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RESEARCH ARTICLE

“STRENGTHENING THE FOUNDATION - ESCALATES THE COMPLIANCE: ON PATH OF CONTINUAL IMPROVEMENT -AN OBSERVATIONAL STUDY AMONG HEALTH CARE WORKERS IN TERTIARY CARE HOSPITAL, CENTRAL INDIA”

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Abstract

Introduction: Healthcare-associated infections (HCAIs) are more likely to occur in healthcare settings, driven by factors involving host, pathogen and environmental elements, including healthcare personnel. Infection prevention and control (IPC) practices are crucial to mitigate pathogen transmission, with hand hygiene being especially effective. Despite knowledge of guidelines, adherence remains inconsistent, necessitating structured IPC education

Aim: To evaluate the impact of a structured, multifaceted educational intervention on the knowledge and compliance of healthcare workers regarding IPC practices at a tertiary care centre.

Methodology: A tertiary care facility in central India served as the site of this observational study for over eight months (Feb–Sept 2024), involved 394 participants, including nursing staff, interns, postgraduate students and hygiene warriors. The intervention included interactive CMEs, hands-on training, educational videos, and participatory activities like role plays and competitions. Pre- and post-intervention assessments measured knowledge improvement, while post-intervention door-to-door evaluations identified practical compliance.

Results: The intervention significantly enhanced participant's knowledge, with mean pre-test scores of 7.85 ± 1.47 increasing to 9.25 ± 1.19 post-intervention ($p < 0.0001$). Improvements were notable in hand hygiene practices, PPE use, and biomedical waste management. Interactive modules and multimedia tools effectively reinforced IPC measures.

Conclusion: The educational intervention significantly improved IPC knowledge and compliance among healthcare workers, highlighting the need for ongoing training. Sustained education in IPC practices is essential to foster a safety culture, reduce HCAI rates, and improve patient outcomes.

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Introduction:-

Infections linked to healthcare are always more likely to emerge and spread in healthcare institutions. The interaction of the host, pathogen, and environment, as well as the healthcare staff from all angles, must be taken into account when addressing the difficulties associated in containing these outbreaks. (Holmes and Castro-Sánchez, 2015) Effective infection prevention and control strategies lessen the likelihood that resistant bacteria may proliferate in medical settings (Joy et al., 2016). However, many healthcare institutions lack the infrastructure and systems necessary for infection prevention and control, which leads to the spread of resistant bacteria and the development of illnesses linked to healthcare (Zaidi et al., 2005; Charani et al., 2013). Therefore, it is essential to modify a training program that takes a comprehensive approach in order to meet the difficulties in containing infections linked to healthcare at a medical facility. The manner in which a contemporary healthcare institution or organization functions is crucial in this respect.

When rigorously followed by healthcare professionals, standard precautions such as infection control procedures can greatly reduce the spread of diseases. (WHO 2018). Hand hygiene, which includes the fundamental procedures of hand washing, hand sanitization, and use of gloves, is the most crucial and successful part of this protocol. (Boyce JM and Pittet D. 2002) Regardless of the patient's symptoms, these simple steps have consistently been demonstrated to stop the spread of infections. Few studies in France (Tavolacci et al., 2008), Ghana (Bello et al., 2011), Ethiopia (Tenna et al., 2013), and India (Suchitra and Devi, 2007) demonstrate the need for more emphasis on education regarding nosocomial infection sources. They also imply that healthcare professionals do not follow normal safeguards and hand washing procedures, even though they are aware of the fundamentals. They advise creating guidelines for each institution and teaching HCS on these ideas.

Aim and Objectives:-

To evaluate the impact of a structured multifaceted educational interventions on the knowledge and compliance of healthcare workers regarding hospital infection prevention practices at a tertiary care centre.

Materials and Methodology:-**Study Design and Setting:**

The current observational study was carried out in several sessions from February 2024 to September 2024 at a tertiary care facility in Central India over a period of eight months. Hospital Infection Control Committee and the Department of Microbiology planned to conduct Continued Medical Education (CMEs) and Hands on training programs to strengthen the health care system which is the foundation of the hospital in consideration of deficiencies observed in pre-intervention assessment door-to-door survey of ICU, Wards, OPD. In this survey, expert team observed the workplace culture with the help of checklist at each continuum of care, YES response noted with correct & available practice, addressed them on wrong practices wherever necessary. During this survey we have noted deficiencies in the checklist observed area wise and planned to emphasize particular topics and focus need to be given on particular health care population.

Study Participants:

Interns, postgraduate students, nursing staff and hygiene warriors from various departments including critical regions (Intensive Care Unit), made up the 394 participants in total. As there were more participants, CME cum training programmes are decided to conduct in multiple sessions over 8 months of duration in small batches. All Head of Departments & Matron were informed officially about the training with systematic schedule program by considering the duties and working hours of participants.

Educational Interventions:

The training program consisted of multiple components(Fig1) aimed at enhancing knowledge about health care associated infection prevention. The primary intervention phase included Continued Medical Education (CMEs) in which interactive, didactic educational sessions were delivered by senior subject fraternity of the institute emphasizing hand hygiene, personal protective equipment (PPE) usage, spill management, safe injection practices, biomedical waste management and main four key indicators of Health care associated infections i.e CLABSI, CAUTI, SSI & VAP followed by video demonstration and hands-on training by subject experts on Hand Hygiene (both with soap & hand rub), spill management and safe injection practices in every session. Before each session we have shared 10 questionnaire list as a pre-test through google form to assess the baseline knowledge about same subject. Questions were structured by the subject faculties of the same department. Each correct answer being carried

one mark while zero for incorrect answer. Same questionnaire was used for each session to exclude interviewers bias.

During this 8 months in addition to traditional lectures, innovative effective methods were employed to engage the healthcare workers. Educational role plays (street plays) (**Participatory Learning & Action PLA module**) (**Gosling and Edwards, 2003**). and dance performances regarding good practices, competition like posters, slogans and “Best Ward Award” competition were organized to increase awareness of hospital infection prevention practices among health care workers. PLA module is truly participative process and can be a very effective way of acquiring a deep understanding of the situation within participants. Educational self created videos on critical topics such as cough etiquettes, hand hygiene, safe injection practices and spill management were created and displayed in OPD areas through television screens. These videos aimed to reinforce the training provided during the educational sessions and were made accessible to both healthcare workers and patients. These activities targeted not only healthcare workers but also patients and visitors in the OPD, wards, and ICU. In Post training assessment door-to-door rounds (Knowledge, Attitude, Practice i.e KAP Survey Model) (**Gaikwad et al., 2018**) were conducted to ensure compliance and finding the blind spots in actual knowledge and workplace performance which were noted in the same checklist format (Fig 2) used in the pre-training assessment. It helped to understand considerable gaps between what is said and what is done.

Also, the same participants were given access to the same questionnaire list via Google Form as a post-test to determine the intervention's efficacy during this post-training survey.

Fig. 1:-Study Protocol Flow Chart-

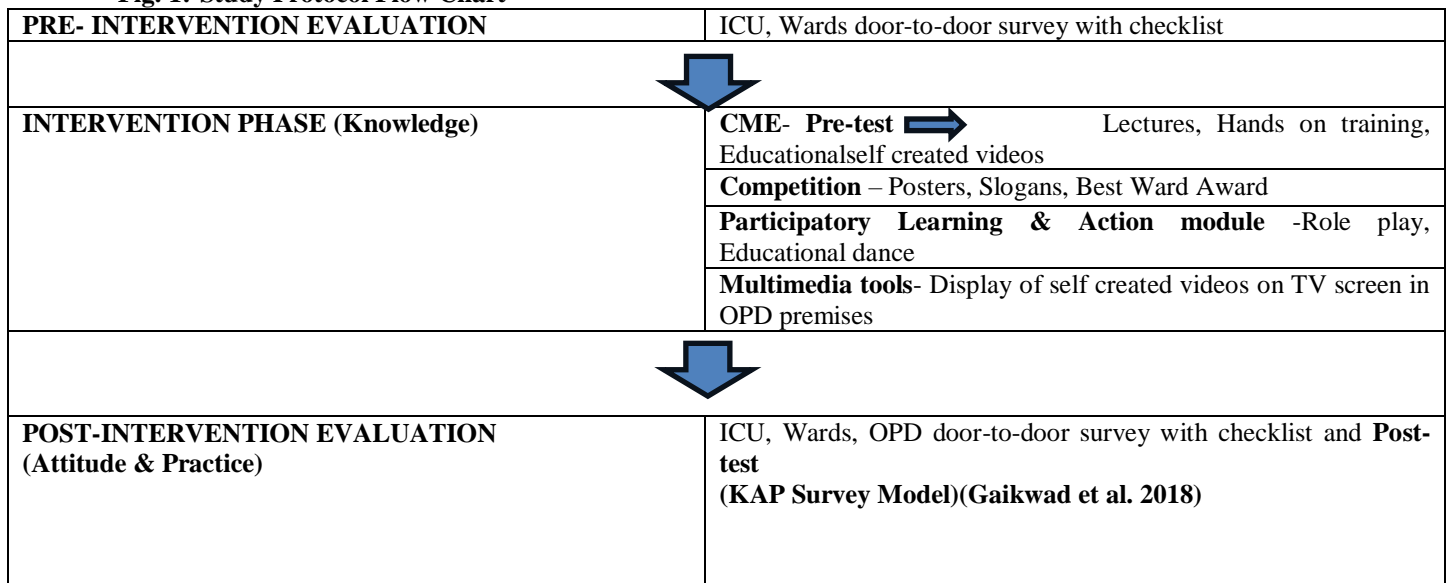


Fig 2:- Checklist used for door-to- door OPD, ICU and wards survey-

Infection Prevention and Control Assessment Checklist

Name of Health facility	
Date of Assessment	
Name of Assessor	

1) Hand Hygiene

No.	INDICATORS	REFERENCE TO MARK RESPONSES	RESPONSE OPTIONS	COMMENTS/OBSERVATIONS
1	Is soap and water OR 70% alcohol based hand rub available in the healthcare facility for handwashing?	Mark this question as Yes if either soap and water OR 70% alcohol based hand rub is available in the healthcare facility. Point of verification - Record review of incident register for consumables		
2	Is hot/running water facility for hand washing available in the healthcare facility?	Mark this question as Yes if wash basin/running water is available for 24 hours in the healthcare facility. Point of verification - Observation & Staff Interview Observation on running water availability in the facilities and Staff interview of the same		
3	Does the healthcare facility have IEC posters for hand hygiene displayed near handwashing area?	Mark this question as Yes if IEC poster to practice proper steps of hand washing is displayed near the handwashing area. Point of verification - Observe		
4	Does the staff follow 5 moments of hand hygiene practices?	Mark this question as Yes if all the 5 hand hygiene practices mentioned below are observed: 1. Before touching a patient 2. After touching a patient 3. Before clean aseptic procedure 4. After body fluid exposure 5. After touching patient surroundings. Point of verification - Observe		

2) Personal Protective Equipment

No.	INDICATORS	REFERENCE TO MARK RESPONSES	RESPONSE OPTIONS	COMMENTS/OBSERVATIONS
1	Is the staff using Personal Protective Equipment (PPE) appropriately? (Goggles, gloves, surgical mask, aprons, N95 respirators, footwear, eye wear wherever is applicable)	Mark this question as Yes if staff are using gowns, gloves, surgical mask, aprons, N95 respirators, footwear, eye wear wherever is applicable appropriately. Point of verification - Observe		
2	Does the healthcare workers dispose the PPE as per national IPC guidelines?	Mark this question as Yes if PPE is disposed in yellow bag as per the national IPC guidelines. Point of verification - Observe and Record Review Observe waste disposal and Record review of Written plan for BMW		

3) Biomedical waste management (BMW), Sharp safety and Spill management

No.	INDICATORS	REFERENCE TO MARK RESPONSES	RESPONSE OPTIONS	COMMENTS/OBSERVATIONS
1	Is the healthcare staff trained on latest Biomedical waste management (BMW) guidelines including spill management?	Mark this question as Yes if staffs are trained on latest BMW guidelines including spill management. Point of verification - Record review of BMW training attendance sheet and observe the spill management in case of any accident		
2	Does the healthcare facility staff perform spill management in case of any spill?	Mark this question as Yes if the staff are performing spill management as per following IPC guidelines: A. Sputum spill management: Immediate evacuation for 1 hour - wear PPE to re-enter - Cover the spill area with paper towels soaked in 5% Phenol solution and wipe with the same after 20 minutes (do not pour directly on the spill area) - sterilise the used materials B. Blood spill management: 0.5% & 0.05% freshly prepared Sodium Hypochlorite solution should be used according to area of spillage procedure. Specific review point - Observe and Record Review of BMW guideline AND Hypochlorite Preparation log book		
3	Is the practice of not recapping the needles after use followed in healthcare facility?	Mark this question as Yes if practice of recapping needle after use is not followed to avoid the risk of needle stick injury. Point of verification - Observe		
4	Is the sharp disposal done in the healthcare facility as per national guidelines?	Mark this question as Yes if puncture-proof container is available for sharps disposal and is used in the healthcare facility. Point of verification - Record Review and Observe Check availability and record of puncture-proof container in incident register and Observation during OPD hours		
5	Are colour coded bags/bins for Biomedical waste (BMW) segregation and disposal used in the healthcare facility?	Mark this question as Yes if red, yellow, blue, black colour coded bins or bags are available in the healthcare facility. Point of verification - Observe and Record Review Check availability of colour coded bags in stock room or check the entry in incident register		
6	Is the waste segregated at the point of generation in the healthcare facilities?	Mark this question as Yes if Biomedical waste is segregated into containers or bags at the point of generation. Point of verification - Observe and Record Review Observe waste segregation and Review BMW log book with details for every point of waste generation		
7	Are the waste bins emptied in 48 hours in the healthcare facilities?	Mark this question as Yes if waste bins are emptied in 48 hours. Point of verification - Staff Interview and Record Review Staff interview about the waste disposal and Record review of log book provided by BMW operator		

Data Collection and Analysis:

A standardized questionnaire was used to assess participant's knowledge both before and after the multifaceted educational intervention. The effectiveness of the educational intervention was assessed by analysing the results of the pre-test and post-test. To ascertain the importance of the observed changes, statistical analysis was carried out, concentrating on comparing the mean scores for each question and general knowledge before and after training. Data analysis was done using the Statistical Package for Social Sciences 26.

Results:-

Result no. 1:-Demographic distribution of study subjects.

Parameter	No of participants	Percentage
Age (Mean ±SD)	35.20±9.59	
Gender	Female	340
	Male	54
Grand Total	394	100.00

The mean age of the 394 participants in the study was 35.20 years (SD ± 9.59). A significant majority of the participants were female, accounting for 86.29% (n = 340), while males represented only 13.71% (n = 54).

Result no. 2:-Distribution of study subjects according to designation.

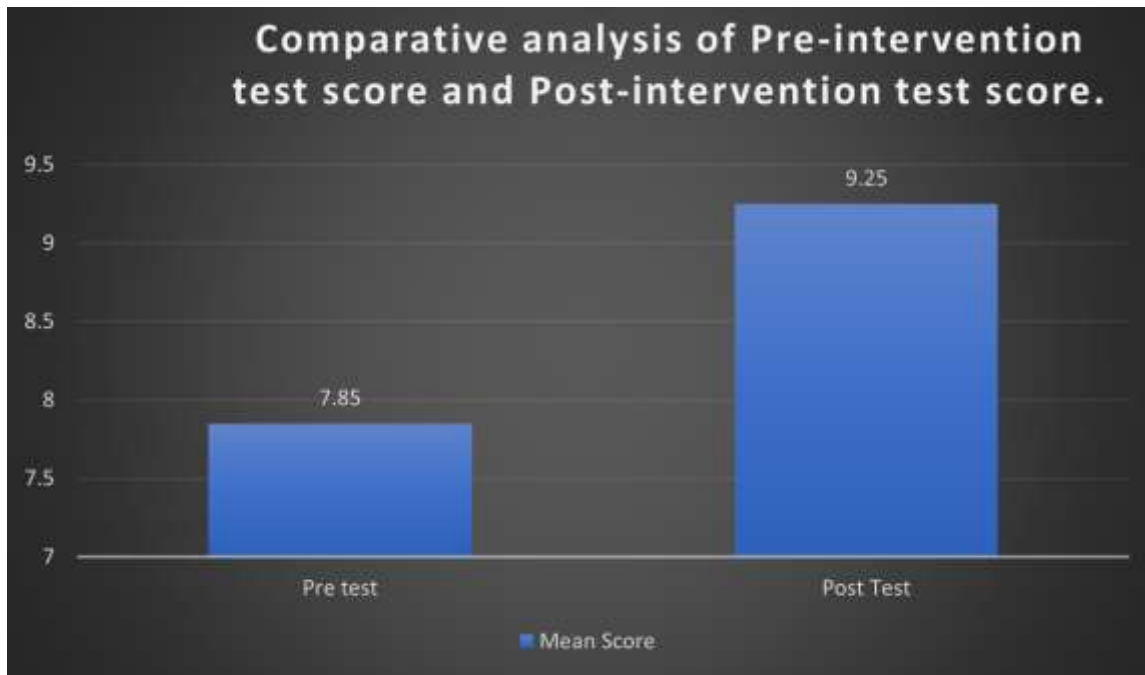
Designation	No of participants	Percentage
Staff nurse	354	89.85
Hygiene warriors	26	6.60
Interns	8	2.03
Junior resident	6	1.52
Grand Total	394	100.00

The majority of participants were staff nurses, comprising 89.85% (n = 354) of the sample. Other designations included hygiene warriors (6.60%, n = 26), interns (2.03%, n = 8), and junior residents (1.52%, n = 6).

Result no.3:-Pre- test and Post- test scores and gain in cognitive learning.

Score	Mean± SD	SEM	P value
Pre-intervention question test	7.85±1.47	14.749	<0.0000 (Statistically Significant)
Post-intervention question test	9.25±1.19		

A statistically significant improvement in test scores was observed following the training program. The mean **Pre-test** was 7.85 ± 1.47 , and the mean **Post-test** increased to 9.25 ± 1.19 ($P < 0.0001$), indicating a significant gain in knowledge after the intervention.

**Result no. 4:-Comparison of question wise Pre- test and Post- test with p value.**

Question	Pre- test		Post- test		P value
	mean	SD	mean	SD	
1. According to WHO, there are ---- moments of hand hygiene.	0.64	0.48	0.93	0.25	<0.0000*
2. Handwashing is most important procedure for-----	0.86	0.34	0.96	0.20	<0.0000*

3. Post-exposure prophylaxis for HIV should be taken within-----hours of exposure	0.98	0.14	1.00	0.00	0.2417
4. Risk of transmission of blood-borne infection after needle-stick injury is maximum for-----	0.44	0.50	0.94	0.24	<0.0000*
5. When should eye protection be worn? Select three.	0.98	0.14	0.99	0.11	0.5741
6. During doffing of PPE, what should you remove first?	0.51	0.50	0.85	0.36	<0.0000*
7. Blood bag is disposed in?	0.77	0.42	0.89	0.31	<0.0000*
8. What are the types of Health care associated infections?	0.97	0.17	0.96	0.19	<0.0000*
9. What is the recommended vaccination schedule for Hepatitis B vaccine?	0.83	0.37	0.94	0.23	<0.0000*
10. Which of the following environment is N95 mask usage recommended for?	0.86	0.34	0.95	0.22	<0.0000*

* Statistically significant.

The majority of the questions showed statistically significant improvements when pre-test and post-test results were compared question by question. Knowledge of needle-stick injury risk (pre-test: 0.44, post-test: 0.94, $P < 0.0001$), hand hygiene (mean pre-test: 0.64, post-test: 0.93, $P < 0.0001$), and PPE removal (pre-test: 0.51, post-test: 0.85, $P < 0.0001$) all showed notable improvements. Certain issues, like eye protection and HIV post-exposure prophylaxis, did not reveal statistically significant differences ($P > 0.05$).

This analysis suggests that the training program was effective in increasing the knowledge of healthcare workers regarding health care associated infection prevention, with significant improvements in most areas.

Result no.5:- Various educational interventions used in the study.



- 1- Infection Prevention Practice Training for Interns and Post graduate students, explaining importance of BMW management
- 2- Infection Prevention Practice Training for Nurses and Hygiene warriors, demonstrating hand hygiene steps.
- 3- Poster competition in OPD premises, delivering take home messages for Health care workers.
- 4- Educational role play on infection prevention practices showing good practices (Standing White One) overcoming the organisms (Seating Black One) like VRSA, MRSA, VRE etc
- 5- Educational skit on importance of standard precautions to be taken during Tuberculosis.
- 6- Educational dance on Hand Hygiene, showing steps of Hand wash.

In case of **Participatory Learning & Action module**(Gosling and Edwards, 2003), we have asked group of participants to present a role play on same situation by their own way that definitely encouraged participants to discuss, analysed the same issue and could compare how different groups see the same problems and challenges. It provided different perspectives by different group of participants.

Educational dance activity not only emphasized the participants make to learn but also made interesting and attentive by visitors, patients and health care workers.

Even in the post-intervention phase, we observed a significant improvement in KAP(Gaikwad et al.,2018). of the study group, we noticed more YES response in checklist column of post intervention training.

Discussion:-

The aim of the current study was to evaluate how a structured educational intervention affected healthcare workers' awareness of and adherence to infection prevention measures related to healthcare. 394 healthcare professionals took part, with nursing staff making up the majority (89.85%), followed by junior residents (1.52%), interns (2.03%), and hygiene warriors (6.6%). This distribution highlights the significance of infection control education among individuals who have the most direct contact with patients, reflecting the important frontline roles in patient care.

The results demonstrate a significant improvement in the knowledge of healthcare workers post-intervention. The mean pre-test score was 7.85 ± 1.47 , which increased to 9.25 ± 1.19 following the intervention, with a statistically significant P value of < 0.0001 . This substantial improvement highlights the effectiveness of continuing medical education cum training programs in enhancing knowledge about infection control measures, which is crucial in preventing health care associated infections (HCAIs).

The intervention was designed to address the key gaps in knowledge regarding hospital infection prevention practices. This covered topics that are essential to lowering healthcare-associated infections (HCAIs), including hand cleanliness, the use of personal protective equipment (PPE), biomedical waste management, post-exposure prophylaxis, and safe injection techniques. The post-intervention knowledge scores for most questions showed significant improvements, particularly in areas such as the number of WHO-defined moments for hand hygiene, the importance of handwashing, and the appropriate response to needle-stick injuries.

A unique aspect of this study was the use of **Participatory Learning & Action module**(Gosling and Edwards,2003) including educational role plays, street plays. It emphasised the need of outsiders to learn about from insiders. Under several names, including Nukkadnātak in North India, Path nātya in Maharashtra, VeedhiNātakam in Andhra Pradesh, Bayalāta and Nalakatha in Karnataka, and Terukkuttu in Tamil Nadu, it was formerly a widespread tradition in many regions of India for a long time. (Mathur,1964 ; Rudisill, 2011). These traditional methods were highly effective in engaging healthcare workers and reinforcing infection control practices. And non-traditional methods like multimedia tools such as displaying of self -created educational videos on large TV screen of OPD premises, which were conducted both for healthcare workers and patients. All these are provided an interactive way to convey critical information in a more relatable and memorable format. This is particularly important in an environment where compliance with infection prevention measures can significantly reduce the risk of HCAIs.

The inclusion of multimedia tools, specifically educational videos on cough etiquette, hand hygiene, and spill management, further supported the training initiative. Displaying these videos in OPD areas ensured that not only healthcare workers but also patients and visitors could benefit from this knowledge. The continuous display of such videos reinforces the learning process and helps in the retention of information over time.

In order to determine how educational and training programs affect healthcare staff's knowledge of nosocomial infections, standard precautions, and hand hygiene, Mohit Goyal (**Goyal and Chaudhry, 2019**) undertook a study. The goal of the training was not just to impart theoretical knowledge; it was also to encourage two-way engagement by emphasizing hand hygiene practices and providing practical demonstrations and hands-on training of the principles taught. The author also came to the conclusion that frequent training and education programs are necessary to help people remember the basics of hand cleanliness and routine safeguards against nosocomial infections. Since these students are the future of the healthcare workforce, it is anticipated that this will greatly lower the morbidity and mortality rate from nosocomial infections. Sensitization and reinforcement will promote adherence to standard precautions. The ideal time to instil good hand hygiene practices and encourage students to adhere to recommended safeguards is during primary training.

The question-wise analysis further highlighted the effectiveness of the intervention. For example, the correct response rate to the question regarding the risk of blood-borne infections after a needle-stick injury showed a marked improvement from 0.44 to 0.94 ($P < 0.0001$). Similarly, the correct identification of when PPE should be removed first increased significantly post-intervention, from 0.51 to 0.85 ($P < 0.0001$). These improvements suggest that the educational program successfully clarified critical steps in infection prevention protocols that are often misinterpreted or overlooked. However, some questions, such as post-exposure prophylaxis for HIV and the appropriate environments for N95 mask usage, did not show significant improvement. This may indicate that these topics were either already well understood by participants or that further clarification is needed in future educational efforts.

The results of this study underline the critical role that ongoing education plays in healthcare settings, particularly concerning infection prevention and control. HCAs remain a major public health issue, and training programs that actively engage healthcare workers through innovative methods can significantly improve knowledge and compliance. The use of role plays, street plays, and multimedia tools in this study provides a model for other healthcare facilities to follow in their infection control education programs.

Veena Manjunath (**Manjunath, 2022**) investigated how effectively educational interventions may enhance healthcare professional's understanding and application of infection prevention and control. The findings of the study demonstrated the effectiveness of the training intervention in raising their knowledge of appropriate infection prevention and control procedures. To prevent and control infections linked to healthcare, healthcare personnel must undergo repeated training and retraining.

In order to characterize the educational interventions on infection control practices to lower HCAs or prevent particular infectious diseases, Elina Koota (**Koota, 2024**) carried out a systematic review and examined 12 research. The primary conclusion was that localized, one-time educational interventions on infection control methods had been created. Seven evaluation areas were used to analyse the results of these educational activities. In three of the domains examined—skills, knowledge, and self-efficacy in the first study, and benefits to the patient, behaviours, and knowledge in the second—two studies found statistically significant results. Five of the seven trials that assessed patient benefits demonstrated statistically significant improvement.

Therefore, it is advised that the learning-teaching curriculum include ongoing medical education and workshops for small groups of 25–30 nursing officers, interns, post-graduate students, and resident physicians at regular intervals. These effective educational interventions for health and social care professionals on infection control practices are advised to reduce healthcare-associated infections (HCAs) and prevent infectious diseases.

Limitations-

Despite focusing on a potential target population that can be crucial in preventing infections linked to health care, our study's sample size is small given that it only includes one government medical college in Central India and takes into account factors like working hours, emergency duties, leave considerations, and a lack of staff to fill in. We are unable to provide training for the entire nursing staff, nursing students, interns, postgraduate students, and hygiene warriors. but will be discussed in our upcoming training courses.

Conclusion:-

In conclusion, the present study demonstrates that a multifaceted educational intervention, combining traditional lectures with interactive and multimedia components, can lead to substantial improvements in knowledge, attitude

and practice (KAP survey model) regarding infection prevention. Such interventions are essential for fostering a culture of safety and hygiene in healthcare facilities, ultimately declines the incidence of Health care associated infections, reduces hospital stay that helps to improve patient's outcomes. Regular follow-ups and refresher training will be crucial to sustaining these improvements in the long term.

Footnotes:

Declaration of conflicting interest:

No conflicts of interest are disclosed by the authors.

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