description of the variables knowledge (X1), attitude (X2), work experience (X3), condition of equipment and facilities (X4), work safety culture (X5), radiographer compliance (Y1), and radiation safety (Y2).

Table 2. Descriptive Statistics

Name	Mean	Median	Scale min	Scale max	Standard deviation	Excess kurtosis	Skewness	Cramér-von Mises p value
X1.1	2.6	3	2	4	0.554	-0.835	0.198	0
X1.2	4.1	5	2	5	1.044	-0.769	-0.766	0
X1.3	4	4	2	5	1	-0.721	-0.632	0
X2.1	3.833	4	2	5	1.128	-1.327	-0.386	0
X2.2	3.867	4	2	5	0.957	-1.142	-0.198	0
X2.3	3.967	4	2	5	1.048	-1.148	-0.479	0
X3.1	3.8	4	2	5	1.194	-1.39	-0.455	0
X3.2	3.9	4	2	5	0.978	-1.227	-0.239	0
X3.3	3.7	4	2	5	1.215	-1.62	-0.202	0
X4.1	4.233	5	2	5	1.086	-0.123	-1.156	0
X4.2	4.2	4	2	5	0.872	-0.481	-0.738	0
X4.3	4.1	4	3	5	0.79	-1.406	-0.188	0
X4.4	4.167	5	2	5	1.128	-0.739	-0.935	0
X5.1	4.067	5	2	5	1.153	-0.901	-0.825	0
X5.2	3.9	4	2	5	0.87	-0.404	-0.435	0
X5.3	3.867	4	2	5	0.846	-0.939	-0.078	0
X5.4	3.667	4	2	5	1.164	-1.549	-0.094	0
Y1.1	3.933	4	2	5	1.062	-0.974	-0.563	0
Y1.2	3.833	4	2	5	1.128	-1.327	-0.386	0
Y1.3	3.833	4	2	5	1.098	-1.38	-0.286	0
Y2.1	4.467	5	3	5	0.618	-0.321	-0.758	0
Y2.2	4.433	5	3	5	0.667	-0.402	-0.805	0
Y2.3	4.067	4	3	5	0.814	-1.53	-0.129	0

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Radiographers and the implementation of radiation safety SOPs. The respondents in this study were employees (radiographers) of the Radiology Unit at Clinic X Mecca, KSA, in 2024, totaling 30 people, with the results of the validity test as in the table below.

Table 3. Validity Test Results

Indicator	(X1) Knowledge	(X2) Attitude	(X3) Work experience	(X4) Condition of Work Tools and Facilities	(X5) Occupational Safety Culture	(Y1) Compliance Radiographer	(Y2) Radiation Safety
X1.1	0,820						
X1.2	0,922						
X1.3	0,908						
X2.1		0,913					
X2.2		0,906					
X2.3		0,947					
X3.1			0,935				
X3.2			0,896				
X3.3			0,932				
X4.1				0,935			
X4.2				0,863			
X4.3				0,859			
X4.4				0,962			
X5.1					0,929		
X5.2					0,886		
X5.3					0,874		
X5.4					0,867		
Y1.1						0,973	
Y1.2						0,961	
Y1.3						0,927	
Y2.1							0,859
Y2.2							0,839
Y2.3							0,890

From the table presented previously, it can be seen that each metric in this study has been confirmed valid because the Loading Factor value generated by each metric exceeds 0.7. In addition, the image shown below illustrates the results of the loading factor evaluation carried out using the SmartPLS application as explained below. Indicator Y1.1 in the Radiographer Compliance Variable has the highest Outer Loadings value of 0.973, and the lowest Outer Loadings value is in the Knowledge variable in indicator X1.1 of 0.820.

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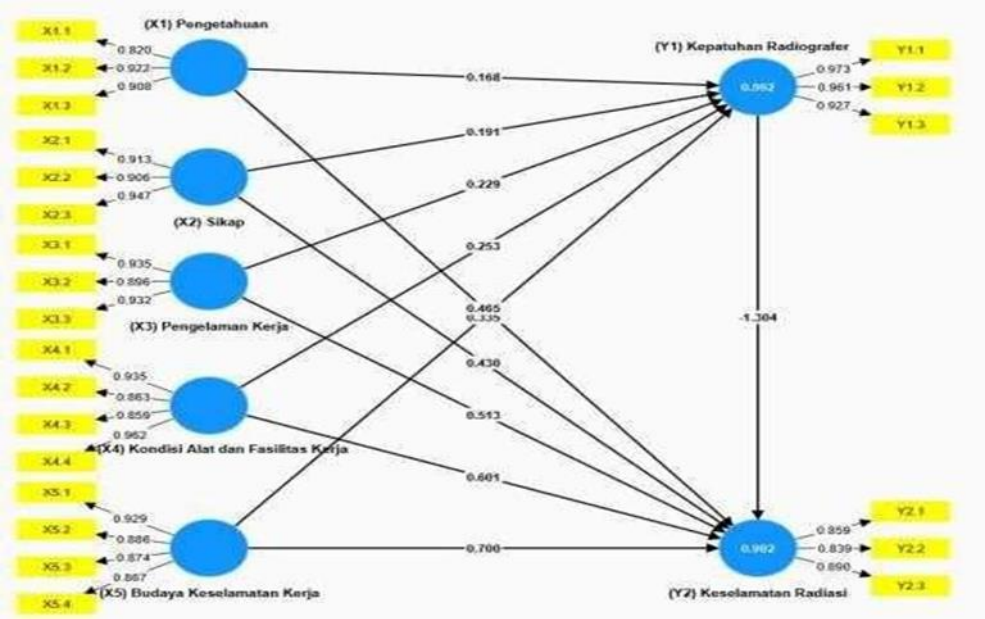

Figure 2. Loading Factor Test Results

Another measuring tool in measuring validity is AVE (Average Variance Extracted). The AVE value must be >0.5 (Hair et al., 2019). It can be seen in the table below. The Radiographer Compliance Variable has the highest AVE value of 0.911. The one with the lowest AVE value is the Radiation Safety Variable, with a value of 0.745.

Table 4. Average Variance Extracted (AVE) Value

Variable	Average variance extracted (AVE)
(X1) Knowledge	0,783
(X2) Attitude	0,851
(X3) Work Experience	0,848
(X4) Condition of Work Equipment and Facilities	0,821
(X5) Work Safety Culture	0,791
(Y1) Radiographer Compliance	0,911
(Y2) Radiation Safety	0,745

It can be seen from the table above that all AVE values of each Variable are >0.5. It can be concluded that the loading factor and AVE values have met the requirements of Convergent Validity.

Table 5. Cross Loading Values

Indicator	(X1) Knowledge	(X2) Attitude	(X3) Work experience	(X4) Condition of Work Tools and Facilities	(X5) Occupational Safety Culture	(Y1) Compliance Radiographer	(Y2) Radiation Safety
X1.1	0,820	0,643	0,417	0,059	0,385	0,502	0,508
X1.2	0,922	0,786	0,794	0,327	0,620	0,786	0,769
X1.3	0,908	0,828	0,800	0,389	0,791	0,849	0,886

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Indicator	(X1) Knowledge	(X2) Attitude	(X3) Work experience	(X4) Condition of Work Tools and Facilities	(X5) Occupational Safety Culture	(Y1) Compliance Radiographer	(Y2) Radiation Safety
X2.1	0,810	0,913	0,743	0,246	0,729	0,781	0,790
X2.2	0,746	0,906	0,690	0,416	0,672	0,793	0,784
X2.3	0,827	0,947	0,841	0,449	0,780	0,888	0,873
X3.1	0,739	0,704	0,935	0,421	0,793	0,859	0,809
X3.2	0,683	0,726	0,896	0,440	0,769	0,823	0,828
X3.3	0,767	0,842	0,932	0,486	0,850	0,904	0,901
X4.1	0,301	0,382	0,443	0,935	0,443	0,615	0,612
X4.2	0,353	0,405	0,521	0,863	0,358	0,602	0,574
X4.3	0,215	0,286	0,328	0,859	0,307	0,474	0,512
X4.4	0,295	0,381	0,462	0,962	0,396	0,603	0,603
X5.1	0,718	0,734	0,833	0,305	0,929	0,846	0,819
X5.2	0,493	0,615	0,767	0,382	0,886	0,780	0,703
X5.3	0,709	0,676	0,776	0,432	0,874	0,809	0,821
X5.4	0,591	0,779	0,731	0,371	0,867	0,804	0,780
Y1.1	0,784	0,855	0,892	0,635	0,908	0,973	0,931
Y1.2	0,843	0,873	0,878	0,562	0,897	0,961	0,942
Y1.3	0,761	0,825	0,914	0,628	0,802	0,927	0,900
Y2.1	0,680	0,706	0,753	0,569	0,823	0,835	0,859
Y2.2	0,723	0,784	0,828	0,481	0,682	0,798	0,839
Y2.3	0,784	0,803	0,801	0,598	0,772	0,872	0,890

Based on the table above, it can be seen that each Variable has a cross-loading factor value above >0.7, meaning that the variables in this study have met the requirements.

Reliability Test; Cronbach's Alpha. The following table shows the Cronbach's alpha value as follows:

Table 6. Cronbach's alpha value

Variables	Cronbach's alpha
(X1) Knowledge	0,864
(X2) Attitude	0,912
(X3) Work Experience	0,910
(X4) Condition of Work Tools and Facilities	0,926
(X5) Work Safety Culture	0,912
(Y1) Radiographer Compliance	0,951
(Y2) Radiation Safety	0,828

From the table above, it can be seen that all indicators in each Variable have met the reliability test requirements, namely the Cronbach's alpha value> 0.6.

Composite Reliability. Composite Reliability is to test the reliability value of the indicators in the Variable. If it has a composite reliability value> 0.7, then a variable can be declared to meet. The data is as follows.

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Table 7. Composite Reliability Value

Variables	Composite reliability (rho_a)
(X1) Knowledge	0,912
(X2) Attitude	0,917
(X3) Work Experience	0,913
(X4) Condition of Work Tools and Facilities	0,934
(X5) Work Safety Culture	0,913
(Y1) Radiographer Compliance	0,952
(Y2) Radiation Safety	0,830

Hypothesis Testing. The criteria for accepting the hypothesis are if the T-Statistic is more than 1.96 and the P-value is less than 0.05, then Ha is accepted, Ho is rejected, and vice versa. The hypotheses proposed are as follows:

Table 8. Hypothesis Test Results

Variables	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
(X1) Knowledge -> (Y1) Radiographer Compliance	0,168	0,184	0,053	3,184	0,001
(X1) Knowledge -> (Y2) Radiation Safety	0,465	0,421	0,133	3,483	0,000
(X2) Attitude -> (Y1) Radiographer Compliance	0,191	0,193	0,066	2,905	0,004
(X2) Attitude -> (Y2) Radiation Safety	0,430	0,407	0,128	3,356	0,001
(X3) Work Experience -> (Y1) Radiographer Compliance	0,229	0,199	0,063	3,646	0,000
(X3) Work Experience -> (Y2) Radiation Safety	0,513	0,495	0,120	4,274	0,000
(X4) Condition of Work Equipment and Facilities -> (Y1) Radiographer Compliance	0,253	0,247	0,040	6,375	0,000
(X4) Condition of Work Equipment and Facilities -> (Y2) Radiation Safety	0,601	0,562	0,137	4,398	0,000
(X5) Work Safety Culture -> (Y1) Radiographer Compliance	0,335	0,347	0,068	4,925	0,000
(X5) Work Safety Culture -> (Y2) Radiation Safety	0,700	0,623	0,207	3,379	0,001
(Y1) Radiographer Compliance -> (Y2) Radiation Safety	-1,304	-1,139	0,472	2,765	0,006

Another instrument to assess validity is the Average Variance Extracted, commonly known as AVE. For the AVE value to be considered acceptable, it must exceed 0.5 (Hair et al., 2019). The following table illustrates this data. The Variable related to Radiographer Compliance showed the highest AVE value of 0.911. In contrast, the Variable related to Radiation Safety had the lowest AVE value, recorded at 0.745. The results of the study showed that each AVE value for each Variable exceeded 0.5. Therefore, we can conclude that both the Loading Factor and AVE values meet the Convergent Validity.Discriminant Validity criteria. The influence of internal and external factors on

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radiographer compliance and its impact on the implementation of radiation safety SOPs at Clinic X Mecca, KSA, is an important theme in the context of occupational safety. KnowledgeKnowledge, attitude, work experience, equipment conditions, and occupational safety culture are some of the factors that can affect radiographer compliance in carrying out radiation safety procedures. This study aims to explore the relationship between these variables and radiographer compliance and radiation safety. The results of the study showed that the knowledge variable had a positive and significant effect on radiographer compliance. Research by Utami (2012) showed that knowledge about the impact of radiation had a significant relationship with the practice of using personal dose monitoring devices, with a p-value <0.05. In addition, research by Zainal et al. (2020) found that increasing knowledge about radiation safety was directly related to increasing compliance among medical personnel. Another study by Rahman et al. (2021) also supports this finding by showing that education and training increase awareness of radiation risks.

Knowledge variables have a positive and significant effect on radiation safety. Research by Noor et al. (2022) found that good knowledge of radiation safety can reduce the incidence of radiation accidents. In addition, research by Khan et al. (2021) showed that a better understanding of radiation risks improves safety practices in hospitals. This finding is in line with a study by Javed et al. (2023), which emphasized the importance of continuous training to improve medical personnel's understanding of safety procedures. Attitude has a positive and significant effect on radiographer compliance. Research by Farooq et al. (2021) showed that a positive attitude toward safety procedures increases compliance among radiographers. A study by Ali et al. (2020) found that a proactive attitude towards radiation safety is directly related to compliance with SOPs. In addition, research by Zafar et al. (2019) showed that negative attitudes can be a barrier to compliance with safety procedures. Attitude also has a positive and significant effect on radiation safety. Research by Shah et al. (2022) stated that a positive attitude contributes to reducing radiation-related accidents.

Another study by Qureshi et al. (2021) supports this by showing that attitudes toward safety significantly influence workplace behavior. Work experience has a positive and significant effect on radiographer compliance. A study by Malik et al. (2022) found that longer work experience correlates with higher levels of compliance with radiation safety procedures. A study by Ahmed et al. (2021) also showed that practical experience increases understanding of radiation risks among medical personnel. Work experience also has a positive and significant effect on radiation safety. A study by Raza et al. (2020) showed that work experience increases awareness of proper safety practices in the use of radiography equipment. The condition of equipment and work facilities has a positive and significant effect on radiographer compliance. A study by Bukhari et al. (2021) emphasized the importance of equipment conditions in supporting compliance with radiation safety SOPs. The condition of equipment and work facilities also has a positive and significant effect on radiation safety. A study by Siddiqui et al. (2022) showed that good equipment reduces the risk of accidents related to the use of radiography equipment. Occupational safety culture has a positive and significant effect on radiographer compliance. Research by Hussain et al. (2021) emphasized the importance of organizational culture in promoting compliance with safety procedures in hospitals. Occupational safety culture also has a positive and significant effect on radiation safety. This is in line with research by Akhtar et al. (2022), which shows that a strong safety culture can reduce radiation-related accidents in the workplace.

The most influential variables on Radiographer Compliance are "Work Safety Culture" (0.601) and "Work Equipment and Facility Conditions" (0.465). This shows that the better the work safety culture and equipment conditions, the more radiographers comply with the procedures. The most influential Variable on Radiation Safety is "Work Safety Culture" (0.700). This shows that a strong

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work safety culture greatly contributes to radiation safety. Radiographer Compliance has a significant negative effect on Radiation Safety (-1.304). This could indicate that other factors are more dominant in improving radiation safety than just compliance. From the results of the SEM analysis shown in the diagram, it can be seen that the influence of "Knowledge" (X1) and "Work Training/Experience" (X3) on Radiographer Compliance (Y1) and Radiation Safety (Y2) is relatively small compared to other factors such as Work Safety Culture (X5) and Work Equipment & Facility Conditions (X4). Several reasons can explain this phenomenon, including High KnowledgeKnowledge does not always mean high compliance. A radiographer may have a good understanding of radiation safety procedures but, in practice, still be undisciplined in implementing safety rules. Other factors such as work fatigue, time pressure, or lack of supervision can have a greater influence on compliance than mere KnowledgeKnowledge.

CONCLUSION

Based on the results of the research and data analysis as described in the previous chapter, this research concludes that Knowledge, Attitude, Work experience, Condition of equipment and facilities, and Workplace safety culture have a positive and significant effect on radiographer compliance in the Radiology Unit of Clinic X Mecca, KSA and the implementation of radiation safety SOPs in the Radiology Unit of Clinic X Mecca, KSA. Based on the SEM (Structural Equation Modeling) analysis displayed in the diagram, the following are the main conclusions of the study Factors Affecting Radiographer Compliance (Y1) are Knowledge (X1) has a positive effect on radiographer compliance with a coefficient of 0.168, Attitude (X2) also contributes positively with a coefficient of 0.191, Work Experience (X3) shows a positive effect on compliance with a coefficient of 0.253. Condition of Work Equipment and Facilities (X4) has a greater contribution with coefficients of 0.335 and 0.465, and Work Safety Culture (X5) has the greatest effect on radiographer compliance with a coefficient of 0.700. Factors Affecting Radiation Safety (Y2) are Radiographer Compliance (Y1) has a significant negative impact on radiation safety with a coefficient of -1.304. This may indicate the presence of other factors that play a role in radiation safety that have not been included in the model. The most influential factor in radiographer compliance is work safety culture (X5). The factor that directly influences radiation safety is radiographer compliance (Y1), but with a negative relationship, which may require further analysis. Referring to the results and conclusions of this study, the following suggestions can be outlined.

1. Radiographers always wear PPE when working in the radiology room because PPE is the only shield closest to the radiographer's skin, which can protect against possible radiation exposure when in the radiology room, so it is highly recommended that radiographers always wear it completely.
2. Radiographers should immediately leave the radiology room after completing their duties there in order to avoid or minimize radiation exposure.
3. It is recommended that the management of Clinic X Mecca provide ongoing training to all radiographers to improve their practical skills further and so that they understand the latest developments in the field of radiology.
4. The management of Clinic X Mecca should always involve radiographers in emergency meetings and simulations and invite them to discuss with the aim of making them feel involved in making safety policies in the clinic.
5. It is recommended to increase references that can support the topic being studied in order to obtain a better research model supported by strong theories. It is recommended to develop more broadly by examining other variables that are not only internal factors (knowledge,

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attitude, work experience), external factors (condition of equipment and facilities, work safety culture), and radiographer compliance alone, which are analyzed for their influence on the implementation of radiation safety SOPs, but other predictors such as health awareness, work stress, work discipline, leadership style, organizational climate, and compensation and salary can also be analyzed.

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