Knowledge and Practice Regarding Use of Biosafety Cabinet Among Nurses at Tertiary Cancer

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Abstract

Background: A Biosafety Cabinet (BSC) is a primary containment device that protects healthcare workers, patients, and the environment from exposure to infectious and hazardous agents such as chemotherapy drugs. Proper knowledge and practice of Biosafety Cabinet use are essential in oncology settings where nurses frequently prepare cytotoxic drugs. In Nepal, however, nurses often undertake chemotherapy preparation without sufficient theoretical or practical training, increasing occupational risks. The aim of this study was to assess the knowledge and practices of nurses regarding the use of BSCs at B.P. Koirala Memorial Cancer Hospital.

Methodology: A descriptive cross-sectional study was conducted among nurses of B.P. Koirala Memorial Cancer Hospital, Bharatpur, Chitwan. A total of 100 nurses were selected using non-probability purposive sampling technique. Semi structured questionnaire was used to collect data within 2 weeks. The data collected was entered in SPSS version 22. Descriptive statistics (mean, standard deviation, frequency, percentage, etc.) and inferential statistics (chi square test) were calculated in the evaluation of the data.

Results: Findings of this study showed that 14.0% of respondents had poor knowledge, 54.0% had moderate knowledge, and 32.0% had good knowledge of BSCs. In practice, 2.1% had poor practice, 17.0% had moderate practice, and 80.9% demonstrated good practice. Knowledge was not significantly associated with socio-demographic variables ($p > 0.05$), while practice was significantly associated with department where they work ($p = 0.039$), but not with age, education, or years of experience.

Conclusion: The study highlights satisfactory levels of practice but moderate gaps in knowledge regarding the use of BSC among oncology nurses. The findings call for structured training, curriculum enhancement, and standardized institutional protocols to strengthen biosafety practices and ensure protection of healthcare workers and patients in tertiary cancer care settings.

Keywords: Biosafety cabinet, Knowledge, Nursing staff, Chemo-theraupetic drugs

Background

A Biosafety Cabinet (BSC) is a ventilated laboratory workspace with laminar flow designed to provide personnel, environmental, and product protection when working with potentially infectious microorganisms and hazardous materials.[1] Biological safety cabinets (BSCs) are primary containment equipment designed to protect the personnel from the immediate laboratory exposure to infectious and hazardous agents. A BSC operates by maintaining airflow patterns and filtering out contaminants through HEPA filters.[2]

BSCs are classified into three types depending on the level of protection needed, Class I BSC provides protection to personnel and the environment but not to the product, as unfiltered air enters the cabinet. Class II BSC offers personnel, environmental, and product protection through laminar airflow and HEPA filtration, making it commonly used in healthcare and research settings. Class II cabinets are further subdivided into Type A1/A2, which recycle filtered air back into the room, and Type B1/B2, which vent air completely outside. Class III BSC, also known as "glove boxes," provide the highest

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level of protection by being fully enclosed and operated with sealed gloves, suitable for handling highly hazardous materials.[1,2]

Knowledge in biosafety refers to the understanding and awareness of principles, guidelines, and safe practices when handling hazardous biological agents and aerosols. It includes familiarity with biosafety protocols, the proper use of equipment such as biosafety cabinets, and the risks associated with biohazard exposure.[2] Knowledge refers to an individual's understanding of the BSCs. This encompasses familiarity with operational procedures, safety protocols, and the principles underlying the cabinet's function.[3]

Practice, on the other hand, is the application of this knowledge in real-world settings. It involves adhering to standard operating procedures (SOPs), using personal protective equipment (PPE) correctly, and following guidelines for the safe handling, containment, and disposal of biohazards. 1 Practice involves the consistent application of safety protocols and procedures in the laboratory, including the correct use of biosafety cabinets (BSCs). It underscores the importance of routine training, proper handling techniques, and adherence to established guidelines to ensure laboratory safety.[4]

Proper practice of BSC protects the operator from infectious and hazardous agents and prevents environmental contamination. This underscores the importance of understanding and following correct use of BSC practice to maintain a safe laboratory environment.[5]

Assessing the knowledge and practice of nurses regarding (BSCs) is crucial for optimizing self protection and minimizing contamination, especially in high-risk areas like chemotherapy drug preparation. Improper use or lack of knowledge about BSC handling can lead to occupational exposure to hazardous agents, as highlighted by various studies and OSHA guidelines.[6] By assessing nurses' knowledge and practices, healthcare institutions can identify gaps and address them with targeted training, reducing the risks of exposure and improving overall safety standards.

In a descriptive study on knowledge on importance on use of laminar bio safety cabinet for preparation of chemotherapy drugs among staff nurses working in Bombay hospital, Indore, where questionaires were asked to 30 nurses preparing chemotherapy drugs, 68% were unaware of the critical importance of BSCs in protecting against hazardous drug exposure. This lack of knowledge poses significant risks to healthcare workers in one hand and patients in other. [7]

Another study done in Dhaka, Bangladesh on knowledge and practice of handling chemotherapy agents by nurses, among 96 nurses, 66.7% of respondents prepared chemotherapy agents using BSCs or laminar airflow systems while 33.3% did not use any equipment, increasing the risk of exposure to hazardous agents..[8]

This study on knowledge and practices regarding usage of biological safety cabinets assessed knowledge and practices related to biological safety cabinet (BSC) usage among 13 participants from research centers using WHO guidelines which revealed,

Pre-training knowledge on BSC usage was diverse, with an average score of 75%. [9]

Conceptual framework

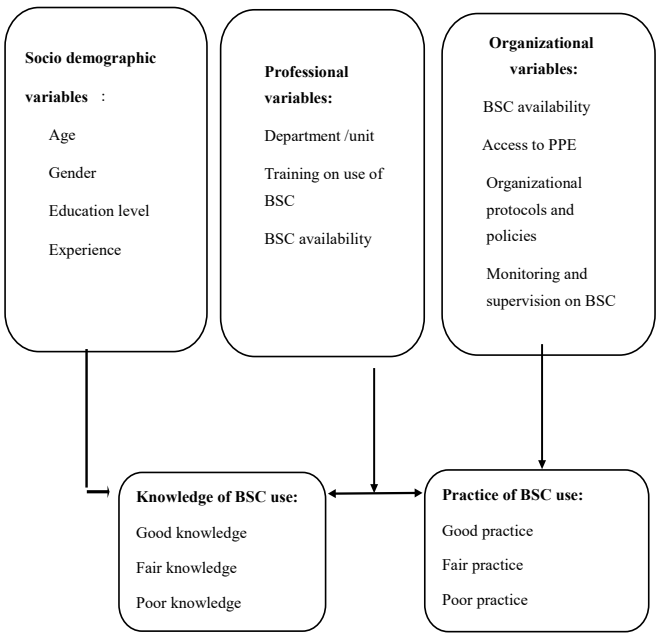

Figure 1 : Conceptual Framework of Knowledge and Practice of Nurses Regarding use of Biosafety Cabinet

Methodology

A cross-sectional study was conducted to assess the knowledge and practice of nurses regarding the use of biosafety cabinets (BSC) at B.P. Koirala Memorial Cancer Hospital (BPKMCH), Bharatpur-7, Chitwan. BPKMCH, established in 1992, is a well-equipped tertiary care cancer hospital where nurses play a vital role in the preparation and administration of chemotherapy drugs. Chemotherapy medications are prepared on-site in designated preparation areas using biosafety cabinets to maintain sterility and minimize occupational exposure to cytotoxic agents; therefore, adequate knowledge and proper use of BSCs are essential to prevent environmental contamination and potential health hazards to patients and healthcare workers. The research questions were:

What is the level of knowledge among nurses regarding biosafety cabinet ?

What is the level of practice of proper biosafety cabinet use among nurses?

Is there any association between knowledge and practice with selected variables?

The sample comprised 100 nurses working in all departments of BPKMCH, and purposive sampling was used to select participants from all wards to ensure relevance to the study objectives. Additionally, 10% of the study population was used for pretesting and excluded from the final analysis. Data were collected using a structured questionnaire developed through an extensive review of literature and consultation with a research advisor. The instrument consisted of three parts:

Part I : Questions related to socio-demographic and work-related variables.

Part II : Questions related to knowledge about BSC.

Part III : Questions related to practice of BSC use.

Nurses were asked to identify the correct statements about biosafety cabinet usage by ticking the correct options. Scoring: Each question on knowledge of biosafety cabinet was scored as 1 point for the correct answer and 0 for the wrong answer. The total score on 0 to 100 scale was calculated as per Blooms cutoff point. Good knowledge = 80-100% ,Fair knowledge = 60-79% Poor knowledge =<59%

Regarding Practice , Nurses were asked to indicate their agreement with statements about their practices using a Likert scale using Always, Sometimes, Never for practice-related questions were scored 2 points for always , 1 points for sometimes and 0 points for never. Practice Score: Good Practice = 80-100% Fair Practice = 60-79% Poor Practice = <59%

Initially, information was gathered through the utilization of duly validated preestablished questionnaires. The gathered data was checked accuracy, reliability, and completeness. Subsequently, the collected data was entered and analyzed by using SPSS 22. The analysis involved the use of both descriptive and inferential statistical methods to calculate the mean and standard deviation of Categorical variables. Statistical tools such as inference of statistics and chi-square were employed, and the study findings was presented in various tables.

Ethical Consideration

Ethical approval for the study was obtained from relevant authority of BPKMCHNC and the Institutional Review Committee of B.P Koirala Memorial Cancer Hospital. Additionally, permission was sought from BPKMCH for data collection. Prior to gathering data, informed written consent was obtained from each nurse. Throughout the study, nurses' confidentiality was rigorously upheld, and the collected information was strictly used for research purposes. Questionnaire was carried out by maintaining privacy.

Findings of the study

The analysis and interpretation of the data on knowledge and practice regarding use of safety cabinet among nurses of tertiary cancer hospital of Nepal was obtained from 100 nurses of B P Koirala Memorial Cancer hospital. The obtained data was analyzed according to the research question and objectives of the study. The collected data were checked for accuracy and completeness and then tabulated. The findings were analyzed in frequency, percentage and mean and are presented into different tables.

Table 1: Respondent's Sociodemographic Variables : Age , Sex, Educational Status, Experience (n=100)

Variables	Frequency (n)	%
Age(Years)		
<25	14	14.0
25-34	63	63.0
35-44	20	20.0
≥45	3	3.0
Mean–SD	30.92–6.440	
Min	19	
Max	56	
Sex		
Female	100	100.0
Educational Status		
PCL	33	33.0
BN	39	39.0
BSC	28	28.0
Years of experience		
<1 years	14	14.0
1 years - <2 years	19	19.0
2 years - <5 years	27	27.0
≥ 5 years	40	40.0
Departments		
Radiation Oncology	12	12.0%
Medical Oncology	35	35%
Surgical Oncology	31	31%
Intensive Care Unit	8	8%
Hospice	2	2%
Urgent Care Unit	3	3%
Operation Theatre	9	9%

Table 2 Respondent's Knowledge on Concept of Biosafety Cabinet (n =100) Correct Response

Statements	Frequency (n)	Percentage (%)
BSC is a ventilated workspace designed to protect the operator, environment and materials . BSC protects workers from Hazardous drug and	88	88.0
aerosols particle.	100	100.0
Class II BSC used for cytotoxic drugs handling.	48	48.0
Class II BSC has Vertical laminar airflow Sash ensures proper airflow balance and act as a	44	44.0
barrier UV light is supplemental method to maintain	89	89.0
sterility in the cabinet	26	26.0

Table 2 shows 88.0% of the respondents answered the definition of BSC, while 100.0% of respondents answered that BSCs protects workers from Hazardous drug and aerosols particle, while 48.0% of respondents answered the class of BSC. Similarly, 44.0% of the respondents answered correctly the airflow in class II BSC, 89% of respondents had known that sash ensures proper airflow balance. Only 26.0% of respondents answered that UV light is supplemental method to maintain sterility.

Table 3 Respondent's Knowledge on Safe Work Practice in Biosafety Cabinet

n=100 (Correct Response)

Statements	Frequ ency (n)	Percen tage (%)
Before BSC use, verify the sash height and airflow alarms and allow the cabinet to run for 4 minutes.	71	71.0
Double gloves , gown, goggles, and a respirator mask mandatory when preparing chemotherapy in BSC	90	90.0
Separate clean and contaminated materials to minimize crosscontamination	86	86.0
Double gloving to provide an additional layer of protection against hazardous drug exposure	87	87.0
Materials should be placed at the center towards the back of the cabinet	68	68.0
Use absorbent pads and spills kit to clean chemotherapy spill.	96	96.0
Before turning UV light, Close the sash , decontaminate the work surface and ensure blower motor is off	82	82.0

Table 3 shows that 71.0% of the respondents correctly answered verifying sash height and airflow alarm and allowing cabinets run for 4 minutes. Double gloves, gown, goggles and respirator use for BSC use was answered by 90.0% of respondents. Similarly, separate clean and contaminated materials to minimize cross-contamination was answered by 86.0% of the respondents. while 87.0% answered double gloving for additional protection, 68.0% of respondents answered placement of material at back of cabinet. Chemotherapy spill management by use of absorbent pads was answered by 96.0% whereas 82.0% of respondents answered Closing the sash, decontaminate the work surface before turning UV light on.

Table 4 Respondent's Knowledge on Maintenance of Biosafety Cabinet

n=100 Correct Response

Statements	Frequency (n)	Percentage (%)
HEPA filter should be annually tested	25	25.0
Use a bleach solution followed by a sodium thiosulfate rinse for decontaminating BSC	34	34.0
BSC blower is turned off after removing all items and decontaminating the interior	89	89.0

Table 4 shows that 25.0% of the respondents answered annually changing of HEPA filter while, 34.0% of the respondents correctly answered using a bleach solution followed by a sodium thiosulfate rinse for BSC decontamination. Similarly, 89.0% of respondents answered turning BSC blower motor off after removing all items.

Table 5 Distribution of Respondent's Using Biosafety Cabinet

n =47

Variables	Frequency (n)	Percentage (%)
Radiation Oncology	12	12.0
Medical Oncology(Medical Oncology II, Day Care, Hematology, Cabin)	35	35.0

Table 5 shows distribution of respondent's using Biosafety Cabinet where 12% of respondent's were from Radiation Oncology while 35% which was the highest were from Medical Oncology wards.

Table 6 Respondent's Practice Before Use of Biosafety Cabinet

n=47

Statements	Never (n%)	Sometimes (n/%)	Always (n/%)
Use a BSC when preparing chemotherapy drugs	0(0.0)	0(0.0)	100 (100.0)
Check the certification and maintenance status of the BSC	8(17.0)	23(48.9)	16(34.0)
Allow the BSC to run for 4 minutes before working in BSC	4(8.5)	16(34.0)	27(57.4)
Verify the sash height and ensure the sash alarm is functional	1(2.1)	16(34.0)	30(63.8)
Wear appropriate PPE	0(0.0)	7(14.9)	40(85.1)
Verify inward airflow in BSC using recommended method	20(42.6)	8(17.0)	19(40.0)
Ensure BSC is functioning properly before preparing chemotherapy drugs	0(0.0)	9(19.1)	38(80.9)

Table 6 shows that 100.0% of always used BSC while preparing chemotherapy. While 17.0% of respondents never checked certification of BSC while 48.9% checked sometimes while 34.0% always checked, 8.5% of respondents never allowed BSC to run for 4 minutes before use while 34.0% sometimes allowed whereas 57.4% always. Verification of sash height was done always by 2.1% while 34.0% only did it sometimes and 63.8% never did it. Similarly, 14.9% sometimes wore appropriate PPE and 85.1% always wore them. About the airflow , 42.6% never verified it while 17.0% sometimes and 40.0% always verified them, 0.0% never ensured BSC is functioning , 19.1% sometimes while 80.9% always ensured.

Table 7 Respondent's Practice During Use of Biosafety Cabinet

n=47

Statements	Never (n/%)	Sometimes (n/%)	Always (n/%)
Adjust stool bench height so my face is above the bottom of the sash	2(4.3)	10(21.3)	35(74.5)
Ensure that absorbent plastic backed material is placed	1(2.1)	9(19.1)	37(78.7)
Wipe the external surfaces of all equipment's and supplies before placing them inside the BSC	0(0.0)	8(17.0)	39(83.0)
Follow the recommended safe disposal procedures for contaminated materials	0(0.0)	5(10.6)	42(89.4)
Avoid placing any non-chemotherapy materials inside the BSC	4(8.5)	1(2.1)	42(89.4)
Follow the guidelines for avoiding direct exposure to chemotherapy drugs	1(2.1)	5(10.6)	41(87.2)
Aware of protocols for handling chemotherapy spills	0(0.0)	4(8.5)	43(91.5)

Table 8 shows 4.3% of the respondents never adjusted the bench height, 21.3% of them did sometimes while 74.5% of always adjusted the height of stool, 2.1% of respondents ensured that absorbent plastic backed material is placed, 19.1 % sometimes ensured it while 78.7% of them always did it Similarly, 0.0% of the respondents never wiped the external surface of all equipment's while 17.0% sometimes and 83.0% of the respondents always did it, 10.6% followed recommended safe

disposal sometimes and 89.4% followed it always. While 8.5% of them placed non-chemo materials inside BSC, 2.1% sometimes and 89.4% always did , 2.1% never followed guidelines for avoiding direct exposure to chemo drugs whereas 10.6% sometimes and 87.2% always followed it. Likewise, 0.0% were never aware of chemo spills handling protocol, 8.5% were sometimes while 91.5% always have been aware.

Table 8 Respondent's Practice After Use of Biosafety Cabinet

n=47

Statements	Never	some-times	always
Monitor and document BSC performance and maintenance logs	7(16.7)	10(23.8)	25(59.5)
Decontaminate the BSC surfaces before and after each use	0(0.0)	2(4.3)	45(95.7)
Check air pressure and airflow direction inside BSC Turn off fluorescent light and blower motor switch	3(6.4)	8(17.0)	36(76.6)
after completing work Turn on the UV light if required by the SOP ;and	0(0.0)	4(8.5)	43(91.5)
ensure the sash is closed while it is on Follow WHO and CDC guideline for working with	2(4.3)	2(4.3)	43(91.5)
chemotherapy drugs Ensure that the BSC is regularly tested for airflow	1(2.1)	5(10.6)	41(87.2)
velocity	1(2.1)	6(12.8)	40(85.1)

Table 9 shows 16.7% of respondents never monitored BSC performance 23.8% sometimes did it whereas 59.5% always did it, 0.0% of the respondents never checked air pressure, 2.4% of respondents only checked it sometimes while 97.6% always checked it likewise, 7.1% never turned off the fluorescent ,while 14.3% sometimes did it 78.6% of them always did it, 0.0% of respondents never turned on the UV light and ensured sash is on, while 9.5% of them sometimes did it 90.5% of them always did it. Similarly, 2.4% of respondents never followed WHO and CDC guidelines 9.5% of them sometimes, 88.1% of them always followed the guideline, 2.4% of respondents never ensured that BSC is regularly tested for airflow and velocity whereas 11.9% of them sometimes and 85.7% always ensured.

Table 9 Respondent's Level of Knowledge Regarding Use of Biosafety Cabinet

n=100

Level of knowledge	Frequency	Percentage
Poor (<59%)	14	14.0
Moderate (60-79%)	54	54.0
Good (80-100%)	32	32.0

Table 10 shows that 14 % of the respondents had poor knowledge on BSC while 54% of them had moderate knowledge, 32% of respondents had good knowledge on BSC.

Table 10 Respondent's Level of Practice Regarding Use of Biosafety Cabinet

n=47

Level of knowledge	Frequency	Percentage
Poor (<59%)	1	2.1
Moderate(60-79%)	8	17.0
Good (80-100%)	38	80.9

Table 11 shows that 2.1% of the respondents had poor practice regarding use of BSC whereas 17.0% of them had moderate level of practice, 80.9% of respondents had good level of practice.

Table 11 Association Between Level of Knowledge with Selected Socio-Demographic Variables n=100

Variables	Level of knowledge				
Age	Poor(n/%)	Moderate (n/%)	Good(n/%)	Chi Square	P- value
<25	0(0.0)	11(78.6)	3(21.4)	9.498	0.147
25-34	12(18.5)	32(50.8)	19(30.2)		
35-44	2(11.1)	9(45.0)	9(45.0)		
>45	0	2 (66.7)	1(33.3)		
Educational status of respondents					
PCL	7(21.2)	15(45.5)	11(33.3)	2.607	0.626
BN	4(10.3)	22(56.4)	13(33.3)		
BSC	3(10.7)	17(60.7	8(28.6)		
Department of respondent					
Radiation Oncology	2(16.7)	4(33.3)	6(50.0)	9.162	0.689
Medical Oncology	6(17.1)	19(54.3)	10(28.6)		
Surgical Oncology	3(9.7)	19(61.3)	9(28.1)		
Intensive Care Unit	1(12.5)	4(50.0)	3(37.5)		
Operation Theatre	1(11.1)	4(44.4)	4(44.4)		
Hospice	0(0.0)	2(100.0)	0(0.0)		
Urgent Care Unit	1(33.3)	2(66.7)	0(0.0)		
Years of work experience					
<1year	0	8(57.1)	6(42.9)	8.287	
1-2 yr	4(21.1)	8(42.1)	6 (38.8)		
2-5 yr	6(22.2)	15(55.6)	6(22.2)		
≥5 years	4(10.0)	23(57.5)	13 (32.5)		
Significance level at 0.05					

Table 12 shows that the level of knowledge isn't statistically significant with sociodemographic variables as P Value > 0.05.

Table 12 Association Between Level of Practice with Selected Socio-Demographic Variables (n=47)

Poor (n/ Variables %)	Moder-ate(n/ %)	Good(n/ %)	Chi Square	P-Value
Age			4.946	0.551
<25 0(0.0)	2(20.0)	8(80.0)		
25-34 1 (3.6)	6(21.4)	21(75.0)		
35-44 0(0.0)	0(0.0)	6(100.0)		
>45 0 (0.0) Educational status of	0 (0.0)	3(100.0)		
respondents			3.704	.448
PCL 0 (0.0)	4(16.7)	20(83.3)		
BN 0 (0.0)	3 (21.4)	11(78.6)		
BSC 1 (11.1)	1 (11.1)	7(77.8)		
Department of respon-dent			6.510	0.039
Radiation Oncology 0 (0.0)	5 (41.7)	7 (58.3)		
Medical Oncology 1 (2.9)	3 (8.6)	31(88.6)		
Years of work experi-ence			7.578	0.271
<1 yr7(63.6)	1 (9.1)	3(27.3)		
1-2yr	3(33.3)	6(66.7)		
2-5 yr	1(8.3)	11(91.7)		
>5 yr	1(6.7)	14(93.3)		
Significance level at 0.05				

Table 13 shows that level of practice was statistically significant with department of respondents P=0.039, The level of practice isn't statistically significant with age, educational status and years of work experience.

Discussion

Socio-demographic and Professional Characteristics of Respondents

This study involves a cross-sectional design to assess the knowledge and practice regarding the use of Biosafety Cabinets (BSC) among nurses in a tertiary cancer center in Nepal. Among the 100 respondents, all were female, and the majority (63%) belonged to the 25–34-year age group, with a mean age of 30.92 ± 6.44 years (range: 19–56 years). A similar cross-sectional study conducted among laboratory staff in public and private clinical diagnostic and research laboratories revealed comparable demographic trends 58% were female, the mean age was 37.6 ± 7.5 years, and 60% were over 36 years old.[15]

In terms of professional experience, the current study found that 43.33% of the nurses had two years of work experience, while only 13.33% had four or more years. In contrast, another study found that 54.9% of laboratory staff had over five years of experience Regarding continuous training education, only 33.34% of nurses had attended such programs, and 66.66% had not indicating a critical gap in ongoing professional development. 7 Similarly, a study revealed that nearly 69% of healthcare workers lacked formal training, closely aligning with the findings of this study.[14]

A concerning finding in this research is that none of the participating nurses had received formal training on BSC use, which mirrors other reports where up to 84.2% of healthcare workers had not received any formal biosafety training.30 This training gap was associated with unsafe practices, such as the reuse of syringes and improper disposal of sharps .

Multiple studies have emphasized the positive impact of training on knowledge and practice. A focused BSC-training study involving[13] laboratory professionals demonstrated significant improvements post-training, particularly among those with less work experience. This supports the idea that targeted training interventions can be especially effective for junior nurses or newly recruited staff.[9] Additionally, research from Addis Ababa indicated that trained nurses scored significantly higher in both knowledge and practice, reinforcing the essential role of training programs.[14]

In this study, the suboptimal use of personal protective equipment (PPE) was also noted none of the respondents used full PPE while handling cytotoxic drugs. Similarly, nearly 69% of nurses in other settings reported not receiving training in handling cytotoxic drugs, and 88.8% had not received any infection prevention training, as reported in other literature.[14]

Furthermore, studies conducted among laboratory staff in Kenya and Pakistan demonstrated clear improvements in BSC knowledge and compliance following structured training. These programs

focused on critical components like HEPA filter maintenance, UV light sterilization, and daily cleaning protocols .The absence of such training in this study's setting may reflect institutional differences in safety policy, resource availability, or prioritization of staff education.[31]

In conclusion, the lack of formal BSC training among nurses in this study is consistent with findings from both national and international research. This highlights an urgent need for structured, periodic, and practical training interventions, especially in oncology settings, to promote safe handling practices and reduce exposure risks associated with cytotoxic drugs. Investing in ongoing workshops and skill-building programs could significantly enhance biosafety practices among nursing professionals.

Respondents Knowledge on Concept of Biosafety Cabinet

Biosafety Cabinets (BSCs) are essential for ensuring the safety of healthcare workers, the surrounding environment, and the integrity of hazardous drugs, particularly cytotoxic agents. As outlined in the WHO Biosafety Manual, BSCs require adherence to 13 biosafety considerations including appropriate location, certified operators, PPE use, UV light handling, maintenance, cleaning, alarms, and decontamination protocols. 2 In this study, 10 of these core considerations were assessed to evaluate the nurses' knowledge across three domains: concept, proper use, and maintenance of BSCs.

In the concept domain, knowledge varied. Positively, 100% of respondents correctly identified that BSCs protect healthcare workers from hazardous drugs and aerosol particles. Similarly, 88% understood that BSCs are ventilated workspaces designed to protect the operator, product, and environment. However, more technical knowledge was lacking: only 48% recognized that Class II BSCs are used for cytotoxic drug handling, and only 44% correctly identified that Class II BSCs operate with vertical laminar airflow. These gaps align with a study conducted in tertiary hospitals in Addis Ababa, where the average knowledge score regarding safe cytotoxic drug handling was also low (mean score 7.8/15), and PPE training coverage was limited to just 31%. 14 Respondents Knowledge on Safe Work Practice in Biosafety Cabinet

Regarding safe use, only 26% of nurses knew that UV light acts as a supplementary sterilization method in BSCs. Although UV irradiation can help reduce surface contamination, it is not sufficient alone due to limited penetration and effectiveness over distance. WHO recommends that BSCs be turned on at least five minutes before use and off five minutes afterward to maintain airflow safety. In this study, 71% of participants were aware of this practice, a promising result when compared to studies where such procedural awareness was far lower.

In terms of Personal Protective Equipment (PPE), 90% of respondents identified that double gloves, gowns, goggles, and respirator masks are required when preparing chemotherapy in BSCs. This finding is consistent with WHO recommendations, which emphasize that gloves must be worn over gown cuffs, with additional protective gear used when handling high-risk substances.[2]

Respondents Knowledge on Maintenance of Biosafety Cabinet

While the use of PPE was well understood, maintenance knowledge was critically lacking: only 25% of respondents were aware that HEPA filters should be tested annually, and only 34% recognized that BSCs should be decontaminated using bleach followed by sodium thiosulfate.

This is a significant concern, as HEPA filter efficiency declines over time, compromising containment integrity .Similarly, failure to follow correct cleaning protocols raises contamination risks. A WHO-supported study found that 77% of participants misunderstood the appropriate disinfectant, falsely believing that sodium hypochlorite alone was sufficient for BSC surfaces, when in fact, the disinfectant should be carefully matched to the microorganisms targeted.

In this study, 14% of nurses had poor knowledge, 54% had moderate knowledge, and 32% had good knowledge of BSC use. When categorized numerically, 3.33% scored between 1–7 (poor), 50% between 8–14 (moderate), and 46.67% between 15–21 (good). A comparable study in India reported that 70% had poor knowledge, 20% moderate, and only 10% good knowledge indicating that the knowledge level at BPKMCH is slightly better, though still not optimal. [24]

Importantly, no significant association was found between nurses' knowledge and sociodemographic variables like age, gender, qualification, work experience, or prior training. The null hypothesis was therefore accepted, as supported by findings from other studies.[7], suggesting that knowledge gaps exist regardless of background.

Furthermore, a study on infection prevention in healthcare settings revealed that even where 57.1% had adequate knowledge, only 48.2% had good practice demonstrating that knowledge does not always translate into action unless reinforced through formal and repeated training.[32]

In contrast to those studies, the present research shows relatively higher levels of moderate to good knowledge (86%) among BPKMCH nurses. This may be attributed to institutional orientation or personal motivation. However, as none of the participants had received formal training on BSC use, the observed knowledge may reflect informal learning or peer influence. This highlights an urgent need to implement structured, evidence-based biosafety training programs that include both theoretical and hands-on components, as studies from Kenya, Pakistan, and elsewhere have shown marked knowledge improvements following such interventions .

Respondents Practice Before Use of Biosafety Cabinet

The CDC Division for Laboratory Systems developed a three-component assessment model for Biosafety Cabinet (BSC) use, which includes steps for preparing to work in the BSC, safely working in the BSC, and completing tasks after use comprising a total of 30 checklist statements. 33 This study included 21 of these statements, categorized into before, during, and after use of the BSC.

In this study, 100% of nurses reported using a BSC when preparing chemotherapy drugs, demonstrating strong compliance with institutional protocols. In contrast, a study revealed concerning findings none of the nurses in that study prepared cytotoxic drugs (CDs) in proper preparation cabins. Instead, 17% prepared CDs in treatment rooms, while 83% worked in general environments without proper aspiration systems, posing significant health risks. 11

Regarding preparation before BSC use, only 16% of respondents in this study consistently checked the certification and maintenance status of the BSC, highlighting a knowledge-practice gap. Additionally, 57.4% of participants always allowed the BSC to run for 4 minutes before beginning work. According to WHO recommendations, the BSC should be turned on for at least 5 minutes before and after use to allow for proper air circulation and to expel potentially contaminated air.[2]

Respondents Practice During Use of Biosafety Cabinet

On the use of Personal Protective Equipment (PPE), 85.1% of respondents in this study always wore PPE, while 14.9% reported only sometimes using it, indicating a generally good adherence. In comparison, the study found that 92% of nurses used gloves, but only 5% used surgical masks during chemotherapy preparation. Notably, none of the nurses in that study used full recommended PPE, and only 62% used gloves and surgical masks together.[11]

A similar study from Togo showed that 77.6% of participants demonstrated good attitudes and practices. However, although prior training significantly improved knowledge scores ($p = 0.03$), it did not show a significant effect on attitude ($p = 0.91$) or practice ($p = 0.84$). Regional disparities and several gaps were also identified in that study, indicating that knowledge alone does not guarantee appropriate biosafety behavior.[28]

Furthermore, in a systematic review, more than 94% of healthcare workers reported routinely wearing gloves, and 55% used laboratory coats during chemotherapy handling. However, less than 6% used proper face or respiratory protection, and only 46% of facilities provided any form of medical surveillance. While 99% reported preparing chemotherapy in laminar airflow hoods, incomplete PPE usage still posed significant occupational risks.

Respondents Practice After Use of Biosafety Cabinet

In this study, 16.7% of respondents never monitored BSC performance after use. Similarly, 2.4% of respondents never followed WHO and CDC guidelines 9.5% of them sometimes, 88.1% of them always followed the guideline, 2.4% of respondents

never ensured that BSC is regularly tested for airflow and velocity whereas 11.9% of them sometimes and 85.7% always ensured .

Similiarly, 2.1% of respondents demonstrated poor BSC practice, 17.0% had moderatelevel practice, and 80.9% showed good-level practice, indicating a generally satisfactory implementation of safe work practices.

Statistical analysis (Table 12) revealed that the level of practice was significantly associated with the department of the respondents ($p = 0.039$). However, there was no statistically significant association with age, educational qualification, or years of experience. This finding aligns with previous studies, suggesting that institutional protocols and departmental culture may influence practice more strongly than individual demographic factors.

Conclusion

This study revealed that nurses at the tertiary cancer hospital had moderate to good knowledge (86%) and generally good practice (80.9%) regarding Biosafety Cabinet (BSC) use. However, significant gaps existed in technical knowledge, including BSC maintenance, HEPA filter testing, and decontamination protocols. None of the participants had received formal training, highlighting the need for structured education. Practice was influenced by departmental protocols rather than individual demographics, emphasizing the role of institutional culture in safe BSC use.

Limitations

Data collection was limited only in B.P Koirala Memorial Cancer Hospital in particular timing of 2 weeks , and was not able to include large sample size and determine information. Thus, the findings may not be generalized in other settings.

Recommendations

Further study should be conducted in another setting with large setting with large number of sample size and extending data collection period.

Regular, hands-on biosafety training should be implemented, supported by clear SOPs and adequate PPE provision. Routine monitoring and departmental audits can reinforce compliance.

Incorporating biosafety content into nursing curriculum and encouraging institutional policy support will further enhance safe practices.

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