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A STUDY TO ASSESS THE EFFECTIVENESS OF A VIRTUAL REALITY-BASED INFECTION CONTROL TRAINING PROGRAM ON ADHERENCE TO HYGIENE PRACTICES AMONG NURSING STAFF IN A MEDICAL-SURGICAL UNIT AT A HOSPITAL IN UDAIPUR.

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Abstract

BACKGROUND AND OBJECTIVES: Infection control is crucial in healthcare settings to prevent the spread of infections. This study explores the efficacy of a virtual reality-based training program for enhancing infection control knowledge and adherence among nursing staff, compared to traditional training methods. The program's effectiveness is assessed through pre-test and post-test evaluations of knowledge and adherence levels, revealing significant improvements in the experimental group. METHOD A quasi-experimental design was used, involving an experimental group that received the VR-based training and a control group that did not. Both groups were assessed using pre-test and post-test measures for knowledge and adherence to infection control practices. Statistical analyses, including t-tests and chi-square tests, were conducted to determine the significance of the results. RESULTS The study found significant improvements in both knowledge and adherence to infection control practices in the experimental group that received VR-based training. Knowledge scores rose from a mean of 5.2 (26%) pre-test to 14.8 (74%) post-test, and adherence scores increased from 2.62 (26.2%) to 7.62 (76.2%), both with a highly significant t-value of 22.25. In contrast, the control group showed minimal, statistically significant but not substantial changes. Chi-square analysis revealed that demographic factors like age, gender, and prior training significantly influenced pre-test scores in the experimental group, underscoring their impact on the training program's effectiveness. INTERPRETATION AND CONCLUSION The virtual reality-based infection control training program significantly improved knowledge and adherence to hygiene practices among nursing staff in the experimental group. The substantial increase in post-test scores demonstrates the effectiveness of VR-based training in healthcare education. The study also suggests that demographic factors impact baseline knowledge and adherence, highlighting the need for tailored educational interventions to enhance effectiveness.

Keywords: **Effectiveness, Virtual Reality-Based Infection Control Training Program, Adherence, hygiene practices Medical-Surgical Unit, Health Outcomes**

INTRODUCTION

Healthcare-associated infections (HAIs) remain a significant challenge in healthcare settings worldwide, contributing to increased morbidity, mortality, and healthcare costs (World Health Organization, 2020). Adherence to evidence-based hygiene practices, particularly among healthcare workers, is a cornerstone of preventing HAIs (Pittet, Hugonnet, & Harbarth, 2009). Despite numerous interventions, suboptimal compliance with hand hygiene and other infection prevention measures persists (Al-Duwaihi et al., 2018). Virtual reality (VR) technology has emerged as a

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promising educational tool with the potential to enhance learning experiences in various fields, including healthcare (Seto, Ha, & Lee, 2019). By creating immersive and interactive simulations, VR can facilitate knowledge acquisition, skill development, and behavior change (Sax et al., 2018). However, the efficacy of VR-based training programs in improving adherence to infection control practices among nursing staff remains relatively unexplored.Nursing professionals play a critical role in preventing HAIs through the consistent implementation of infection prevention and control (IPC) measures (World Health Organization, 2020). Heavy workloads, time constraints, and inadequate training often hinder adherence to recommended practices (Pittet et al., 2009). Traditional training methods like classroom lectures and online modules may not effectively address these issues or lead to lasting behavior changes (Al-Duwaihi et al., 2018). VR technology offers a realistic and engaging learning environment that can overcome these limitations (Sax et al., 2018). Studies have shown VR's effectiveness in improving knowledge and skills in areas such as surgery, patient care, and communication (Seto et al., 2019). However, research on VR's impact on adherence to hygiene practices among nursing staff remains limited.

NEED FOR THE STUDY

Given the persistent problem of HAIs and the potential benefits of VR technology, there is a compelling need to evaluate the effectiveness of VR-based infection control training programs in improving adherence to hygiene practices among nursing staff. By bridging the gap in knowledge about the application of VR in this context, this study aims to contribute to the development of evidence-based interventions to enhance IPC practices and ultimately improve patient safety. Infection control practices, including hand hygiene and adherence to standard precautions, are crucial for managing healthcare-associated infections (HCAIs) and ensuring the safety of both patients and healthcare workers. Despite the implementation of various infection control strategies, compliance remains inconsistent. This study aims to evaluate innovative approaches like the infection control link nurse (ICLN) program for improving adherence to infection control practices. While a previous study showed significant improvements in hand hygiene compliance with the ICLN program, it did not affect adherence to standard precautions. This highlights the need to explore effective methods for enhancing overall infection control.

The study focuses on a medical-surgical unit in a hospital in Udaipur, India, to assess the feasibility and impact of a VR-based training program. The findings could guide the development and implementation of VR-based infection prevention and control training in similar settings, potentially leading to broader improvements in infection control.

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OBJECTIVES

1. To establish baseline levels of knowledge and adherence to hygiene practices among nursing staff before implementing the virtual reality-based infection control training program.
2. To implement the virtual reality-based infection control training program in the experimental group and assess its effectiveness.
3. To evaluate the effectiveness of the virtual reality-based infection control training program by comparing post-intervention knowledge and practice levels with baseline levels in the experimental group.
4. To compare the knowledge and adherence to hygiene practices between the experimental group (receiving VR-based training) and the control group (receiving traditional training or no intervention).
5. To examine the association between improved knowledge and adherence to hygiene practices with various demographic or professional characteristics of the nursing staff in both the experimental and control groups.

ASSUMPTIONS

1. Participants will actively engage with and follow the VR-based training program.
2. The VR training will be delivered consistently to all participants in the experimental group.
3. Observations and assessments will be conducted accurately and objectively.

HYPOTHESES

H1: Nursing staff who received the virtual reality-based infection control training will have significantly higher post-intervention knowledge scores compared to those who did not receive the training at the level of 0.05 significance.

H2: Nursing staff who received the virtual reality-based infection control training will show significantly higher adherence to hygiene practices compared to those who did not receive the training at the level of 0.05 significance.

H3: The experimental group, which received the virtual reality-based infection control training, will show a significantly greater improvement in knowledge scores from pre- to post- intervention compared to the control group at the level of 0.05 significance.

H4: The experimental group, which received the virtual reality-based infection control training, will show a significantly greater improvement in adherence to hygiene practices from pre- to

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post-intervention compared to the control group at the level of 0.05 significance.

RESEARCH METHODOLOGY

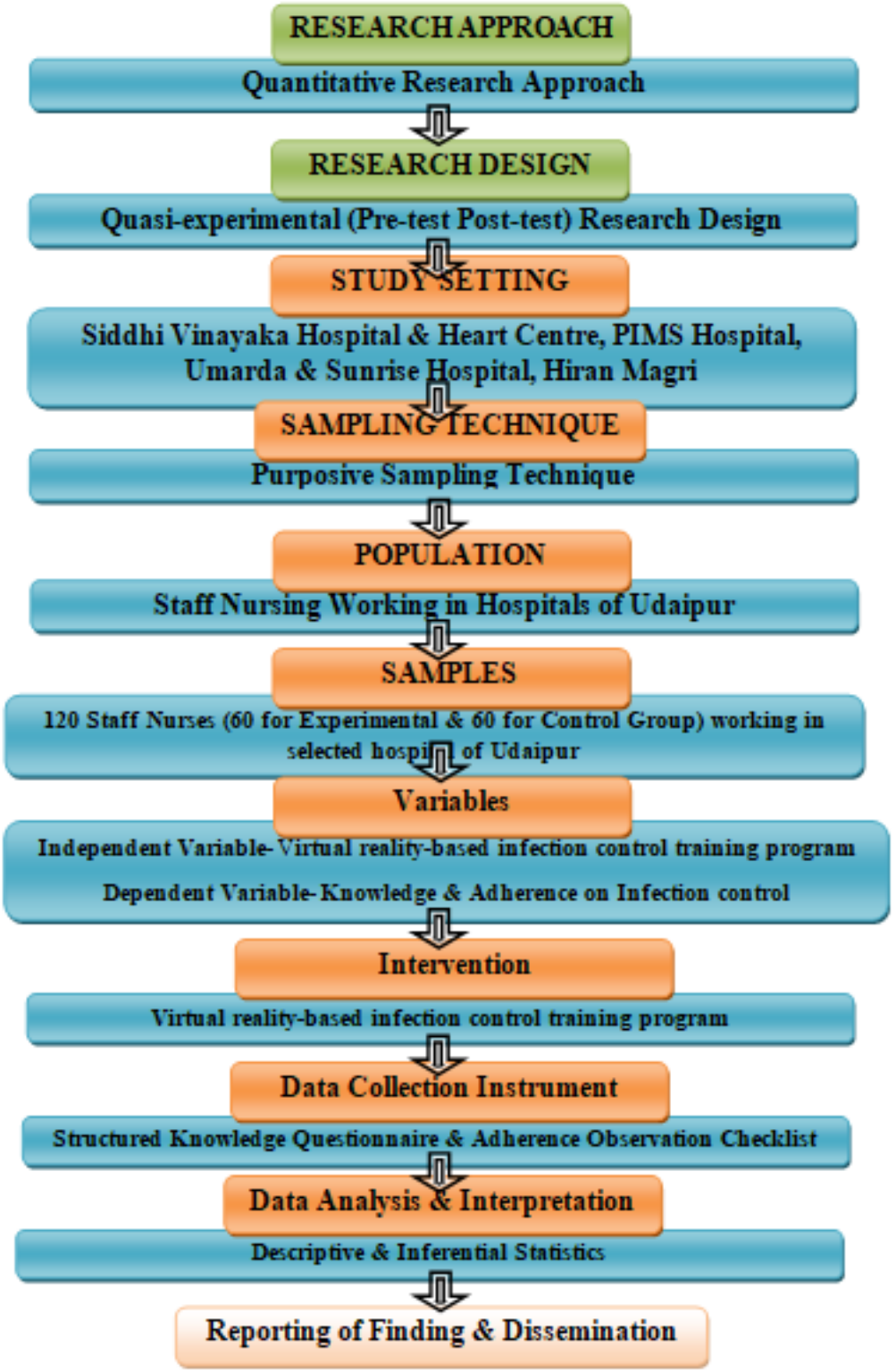

Figure-1: Schematic Presentation of Research Methodology

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RESULT

Distribution of frequency and percentage analysis of selected variables

N=60+60

SR. NO.	Demographic variable		Experimental group		Control group	
			Frequency	Percentage	Frequency	Percentage
1	Age (in years)	21-30	22	36.67	24	40.00
		31-40	12	20.00	18	30.00
		41-50	14	23.33	14	23.33
		Above 51	12	20.00	4	6.67
2	Gender	Male	28	46.67	38	63.33
		Female	32	53.33	22	36.67
3	Highest Level of Education	Diploma in Nursing	18	30.00	23	38.33
		Bachelor's Degree in Nursing	14	23.33	9	15.00
		Master's Degree in Nursing	13	21.67	18	30.00
		Doctorate	5	8.33	3	5.00
		Other	10	16.67	7	11.67
4	Job Role	Staff Nurse	22	36.67	16	26.67
		Charge Nurse	18	30.00	24	40.00
		Nurse Practitioner	4	6.67	8	13.33
		Nurse Manager	12	20.00	10	16.67
		Other Category (Specify)	4	6.67	2	3.33
5	Years of Experience in Nursing	Less than 1 year	8	13.33	2	3.33
		1-5 years	22	36.67	16	26.67
		6-10 years	16	26.67	18	30.00
		11-15 years	12	20.00	16	26.67
		More than 15 years	2	3.33	8	13.33
6	Previous Training in Infection Control	Yes	22	36.67	24	40.00
		No	38	63.33	36	60.00

The table provides a comparative analysis of demographic variables for 60 participants in both the experimental and control groups. Most participants are aged 21-30 years, with 36.67% in the experimental group and 40.00% in the control group. The experimental group has a higher percentage of individuals over 51 years (20.00%) compared to the control group (6.67%). In terms of gender, the experimental group has more females (53.33%), while the control group has more males (63.33%). Regarding education, the control group has a higher percentage with a Diploma in Nursing (38.33%) and a Master's Degree (30.00%), whereas the experimental group has more

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participants with a Bachelor's Degree (23.33%) and a Doctorate (8.33%). Additionally, the experimental group has a slightly higher proportion with other qualifications (16.67%) compared to the control group (11.67%). In terms of job roles, the experimental group includes more staff nurses (36.67%) and nurse managers (20.00%), while the control group has more charge nurses (40.00%) and nurse practitioners (13.33%). Regarding years of experience, the experimental group has a higher number of participants with less than 1 year (13.33%) and 1-5 years (36.67%) of experience, while the control group has more participants with over 15 years of experience (13.33%). Previous training in infection control is slightly more common in the control group (40.00%) than in the experimental group (36.67%), though most participants in both groups have not received such training, with 63.33% in the experimental group and 60.00% in the control group.

Distribution of sample by the level of knowledge in both groups

Groups		Experimental Group (N=60)				Control Group (N=60)			
Level of Knowledge	Score	Pre-test		Post-test		Pre-test		Post-test	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Inadequate knowledge	0-10	56	93.33	3	5	58	96.67	56	93.33
Moderate knowledge	11-15	4	6.67	36	60.00	2	3.33	4	6.67
Adequate knowledge	16-20	0	0	21	35.00	0	0	0	0.00
Total	**20**	**60**	**100**	**60**	**100**	**60**	**100**	**60**	**100**

The table shows that initially, most participants in both the experimental (93.33%) and control (96.67%) groups had inadequate knowledge, scoring between 0-10 points. A small percentage in each group had moderate knowledge, and none had adequate knowledge. After the intervention, the experimental group showed significant improvement: only 5% had inadequate knowledge, 60% had moderate knowledge, and 35% achieved adequate knowledge. In contrast, the control group showed little change, with 93.33% still having inadequate knowledge and only 6.67% reaching moderate knowledge. These findings indicate the educational program's effectiveness, leading to the acceptance of H1 and rejection of the null hypothesis.

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Distribution of sample by the level of adherence in both groups

Groups		Experimental Group (N=60)				Control Group (N=60)			
Level of Knowledge	Score	Pre-test		Post-test		Pre-test		Post-test	
		enc	ntag	enc	ntag	enc	ntag	enc	ntag
Inadequate knowledge	0-10	56	93.33	3	5	58	96.67	56	93.33
Moderate knowledge	11-15	4	6.67	36	60.00	2	3.33	4	6.67
Adequate knowledge	16-20	0	0	21	35.00	0	0	0	0.00
Total	**20**	**60**	**100**	**60**	**100**	**60**	**100**	**60**	**100**

The table shows adherence levels in the experimental and control groups before and after an educational intervention. Initially, poor adherence was common in both groups, with 96.67% in the experimental and 93.33% in the control group scoring 0-4 points. Only a small percentage showed moderate adherence, and none had high adherence. After the intervention, the experimental group showed significant improvement: no participants had poor adherence, 46.67% had moderate adherence, and 53.33% reached high adherence. Meanwhile, the control group showed minimal change, with 91.67% still in poor adherence, 6.67% in moderate adherence, and only 1.67% in high adherence. These results indicate that the educational program significantly improved adherence in the experimental group, leading to the acceptance of H2 and the rejection of the null hypothesis.

Effectiveness of virtual reality-based infection control training program by comparing pre-test and post-test knowledge score of respondents in experimental group & control group (non-interventional):

N=60+60

Groups	Test	Mean	Mean Percentage (%)	SD	Enhancement	Enhancement Percentage (%)	Calculated t-Value	Tabular Value
Experimental Group	Pre-test	5.2	26.0	2.24	9.6	48.0	22.25**	1.66
	Post-test	14.8	74.0	2.48				
Control Group	Pre-test	5.45	27.3	1.92	1.18	5.9	2.9*	1.66
	Post-test	6.63	33.2	2.52				

**Significant, df-118; p>0.05 level The table highlights the effectiveness of a virtual reality-based

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infection control training program by comparing pre-test and post-test knowledge scores in both experimental and control groups of 60 participants each. The experimental group's average knowledge score significantly increased from 5.2 (26.0%) pre-test to 14.8 (74.0%) post-test, showing a 48.0% improvement, with a highly significant t-value of 22.25. In contrast, the control group, which did not receive training, showed a slight increase from 5.45 (27.3%) to 6.63 (33.2%), a modest 5.9% improvement, with a t-value of 2.9. These results indicate that the virtual reality-based training was highly effective in enhancing knowledge in the experimental group, supporting the acceptance of H3 and the rejection of the null hypothesis.

Effectiveness of virtual reality-based infection control training program by comparing pre-test and post-test adherence score of respondents in experimental group & control group (non-interventional):

N=60+60

Groups	Test	Mean	Mean Percentage (%)	SD	Enhancement	Enhancement Percentage (%)	Calculated t-Value	Tabular Value
Experimental Group	Pre-test	2.62	26.2	1.35	9.6	48.0	22.25**	1.66
	Post-test	7.62	76.2	1.12				
Control Group	Pre-test	3.00	30.0	1.47	1.18	5.9	2.9*	1.66
	Post-test	3.33	33.3	1.54				

**Significant, df-118; p>0.05 level The table demonstrates the effectiveness of a virtual reality-based infection control training program by comparing adherence scores in experimental and control groups, each with 60 participants. In the experimental group, the average adherence score increased significantly from 2.62 (26.2%) pre-test to 7.62 (76.2%) post-test, showing a 48% improvement. This change was statistically significant (t-value = 22.25).In contrast, the control group, which did not receive the training, showed only a slight increase from 3.00 (30%) to 3.33 (33.3%), a modest 5.9% improvement, also statistically significant (t-value = 2.9) but much less substantial. These results clearly indicate that the virtual reality-based training was highly effective in improving adherence, leading to the acceptance of H4 and rejection of the null hypothesis.

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Association between pre-test knowledge score of experimental group with demographic variables

N=60

SR. No.	Demographic Variables	Chi-Square Value	Degreeof Freedom	Tabulated Value	Level of Significance
1	Age	8.612	3	7.815	Significance
2	Gender	5.661	1	3.841	Significance
3	Highest Level of Education	9.18	4	9.488	Not Significance
4	Job role	1.75	4	9.488	Not Significance
5	Years of Experience in Nursing	5.34	4	9.488	Non Significance
6	Previous training in infection control	3.864	1	3.841	Significance

Findings revealed that the chi-square value was significant at 0.05% level of significance. It indicted that there is significant association between the pre-test knowledge score and selected demographic variables such as age, gender, and previous training in infection control of experimental group.

Association between pre-test knowledge score of control group with demographic variables

N=60

SR. No.	Demographic Variables	Chi-Square Value	Degreeof Freedom	Tabulated Value	Level of Significance
1	Age	3.884	3	7.815	Non Significance
2	Gender	4.21	1	3.841	Significance
3	Highest Level of Education	2.361	4	9.488	Not Significance
4	Job role	4.236	4	9.488	Not Significance
5	Years of Experience in Nursing	8.79	4	9.488	Non Significance
6	Previous training in infection control	5.363	1	3.841	Significance

Findings revealed that the chi-square value was significant at 0.05% level of significance. It indicted that there is significant association between the pre-test knowledge score and selected demographic variables such as gender, and previous training in infection control of control group.

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Association between pre-test adherence score of experimental group with demographic variables

N=60

SR. No.	Demographic Variables	Chi-Square Value	Degreeof Freedom	Tabulated Value	Level of Significance
1	Age	7.91	3	7.815	Significance
2	Gender	3.96	1	3.841	Significance
3	Highest Level of Education	6.68	4	9.488	Not Significance
4	Job role	3.56	4	9.488	Not Significance
5	Years of Experience in Nursing	7.24	4	9.488	Non Significance
6	Previous training in infection control	6.32	1	3.841	Significance

Findings revealed that the chi-square value was significant at 0.05% level of significance. It indicted that there is significant association between the pre-test adherence score and selected demographic variables such as age, gender, and previous training in infection control of experimental group.

Association between pre-test adherence score of control group with demographic variables

N=60

SR. No.	Demographic Variables	Chi-Square Value	Degreeof Freedom	Tabulated Value	Level of Significance
1	Age	2.631	3	7.815	Non Significance
2	Gender	2.223	1	3.841	Non Significance
3	Highest Level of Education	5.46	4	9.488	Not Significance
4	Job role	3.64	4	9.488	Not Significance
5	Years of Experience in Nursing	6.68	4	9.488	Non Significance
6	Previous training in infection control	1.326	1	3.841	Non Significance

Findings revealed that the chi-square value was no significant at 0.05% level of significance. It indicted that there is no significant association between the pre-test adherence score and selected demographic variables of control group.

DISCUSSION

The study assessed the effectiveness of a virtual reality-based infection control training program by comparing pre-test and post-test knowledge and adherence scores of participants in experimental and control groups. Most participants were young (21-30 years), with the experimental group having

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more older participants (above 51 years) and females, while the control group had more males and participants with higher educational qualifications like a Diploma or Master's Degree in Nursing. Significant improvements were noted in the experimental group's knowledge and adherence scores after the intervention, with many participants shifting from inadequate to moderate or adequate knowledge levels and from poor to moderate or high adherence. The control group showed minimal improvement. These results highlight the superiority of virtual reality-based training in enhancing infection control practices. The study also found significant associations between demographic variables (age, gender, previous training) and pre-test knowledge and adherence scores, particularly in the experimental group. These findings suggest that demographic factors may influence baseline knowledge and adherence, emphasizing the need to consider these variables in educational program design. Overall, the study supports using virtual reality to improve infection control practices among healthcare professionals.

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