Effect of Massive Online Courses on Improving Nurses' Performance Regarding Infection Prevention Measures

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Abstract:

Background: The massive online courses (MOCs) can be a promising tool in enhancing nurses' knowledge and practices regarding infection prevention and control measures. E-learning provides a flexible and accessible platform for healthcare professionals to learn about infection prevention and control measures conveniently. **Aim** of this study was to evaluate the effect of massive online courses on improving nurses' performance regarding infection prevention measures. **Research design**: quasi experimental research design was used to conduct this study**. Setting:** The present study was conducted at Zagazig university Hospitals in Sharkia governorate, Egypt. **Subjects:** The study sample included a purposive sample of 128 nurses working in Zagazig university Hospitals. **Tools of data collection:** Two tools were used for collecting data; Self-reporting questionnaire for nurses to evaluate nurses' knowledge regarding Infection prevention measures and Observational checklist to evaluate nurses' practices regarding Infection prevention measures. **Results:** the study results showed that satisfactory total knowledge level in the pre phase was less than fifth of studied nurses (15.6 %) while in the post phase was less than two thirds of studied nurses (62.5%) had satisfactory knowledge. Regarding to satisfactory total practice level in the pre phase was 18% while in the post phase was 69.5%. **Conclusion:** MOCs have a significant impact on the knowledge and practices of healthcare professionals in infection prevention and control practices. The study's findings highlight the effectiveness of using MOCs in enhancing healthcare workers' knowledge and practice levels regarding infection prevention and control measures in healthcare settings. MOCs provide a unique opportunity for healthcare professionals to learn through interactive means and to access the latest information on infection prevention and control practices. **Recommendations:** Online learning can be an effective way to enhance knowledge and practices related to infection control and prevention. Further research is essential to establish the efficacy of MOCs in healthcare settings comprehensively.

Key words: Infection prevention measures, Massive online course, Nurses performance.

Introduction

The purpose of standard precautions, which were created and put into use long ago in the history of medicine, is to guarantee that healthcare facilities follow the bare minimum infection prevention procedures. In order to improve the wellbeing of healthcare workers (HCWs) and patients [(1)], standard precautions were improved and updated in response to various hazards of exposure among HCWs [(2).] HCWs, particularly nurses, are more likely to contract an infection from occupational exposure in various healthcare settings than the general public [(3),] and following standard precautions in all circumstances would be considered one of the most effective ways to minimize cross-transmission, regardless of whether the patients' infection status is suspected or confirmed [(1).] Despite considerable preparation and progress even with knowledge gained from prior epidemics, HCWs generally do not adhere to recommended protocols, and there were differences in compliance rates across various standard precautions [(4,5).]

Massive Online Courses offer a flexible and cheap method to enhance your career, learn new skills, and deliver high-quality educational experiences at scale. For a range of learning-related purposes, including job advancement, career change, college preparation, supplemental learning, lifelong learning, corporate eLearning & training, and others, many people all over the world use MOCs. Therefore, MOcs is crucial for the growth of nursing and health care [6].

Nursing role includes risk assessment, which considered an activity carried out by the nurse prior to every patient interaction to assess the infectious risk posed to themselves and other patients, visitors and healthcare workers by a patient, situation or procedure. This include an evaluation of the risk factors related to the interaction between the nurse, the patient and the patient's environment to assess and analyze their potential for exposure to infectious agents and identify risks for transmission. The nurse should routinely perform risk assessment many times a day to apply control measures for their safety and the safety of patients and others in the healthcare environment [7].

MOCs have been increasingly utilized in healthcare settings as a means of providing healthcare professionals with education and training opportunities. With the outbreak of COVID-19, there has been a surge in the utilization of MOCs for infection prevention and control training. Online learning provides an avenue for healthcare professionals to learn about the latest infection prevention and control protocols and measures from anywhere at any time, even in situations where physical attendance at seminars or workshops is not possible [8].

It is important to note that MOCs are not a substitute for hands-on or practical training in healthcare settings. Nevertheless, MOCs can be utilized as a primary platform for theoretical and knowledge-based learning in healthcare settings, especially in areas where there is a shortage of skilled healthcare professionals or where traditional methods of training are not feasible[9].

Significance of the study:

The study's objectives were to evaluate the effect of massive online courses on improving nurse's performance regarding infection prevention measures. The results are crucial in guiding the strategies and interventions required to improve workplace policies in healthcare settings and retain a healthcare system's ability to fight a pandemic while also maintaining key health services [10, 11].

Aim of the study:

The current study aim was to evaluate the effect of massive online course on improving nurses' performance regarding infection prevention measures.

Research hypotheses:

- Nurses' knowledge regarding infection prevention measures will be improved after online courses
- Nurse's practices regarding infection prevention measures will be adequate after applying massive online courses.

Subjects and Methods:

Research design:

This study was carried out using a single group, pre-posttest, a quasi-experimental research design. Intervention studies of this kind examine causal hypotheses. In a quasi-experimental approach, the program or policy is considered as a 'intervention' in which a treatment - consisting of the components of the program or policy being assessed - is tested to see how effectively it achieves its goals **Doyle,etal** [12]. In the current investigation, two periods of data collection were combined using a pre-test/post-test technique. Data were gathered prior to the intervention (pre-test) and one month later (post-test).

Setting:

The present study was conducted at Zagazig university Hospital in Sharkia governorate, Egypt. The hospitals involve surgical, medical and emergency hospitals. There were 5 departments in the selected hospital including Operations, Emergency, ICU, Medical, Hemodialysis,

Subjects:

The study sample included a purposive sample of 128 nurses working in the following setting and fulfilled the following criteria**:**

Department	No. of Nurses
Operation room in emergency hospital	23
Emergency unit	7
ICU in surgical hospital	74
Internal medicine in medical hospital	21
Renal dialysis in medical hospital	3

Inclusion Criteria:

- Both sexes.
- Provided direct patient care.
- Work experience at least one year.
- Accept to participate in the study.
- Work in medical surgical area.

Exclusion Criteria:

Nurses who didn't have experience in dealing with these application whatsapp, zoom on cellphone or computer.

Sample size calculation:

The Sample size was calculated through the correlation between feasibility of change and feasibility of post course competency equal to 0.431 with power of test 95% and confidence level 95%, size effect 2, the sample size calculated to be 128 nurses. The standard normal deviate for $\alpha = Z\alpha = 1.9600$, The standard normal deviate for $\beta = Z\beta = 1.6449$, $C = 0.5 * \ln[(1+r)/(1-r)] = 0.3305$ [13]

Tools of data collection:

Two tools were used to collect necessary data.

Tool I: Self-reporting questionnaire:

It was designed by the researcher after reviewing of related literature and opinions of experts for content of validity and included the following two parts;

Part I: **Demographic data of the nurses**: It consisted of six closed ended questions as the following: Nurses' age, sex, level of education, years of experience, Specified department, training courses in infection prevention measures.

Part II: Nurses' knowledge about the standard precautions regarding infection prevention measures was consisted of 20 MCQ questions in four parts as follow;

Part1: Was consisted of three questions on standard precautions.

Part 2: Was consisted of nine questions on nurses' knowledge about occupational exposure to blood and body fluids.

Part 3: Was consisted of three questions on first aid after exposure.

Part 4: Was consisted of five questions on post exposure prophylaxis [14].

Scoring system for nurses Knowledge: A correct answer was scored one and the incorrect answer was scored zero, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. Knowledge was considered satisfactory if the percent score was ≥75% and unsatisfactory if less than <75%based on statistical analysis and related literature review [14].

Tool II: Observational Checklist

It is used to assess nurses' practices regarding infection control prevention measures. It was consisted of five parts including 28 items as the following and the answer with done or not done [15].

Part 1: Risk assessment if nurses exposed to blood or body fluids that cause the spread of infectious agents and Control the risk by wearing personal protective equipment consisted of four items.

Part 2: Was consisted of eight items in hand washing.

Part 3: Was consisted of seven items in personal protective equipment.
Part 4: Was consisted of three items in cleaner hospital environment.
Part 5: Was consisted of six items in waste managments disposal precautions.

Scoring system for nurses' Practice: The items "not done" and "done" on the observation checklists received scores of "zero" and "one," respectively. The results of adding together the item scores for each skill and dividing the total by the number of items produced the part's mean score. Based on statistical analysis and a review of related literature, the practice was considered adequate if the percent score was 75% or higher and inadequate if it was less than 75% [(15).]

Content validity& Reliability:

The content validity of the data collection tools was evaluated by nursing and medical professions. One medical-surgical nursing professor, one general medical professor from faculty of nursing and faculty of medicine Zagazig University Hospital were on the panel. According to their opinion, minor modifications were applied. Test of reliability of study tools by Cronbach's Alpha that used to measure the internal consistency (reliability of used tool) was 0.886 for knowledge, 0.783 for Observational Checklist for nurses' practice**.**

Field Work:

Field work of this study was executed in sex months from January 2023 to June 2023. During this period all the data were collected from the study subjects.

Preparatory phase:

With the use of textbooks, papers and periodicals, internet searches, and other sources, a review of the recent and prior literature that addresses the many facets of the issue was conducted. This was essential for the researchers' familiarization and orientation with the research problem's various facets, as well as to help with the creation of the data collection method and the planning of the educational nursing intervention for health guidance.

Program description:

The training Program will be designed by the researchers after revising of related literature to. This study will be conducted on four consecutive phases (Assessment, Planning, followed by implementation and evaluation).

Assessment phase: The researchers visited the study setting, met with the directors and head nurses to explain the study aim and procedures, and to gain their approval and cooperation. Then, the researchers met with the nurses who fulfilled the inclusion criteria, explained to them the purpose of the study and its procedures as well as their rights, and invited them to participate.

The researchers started by introducing herself to the nurses, the aim of the study and the component of the tools were explained to the nurses at the beginning of data collection, they were assured that the information collected would be treated confidentially and that it would be used only for the purpose of the study. The researcher was available three days (Saturday, Monday and Thursday) at Operations, Emergency, ICU , Medical and Hemodialysis at Zagzig university Hospitals in Sharkia governorate during day shift Eight .am – Eight . Pm. The researcher collected nurses' knowledge and observed nurses' practice (pre-test questionnaire) in one month.

The researchers were interviewed with each subjects individually in the subjects unit to fulfill the pretest questionnaire sheet, the time required for completion of the questionnaire sheet was ranged from 30 minutes – one hour. Also the researcher was observing nurses practical skills about studied procedures.
Planning phase: During this phase, the researcher designed the program based on review of the most recent and relevant literature.

Implementation phase: The online courses

This phase was implemented in four months, one month for knowledge about infection control measures **theoretical part** in the form of text, pictures about definition of infection, causes, standard precautions and the chain of transmission and three months for **the practical part** in the form of three online infection control courses that participants completed. The Courses also include video to demonstrate skills such as proper hand washing procedure, common practices, and donning personal protective equipment.

The course was designed as a self-study course for workplace training with content created the research with the help of ICP professionals. Each course includes text, pictures and graphics to illustrate major concepts. There are interactive sessions with the participants in their free time to take feedback about their understanding knowledge about infection prevention measures through Zoom program and contact with participants through whatsapp groups to follow them through online courses and their progress in the course.

Evaluation: After implementation, the subjects were contacted by the researcher to evaluate post knowledge tests and their practices up in order to evaluate their progress and the improvement in their practices was evaluated using the (post-test) questionnaire for the study group to evaluate the effect of Massive online courses on improving nurses performance regarding infection prevention measures in one month**.**

Pilot study:

Pilot study was conducted on 12 (10 %) of nurses and they were excluded from the total number of nurses to insure the clarity and comprehensiveness of the tool.

Administrative and ethical consideration:

The study was approved by the ethics committees at the participating clinical and educational institutions. Firstly, the study was approved by the research Ethics Committee (REC) at Faculty of Nursing Zagazig University (M.DZU.R/0023/1/1/2023) by written consent also by the dean of faculty. Then, the nurses was interviewed to be informed about the purpose, benefits of the study, and they were also informed that their participation is voluntary, and they have right to withdraw from the study at any time without given any reason. In addition, confidentiality, and anonymity of the subjects were assured through coding of all data. The researchers assured that the data collected will be confidential and improve nurses' knowledge and practice for the purpose of the study.

Statistical analysis:

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows**.** Quantitative data were expressed as the mean ± SD &median (range), and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). Wilcoxon Signed Ranks test was used to compare between paired variable of not normally distributed. Percent of categorical variables were compared using Chi-square test or Fisher's exact test when appropriate. . Spearman rank correlation coefficient was calculated to assess relationship between various study variables, (+) sign indicate direct correlation & (-) sign indicate inverse correlation, also values near to 1 indicate strong correlation & values near 0 indicate weak correlation. All tests were two sided. P-value < 0.05 was considered statistically significant (S), p-value < 0.001 was considered highly statistically significant (HS), and p-value ≥ 0.05 was considered statistically insignificant (NS).

Results:

Table (1): It was found that 61.7 % of nurse's were in the age group of more than 25 years with mean age 26.46±3.9 years. Regarding nursing sex, the majority 93% of the studied nurses were Females nursing. Regarding nursing education, 74.2% of the

studded nurses had technical institute nursing. As well as 50.8% of the study, nurses had more than 5 years of experience with mean±SD 5.4±3.8years. Regarding to department Affiliation 57.8% of study nurses in ICU. In relation to the attended training coerces 93.8% of receive training regarding infection prevention measures

Table (2) This table clarified that there were highly statistically improvement in knowledge of nurses Standard measure Mean±SD 2.1±1.1 pre nursing intervention increased to Mean±SD 2.7±0.63 post intervention, Occupational exposure Mean±SD 5.3±1.6 pre nursing intervention increased to Mean±SD 6.5±1.7 post intervention, First aid Mean±SD 1.4±0.5 pre nursing intervention increased to Mean±SD 2.2 ±0.78 post nurses intervention, Prevention Mean±SD 2. 4±1 pre nursing intervention increased to Mean±SD 3.7±1.5 post nurses intervention, Total Knowledge level Mean±SD 11.1±3.8 pre nursing intervention increased to Mean±SD 15. 1±3.8 post nurses intervention, at (p≤ 0.001).

Table (3) Table (3): this table demonstrated that nurses' practice regarding infection prevention measures throughout study showed that improvement percent in infection prevention measures is (56.95)% and their practice in hand washing in the post phase(74.2)% were satisfactory. Regarding to personal protective equipment practices (83.3) % of nurses were unsatisfactory in the pre phase while improvement percent in Hospital environment was 91.73 %. As regard to Waste disposal practices, 82.0 % were unsatisfactory in the pre phase while in the post phase (28.1) % of nurses practice were unsatisfactory.

Figure (1): This figure shows that satisfactory total knowledge level in the pre phase was 15.6 % while in the post phase was 62.5%. Regarding to adequate total practice level in the pre phase was18% while in the post phase was 69.5%.

Table (4): this table shows that 88.6 % of nurses' who have unsatisfactory knowledge level about infection prevention measures in the pre intervention phase their age≥25 years and 88.9% of nurses' who have unsatisfactory knowledge level about infection prevention measures in the pre intervention phase were male. 91.7% of diploma nurses have unsatisfactory knowledge level regarding infection prevention measures in the pre intervention phase. 12.3% of nurses' who have satisfactory knowledge level about infection prevention measures in the pre intervention phase their experience≥5 years. No one in the renal dialysis have satisfactory knowledge level about infection prevention measures in the pre intervention phase.

Table (5): this table shows that 85.7% of nurses' who have unsatisfactory practice level about infection prevention measures in the pre intervention phase their age <25 years and 83.2% of nurses' who have unsatisfactory practice level about s infection prevention measures the pre intervention phase were females. 84.2of technical institute nurses have unsatisfactory practice level about infection prevention measures in the pre intervention phase. 21.5% of nurses' who have satisfactory practice level about standard precaution for occupational blood and body fluid in the pre intervention phase their experience ≥5 years.

Table (6): reveals that there is change in nurse's knowledge post conduction online courses in which number of unsatisfactory knowledge between nurses less than 25 years old was 28.6% change to 71.4 %, on the other hand diploma nurse's education there was unsatisfactory knowledge with 33.3 % change to 66.7% post program while technical institute nurse's education was unsatisfactory knowledge with 40.0% to 60.0% satisfactory knowledge post program. Bachelors nurse's education was unsatisfactory knowledge with 28.6 % and change to 71.4% satisfactory knowledge post program. While training was unsatisfactory with 82.5% change to 17.5% post program.

Table (7): showed that there is relation between nurses practice level about

standard precaution to occupational blood and body fluid exposure in which there is change in practice between diploma nurse's education from 25% to 70% post program conduction, while 31.6% changed to 68.8 % post program between technical institute nurse's education and 28.6% changed to 71.4 % between bachelor's nurse's education. the majority of them are satisfactory that nurses' practice level about standard precaution for occupational blood and body fluid exposure among studied nurses and their demographic characteristics post intervention phase (P<0.001).

Table (8) this table indicated that there was significant positive correlation between practice score and knowledge score of nurses post-intervention program (p=0.0001).

Discussion:

A study conducted by **Higgins et al.** [16] demonstrated the effectiveness of MOCs on hand hygiene training in healthcare professionals. The study found that MOCs on hand hygiene training were as effective as traditional in-person training programs in improving hand hygiene knowledge and beliefs. Additionally, MOCs provided a unique opportunity for healthcare professionals to learn through interactive videos, simulation scenarios, and peer learning.

Another study conducted by **Jang et al.** [17] and **kim etal**[18] investigated the effectiveness of online infection control education for nursing students. The study found that online infection control education was just as effective as traditional classroom education in improving knowledge and attitudes towards infection control practices.

In the next part, the discussion will concentrate on the main results:

Section I: will be dedicated to demographic characteristics of studied nurses.

The results of the current study are specific to the demographic characteristics of the studied population, which included nurses with a mean age of 26.46±3.9 years and the majority of studied nurses being female. The study also found that a significant proportion three quarters of the studied nurses had technical institute nursing education and over half had more than 5 years of experience (50.8±3.8 years). Moreover, more than half of the nurses worked in the ICU department.

These findings are important in determining the impact of massive online courses (MOCs) on this specific population of healthcare professionals. MOCs are a promising avenue for providing education and training to healthcare professionals, especially in areas where traditional methods of training are inaccessible or difficult to implement. However, the effectiveness of MOCs can vary depending on various factors related to the learners, such as prior education and experience [19]

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Section II: will be dedicated to nurses' level of knowledge about infection prevention measures throughout study phases.

A study conducted by **John et al.** [20] investigated the effectiveness of MOCs in improving the knowledge and skills of healthcare professionals in infection prevention and control. The study found that MOCs can be effective in improving the knowledge and skills of healthcare professionals, but the effectiveness may depend on the learners' prior knowledge and experience. In conclusion, the demographic characteristics of the studied population can provide important insights into the effectiveness of MOCs in healthcare settings.

The current study aimed to evaluate the effect of massive online courses (MOCs) on the prevention of infection and e-learning in healthcare settings. The results showed significant improvement in the knowledge of the studied nurses across domains, including standard measures, occupational exposure, first aid, and prevention. Furthermore, the total knowledge level

significantly increased after the implementation of the intervention.

The findings of the present study are significant as they demonstrate the potential impact of MOCs in improving the knowledge of healthcare professionals in infection prevention and control practices. MOCs provide a cost-effective and accessible platform for healthcare professionals to learn about the latest infection prevention and control protocols and measures. The interactive videos, simulation scenarios and peer-to-peer learning offered by MOCs make them an engaging and effective learning tool[21].

A study conducted by **Xu et al.** [22] reviewed the effectiveness of MOCs on the healthcare industry. The study found that MOCs can improve the knowledge and practices of healthcare professionals, especially in areas where there is a shortage of skilled healthcare workers or where traditional methods of training are difficult to implement. Moreover, MOCs provide a versatile and accessible platform for learning, which can be utilized in diverse settings **(Bittleston, A.)** [23].

Section III: will be dedicated to total nurses' level of practice about infection prevention measures throughout study phases.

The current study aimed to evaluate the effect of massive online courses on improving nurse's performance regarding infection prevention measures. Results showed that nurses' practice regarding standard precautions for infection prevention measures showed a significant improvement percentage in the practices of nurses exposed to blood and body fluids more than half of nurses throughout the study. Additionally, their practice in protective measures in the post-phase of the study (74.2%) was considered satisfactory.

Regarding personal protective equipment practices, majority of nurses were unsatisfactory in the pre-phase of the study. However, there was an improvement almost of studied nurses in hospital environment practices. In waste disposal practices, majority of nurses were considered unsatisfactory in the pre-phase of the study, while in the post-phase, less than one third of nurses' practices were unsatisfactory.

The present study findings indicate the effectiveness of MOCs as an e-learning tool in improving nurses' practices regarding infection prevention and control. MOCs have the potential to bridge the gap in knowledge and practice regarding infection prevention and control measures, especially for healthcare professionals working in areas with limited resources or in rural settings. Moreover, MOCs provide a flexible, cost-effective, and engaging platform for learning that can enhance the continuous professional development of healthcare professionals [24].

The present study findings agree with **Dwivedi et al.** [25] evaluated the effectiveness of e-learning in enhancing healthcare workers' knowledge and practices in infection prevention and control during the COVID- 19 pandemic. The study found that e-learning was an effective tool in improving the knowledge and practice of healthcare workers. They suggested that online training could be utilized to enhance the skills of healthcare workers and to mitigate the risks of healthcare-associated infections. In conclusion, the current study suggests that MOCs can positively impact the practice of healthcare professionals in infection prevention and control in healthcare settings. MOCs offer a versatile, cost-effective, and easily accessible platform for engaging and effective learning [26].

The present study aimed to evaluate the effect of massive online courses on improving nurse's performance regarding infection prevention measures. The present study shows that the satisfactory total knowledge level of the nurses in the pre-phase of the study was less than one third, while in the post-phase, it increased substantially to more than half of studied nurses. Furthermore, the results indicated that the percentage of unsatisfactory total

knowledge level decreased from 84.4% in the pre-phase to 37.5% in the post-phase of the study.

Additionally, the satisfactory total practice level among nurses showed a marked improvement percentage in the post-phase of the study, compared to the pre-phase. Specifically, the percentage of satisfactory total practice level increased from 18% in the pre-phase to 69.5% in the post-phase of the study. These findings highlight the effectiveness of MOCs in enhancing nurses' knowledge and practices regarding infection prevention and control measures. E-learning, through MOCs, provides a convenient and accessible platform for healthcare professionals to learn and stay up-to-date with the latest infection prevention and control protocols and practices. Moreover, the utilization of interactive discussions, simulations, and online peer-to-peer learning in MOCs enhances engagement and educational outcomes for healthcare professionals.

The present study finding agree with **Fernandes et al.** [27], it was reported that e-learning was an effective tool in enhancing the knowledge and practices of healthcare professionals regarding infection prevention and control measures. The authors suggested that e-learning could be employed as a cost-effective technique in facilitating the continuous professional development of healthcare workers.

Section IV: will be dedicated to Relation between nurses Total 'knowledge regarding infection prevention measures pre intervention program and their demographic characters.

The present study finding revealed that in the pre-intervention phase, majority of nurses with unsatisfactory knowledge levels about regarding infection prevention had an age of 25 years or more. Additionally, almost of nurses with an unsatisfactory level of knowledge about infection prevention measures were male nurses.

In terms of educational qualifications, almost all of diploma nurses had an unsatisfactory level of knowledge about IPM in the pre-intervention phase. More than two thirds of technical institute nurses revealed an unsatisfactory practice level about IPM in the pre-intervention phase Moreover, the results showed that nurses with experience of five years or more had a significantly higher percentage (12.3%) of satisfactory knowledge levels regarding infection prevention measures in the pre-intervention phase. Notably, the results also indicated that none of the nurses working in the renal dialysis department had a satisfactory level of knowledge about infection prevention measures in the pre-intervention phase of the study.

The findings of the present study are consistent with those reported by **Oladimeji et al.** [28], who found that healthcare professionals, particularly nurses, had inadequate knowledge and practices related to infection prevention and control measures. The authors also recommended that e-learning interventions, such as MOCs, could be employed to supplement conventional training programs and enhance knowledge and skills acquisition among healthcare professionals.

In conclusion, the utilization of MOCs can bolster the effort to enhance knowledge and practices related to infection prevention and control measures among healthcare professionals. MOCs can also serve as a supplementary tool to conventional training programs and provide a convenient and accessible platform for healthcare workers to learn and update their skills in this aspect [29].

Section V: Relation between nurses practice about regarding infection prevention post intervention program and their demographic characters.

The present study showed that, none of the nurses working in the renal dialysis department had a satisfactory practice level of standard precautions for occupational blood and body fluid in the pre-intervention phase. This implies that intervention measures, such as the use of MOCs could enhance the knowledge, training, and

practice levels of healthcare professionals in diverse clinical settings.

The study investigated the effect of massive online courses on improving nurse's performance regarding infection prevention measures. The study's results presents that the majority of the studied nurses had a satisfactory level of knowledge regarding IPM in the post-intervention phase, with a p-value of less than 0.001.The present study illustrated that a considerable proportion of nurses demonstrated an unsatisfactory level of practice regarding infection prevention measures in the pre-intervention phase .The present study highlights that the majority of the studied nurses exhibited a satisfactory level of practice regarding infection prevention measuresin the post-intervention phase, with a p-value of less than 0.001.

Previous research on the topic also supports the utilization of e-learning interventions in upgrading healthcare workers' knowledge, practice, and skills in infection prevention and control measures. For instance, a study by **Li et al.** (30) noted MOCs' effectiveness in enhancing self-efficacy attitudes and practices regarding hand hygiene procedures among nursing students. The study investigated the effect of massive online courses on improving nurses' performance regarding infection prevention measures. The study's results presents that the majority of the studied nurses had a satisfactory level of knowledge regarding infection prevention measures, with a p-value of less than 0.001.

In conclusion, the study's findings suggest a need for measures to improve nurses and other healthcare professionals' knowledge and practice levels regarding infection prevention measures. This can be achieved through the use of e-learning interventions, such as MOCs, which have demonstrated effectiveness in enhancing healthcare workers' knowledge and training (31).

The findings of this study align with previous research work that examined the use of technology-enhanced learning in healthcare settings. For example, a study by **Campbell et al.** (32) found that e-learning interventions were effective in improving healthcare workers' knowledge regarding infection prevention and control measures in various clinical settings.

In conclusion, the study's findings highlight the effectiveness of using MOCs in enhancing healthcare workers' knowledge and practice levels regarding infection prevention and control measures in healthcare settings. However, it is crucial to ensure that such interventions are evidence-based and carefully tailored to cater to the diverse learning needs of healthcare professionals (33).

The results of this study align with other research works that have indicated the potential of e-learning interventions in upgrading healthcare workers' knowledge, practices, and skills in infectious disease prevention and control measures. For instance, a study by **Phan et al.** (34) found that web-based training programs could enhance healthcare workers' knowledge and skills regarding tuberculosis infection prevention and control in clinical settings.

Conclusion:

In conclusion, the study's findings highlight the potential effect of MOCs in assisting healthcare professionals to upgrade their knowledge, practices, and skills in infection prevention and control measures. Online learning can provide ongoing, convenient and effective access to standardized, up-to-date information on best practices in infection control and prevention and support gaps in current training resources. Other health and educational institutions may benefit from adopting the interactive, media-rich approach taken in the development of the program described in this study. Adopting online learning for staff training is more complex, however, than simply putting courses on the Internet. Organizations need to proactively consider technical, organizational and human factors to promote success and post course support in these areas is essential.

Recommendations:

- Further research is needed to investigate the impact of MOCs on specific populations of healthcare professionals and to identify effective strategies for integrating MOCs into routine healthcare training.
- Further research is required to fully understand the impact of MOCs on routine healthcare training and healthcare outcomes.
- Further studies are required to determine the long-term impact of MOCs on healthcare outcomes and to establish standards for MOOC design and delivery.
- Future studies need to explore further the efficacy of MOCs and other e-learning interventions in diverse healthcare settings and explore the factors that may affect their uptake among healthcare professionals comprehensively.

Table 1: Frequency and Percentage Distribution to Demographic Characteristics and Qualification of Studied Nurses (N=128):

Variables		Frequency	Percent
Age per years	<25 years	49	38.3
	≥25 years	79	61.7
	Mean ±SD	26.46±3.9	
	Median (range)	25(21-35)..	
Sex	Males	9	7.0
	Females	119	93.0
Education	Diploma	12	9.4
	technical institute	95	74.2
	Bachelors'	21	26.4
Experience per years	<5 years	63	49.2
	≥5 years	65	50.8
	Mean ±SD	5.4±3.8	
	Median (range)	4(1-12)	
Department	Operation	23	18.0
Affiliation	emergency	7	5.5
	ICU	74	57.8
	internal Medicine	21	16.4
	Renal dialysis	3	2.3
Training course	yes	120	93.8
	No	8	62

Table 2: Frequency Distribution of Nurses' Knowledge Regarding Infection Prevention Measures Throughout Study Phases (N= 128)

Domains		Time phase		Improvement percent	w	p-value
		Pre	Post			
		n.(%)	n.(%)			
	Mean ±SD	2.1±1.1	2.7±0.63	28.52	2.7	.008
	Median(range)	2(0-3)	3(1-3)			
Standard measure	satisfactory	49(38.3)	103(80.5)			
	unsatisfactory	79(61.7)	25(19.5)			
	Mean ±SD	5.3±1.6	6.5±1.7	23.56	3.32	.001
	Median(range)	5(1-9)	7(1-8)			
Occupational exposure	satisfactory	32 (25.0)	81(63.3)			
	unsatisfactory	96(75.0)	47(36.7)			
	Mean ±SD	1.4±0.5	2.2 ±0.78	52.72	3.48	.0001
	Median(range)	1(0-3)	2(1-3)			
First aid	satisfactory	18(14.0)	54(42.2)			
	unsatisfactory	110(86.0)	74(57.8)			
	Mean ±SD	2. 4±1	3.7±1.5	51.45	4.08	.0001
	Median(range)	2(1-5)	4(1-5)			
Post Exposure Prophylaxis	satisfactory	20(15.6)	80(62.5)			
	unsatisfactory	108(84.4)	48(37.5)			
	Mean ±SD	11.1±3.8	15. 1±3.8	36.3	4.25	.0001
	Median(range)	10(4-19)	17(7-19)			
Total Knowledge level	satisfactory	20(15.6)	80(62.5)			
	unsatisfactory	108(84.4)	48(37.5)			

W:Wilcoxon Signed Ranks Test ,p<0.05 significant, P<0.001 highly significant

Table 3: Frequency Distribution of Nurses' Practice Regarding Infection Prevention Measures throughout study phases (n= 128)

Domains		Time phase		Improvement percent	w	p-value
		Pre	Post			
		n.(%)	n.(%)			
	Mean ±SD	4.2±2	6.5±2.3	56.95	4.67	.0001
	Median(range)	2(1-5)	8(1-8)			
Risk Assessment	satisfactory	28(21.9)	89(69.5)			
	unsatisfactory	100(78.1)	39(30.5)			
	Mean ±SD	4.5±2	6.7±2.2	46.56	3.98	.0001
	Median(range)	5(1-8)	8(1-8)			
Hand Washing	satisfactory	30(23.4)	95(74.2)			
	unsatisfactory	98(76.6)	33(25.8)			
	Mean ±SD	1.3±0.97	2.5±0.82	84.88	4.93	.0001
	Median(range)	1(0-3)	3(1-3)			
Personal protective equipment	satisfactory	21(16.4)	89(69.5)			
	unsatisfactory	107(83.3)	39(30.5)			
	Mean ±SD	1.1 ±0.87	2.2±0.87	91.73	4.92	.0001
	Median(range)	1(0-3)	2(1-3)			
Hospital environment	satisfactory	5(3.9)	61(47.6)			
	unsatisfactory	123(96.1)	67(52.4)			
	Mean ±SD	2.9 ±1.8	4.9±1.8	71.66	4.67	.0001
	Median(range)	2(1-6)	6(1-6)			
Waste disposal	satisfactory	23(18.0)	92(71.9)			
	unsatisfactory	105(82.0)	36(28.1)			
	Mean ±SD	14 ±5.9	22.5±7.3	60.07	5.19	.0001
	Median(range)	12(8-28)	27(8-28)			
Total Practice level	satisfactory	23(18.0)	89(69.5)			
	unsatisfactory	105(82.0)	39(30.5)			

W:Wilcoxon Signed Ranks Test ,p<0.05 significant, P<0.001 highly significant

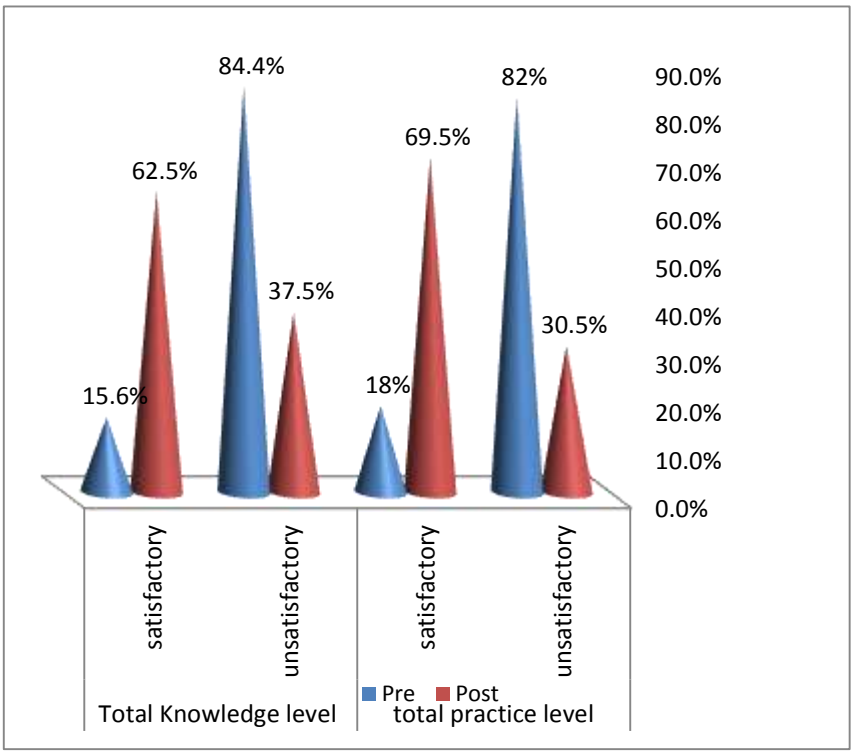

Figure1: Distribution of Nurses' Knowledge and Practice Level Regarding to Infection Prevention measures throughout study phases

Table 4: Relation between Nurses' Total Knowledge Level Regarding to Infection Prevention Measures among Studied Nurses and Their Demographic Characteristics Pre Intervention Phase (N= 128)

variables		Nurses' knowledge pre intervention				n.	χ^2	p-value
		Satisfactory n.20		Unsatisfactory n.108				
		No.	%	No.	%			
Age per years	<25 years	11	22.4	38	77.6	49	2.8	0.094
	≥25 years	9	11.4	70	88.6	79		
Sex	Males	1	11.1	8	88.9	9		
	Females	19	16.0	100	84.0	119	F	0.99
education	Diploma	1	8.3	11	91.7	12	1.4	0.480
	technical institute	17	17.9	78	82.1	95		
	Bachelors'	2	9.5	19	90.5	21		
Experience	<5 years	12	19.0	51	81.0	63	1.1	0.29
	≥5 years	8	12.3	57	87.7	65		
Department	operation	4	17.4	19	82.6	23		
Affiliation	emergency	1	14.3	6	85.7	7	1.4	0.84
	ICU	13	17.6	61	82.4	74		
	Internal Medicine	2	9.5	19	90.5	21		
	Renal dialysis	0	.0	3	100.0	3		
Training	Yes	19	15.8	101	84.2	120	F	0.99
	No	1	12.5	7	87.5	8		

χ^2:Chisquare test , f: Fisher Exact test ,p<0.05 significant, P<0.001 highly significant, p>0.05 work * Knowledge.level no significant.

Table 5: Relation between Nurses' Total Practice Level Regarding to Infection Prevention Measures among Studied Nurses and Their Demographic Characteristics Pre Intervention Phase (N=128)

variables		Nurses' practice pre intervention				n.	χ^2	p-value
		Satisfactory n.23		Unsatisfactory n.105				
		No.	%	No.	%			
Age per years	<25 years	7	14.3	42	85.7	49		
	≥25 years	16	20.3	63	79.7	79	0.73	0.39
Sex	Males	3	33.3	6	66.7	9	F	0.204
	Females	20	16.8	99	83.2	119		
Education	Diploma	2	16.7	10	83.3	12		
	Technical institute	15	15.8	80	84.2	95	1.9	0.38
	Bachelors'	6	28.6	15	71.4	21		
Experience	<5 years	9	14.3	54	85.7	63	1.1	0.28
	≥5 years	14	21.5	51	78.5	65		
Department	Operation	4	17.4	19	82.6	23		
affiliation	Emergency	2	28.6	5	71.4	7		
	ICU	13	17.6	61	82.4	74	1.2	0.88
	Internal Medicine	4	19.0	17	81.0	21		
	Renal dialysis	0	.0	3	100.0	3		
Training	Yes	21	17.5	99	82.5	120	F	0.63
	No	2	25.0	6	75.0	8		

χ^2:Chisquare test , f: Fisher Exact test ,p<0.05 significant, P<0.001 highly significant, p>0.05 no significant.

Table 6: Relation between Nurses' Total Knowledge Level Regarding to Infection Prevention Measures among Studied Nurses and Their Demographic Characteristics Post Intervention Phase (N=128)

variables		Nurses' knowledge post intervention				n.	χ^2	p-value
		Satisfactory n.80		Unsatisfactory n.48				
		No.	%	No.	%			
Age per years	<25 years	35	71.4	14	28.6	49	2.7	0.1
	≥25 years	45	57.0	34	43.0	79		
Sex	Males	6	66.7	3	33.3	9	0	1
	Females	74	62.2	45	37.8	119		
education	Diploma	8	66.7	4	33.3	12		
	technical institute	57	60.0	38	40.0	95	1.1	0.59
	Bachelors'	15	71.4	6	28.6	21		
Experience	<5 years	43	68.3	20	31.7	63	1.7	0.19
	≥5 years	37	56.9	28	43.1	65		
department	operation	14	60.9	9	39.1	23		
affiliation	emergency	4	57.1	3	42.9	7	4.3	0.36
	ICU	49	66.2	25	33.8	74		
	Internal Medicine	10	47.6	11	52.4	21		
	Renal dialysis	3	100.0	0	.0	3		
training	Yes	76	63.3	44	36.7	120	F	0.47
	No	4	50.0	4	50.0	8		

χ^2:Chisquare test , f: Fisher Exact test ,p<0.05 significant, P<0.001 highly significant, p>0.05 no significant.

Table7: Relation between Nurses' Total Practice Level Regarding to Infection Prevention Measures among Studied Nurses and Their Demographic Characteristics Post Intervention Phase (N=128)

variables		Nurses' practice Post intervention				n.	χ^2	p-value
		Satisfactory n.89		Unsatisfactory N.39				
		No.	%	No.	%			
Age per years	<25 years	36	73.5	13	26.5	49	0.58	0. 45
	≥25 years	53	67.1	26	32.9	79		
Sex	Males	6	66.7	3	33.3	9		
	Females	83	69.7	36	30.3	119	F	0.99
education	Diploma	9	75.0	3	25.0	12		
	technical institute	65	68.4	30	31.6	95	0.26	0.88
	Bachelors'	15	71.4	6	28.6	21		
Experience	<5 years	44	69.8	19	30.2	63	0.01	0.94
	≥5 years	45	69.2	20	30.8	65		
Department	operation	15	65.2	8	34.8	23		
affiliation	emergency	4	57.1	3	42.9	7		
	ICU	52	70.3	22	29.7	74	2.1	0.72
	Internal Medicine	15	71.4	6	28.6	21		
	Renal dialysis	3	100.0	0	.0	3		
Training	Yes	84	70.0	36	30.0	120	F	0.44
	No	5	62.5	3	37.5	8		

χ^2:Chisquare test , f: Fisher Exact test ,p<0.05 significant, P<0.001 highly significant, p>0.05 no significant.

Table 8: Correlation Matrix between Nurses' Practice, Knowledge, Age of nurses and Experience years throughout study phases (n=128)

Parameters		knowledge score		practice score	
		(r)	P	(r)	P
Pre	practice score	0.048	0.59		
	Age per year	0.072	0.42	0.039	0.66
	Experience years	0.012	0.89	0.081	0.36
Post	practice score	0.647**	0.0001		
	Age per year	0.063	0.48	0.072	0.42
	Experience per year	0.11	0.23	0.031	0.73

(r) correlation coefficient p<0.05 significant

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