



Surgical team member's application of personal protective equipment: an observational study

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Background: Personal protective equipment (PPE) is a term used to refer to clothing or equipment that creates a barrier to protect an individual from work-place hazards, thereby protecting the worker against work-related injuries and illnesses. This study was aimed at determining the compliance of application of personal protective equipment against the standards.

Methods: One hundred surgical personnel were included in this study from 21 March 2023 to 23 April 2023. Data were collected through direct observation. The standards were directly changed into question forms with two integral checking components, "Yes", and "No". Data were entered and analyzed by statistical package of social sciences (SPSS) version 25.

Result: A total of 100 surgical personnel involved in surgical procedures were assessed for how they applied PPE. Majority of healthcare workers, 61.2%, were compliant with the communicable disease control standard on the application of PPE. The highest compliance rate was observed for the put-on gloves over the gown, while the lowest compliance rate was observed for wearing eye protection.

Conclusion and recommendation: The practice of PPE usage by surgical personnel was suboptimal. Healthcare facilities can better protect their staff and patients from the spread of infections and other hazards through PPE use protocols. Donning and doffing must always be methodical and supervised by another staff member, especially during surgical emergencies. PPE should be used in accordance with infection prevention and control guidelines and the level of risk involved in the specific procedure.

Keywords: Infection, personal protection, protective equipment, surgery

Introduction

Personal protective equipment (PPE) is a term used to refer to clothing or equipment that creates a barrier to protect an individual from work-place hazards, thereby protecting the worker against work-related injuries and illnesses^[1]. It is one component of standard precautions and infection prevention and control measures that reduce the risk of acquiring contamination from potentially infectious body fluids and prevent the transmission of microorganisms through the use of protective clothing such as gloves, gowns, aprons, face masks, and eye protection^[2].

Standard precautions are used for all patient care to prevent the transmission of infectious agents in healthcare settings and assume that all patients may have an infectious agent in their body fluids and that appropriate precautions should be taken,

HIGHLIGHTS

- Compliance of personal protective equipment usage by surgical personnel was suboptimal.
- The highest compliance rate was observed for the put-on gloves over the gown.
- The lowest compliance rate was observed for wearing eye protection.
- Personal protective equipment should be used in accordance with infection prevention and control guidelines and the level of risk involved in the specific procedure.

including the use of PPE, since the type of PPE needed depends on the type of clinical interaction and the degree of contact with blood and body fluids^[3]. healthcare provider must assume that all patients have the potential to transmit infectious agent and take appropriate precautions to protect themselves and vice-versa^[4].

Healthcare workers fail to adhere to standard precaution guidelines despite such a failure increases the risk of mucocutaneous blood and body fluid exposure resulting in blood-borne infection (BBI) like hepatitis A, hepatitis C and HIV^[5-7].

Occupational exposures to blood-borne pathogens through accidental contact with human body fluids are a worldwide concern that can result in the transmission of more than 60 blood-borne infections^[8]. These pathogens can be found in body fluids such as blood, cerebrospinal fluid, pleural fluid, breast milk, amniotic fluid, vaginal secretions, peritoneal fluid, pericardial fluid, synovial fluid, semen, and any other body fluids containing blood^[9].

Study done on blood contact and exposure among surgical personnel in the 864 surgical cases, 10.2% involved blood contact during the procedure. About 1054 individuals had contact

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with blood, resulting in a parenteral exposure rate of 2.2% and a cutaneous exposure rate of 10.2%. The most common sites of contact were the fingers, accounting for 59.4% of the blood contacts and contact of face and neck accounted for 24.2% of contacts, while surgeons and scrub assistants accounted for 73.2% of all contacts and circulators had 16.7% of the blood contacts^[10].

The care of surgical patients with the increased chance of contact with blood means that surgical staffs are more at risk of occupationally acquired infections. For this reason, a better understanding of surgical nurses' adherence with PPE usage is important as it provides an assessment of the efficacy of existing preventative strategies^[11].

Various types of PPEs have been employed to protect Health Care Workers that include gloves to protect the hands, gowns or aprons to protect the skin and/or clothing, masks and respirators to protect the mouth and nose, goggles to protect the eyes, and face shields to protect the entire face therefore selection of PPE depends on the type of anticipated exposure, durability, fit, and appropriateness for the task^[12].

To mitigate occupational exposure risks, the communicable disease control (CDC) developed standard precautions that protect healthcare workers and reduce their risk of infection. Proper donning and doffing of PPE has been identified as key in reducing muco-cutaneous injuries and contact with blood or body fluid splashes related to standard precaution practices^[3,13]. This study was conducted to assess surgical personnel's technique of applying PPE compared to the CDC checklist.

Methods and materials

Study design and setting

More than 600 surgical operations were performed monthly at University of Gondar comprehensive specialized hospital. The hospital has a major operating theatre staffed with 100 physicians (residents and senior surgeons) and 40 surgical nurses. This institution-based observational study was conducted on 100 surgical personnel (senior surgeon, resident, and scrub nurse) involved in surgical operations to assess the application of personal protective equipment at University of Gondar comprehensive specialized hospital in northwest Ethiopia from 21 March 2023 to 23 April 2023. Healthcare workers involved in the surgical procedure were participants of the study and were sampled consecutively. This paper was registered in a research registry and reported in accordance with STROCSS 2021 checklist^[14].

Data collection method

An informed consent from study participants was taken. A consecutive sampling method was used. Two trained anaesthetists collected the data. Data were collected through direct observation of surgical personnel's application of PPE before and after major surgical procedure using standardized checklist (Table 1 and Table 2). Surgical team members are advised to apply two surgical gloves and surgical masks for a major surgery to contain an increasing infection rate. The standards were directly changed into question forms with two integral checking components of yes, no or not applicable (Table 3).

Table 1

CDC recommendation for PPE application

S.N	Recommendation
1	Wearing apron
2	Gown fully covers torso from neck to knees, arms to end of wrists, and wrap around back
3	Gown tie in neck and waist
4	Glove cover the wrist of the gown
5	Eye protection fully covers eyes on all side
6	Facemask covers nose and mouth
7	Respirator fits snugly to face below the chin
8	Gloves removed prior to room exit or before moving to a roommate
9	Gloves removed in manner that limited self-contamination
10	Gown removed prior to room exit or before moving to a roommate
11	Gown removed in a manner that limited self-contamination
12	Eye protection is removed by handling head band or earpieces
13	Facemask is removed by touching only the straps
14	Respirator is removed by pulling bottom strap overhead, followed by top strap after room exit

CDC, communicable disease control; PPE, personal protective equipment.

Data analysis method

Structured questionnaire was prepared. Data were collected by a trained collector. The data were checked, coded, entered, and cleaned using SPSS version 25. Descriptive analysis was performed. Results were expressed in frequencies and percentage.

Result

A total of 100 surgical personnel who wore PPE during the surgery were observed on how they put on and removed PPE. The majority of surgical team members were below 40 years of age (69%). Most of study participants were males (65%). The majority of study participants were physicians (66%). About 34% of participants were BSc degree holder nurses (Table 4). The overall compliance of surgical personnel's that involved in surgical procedures according to the CDC checklist on the application of personal protective equipment was 61.1% (Fig. 1).

All personnel involved in the surgical procedure appropriately wore the glove covering the wrist of the gown in accordance with the CDC checklist item accounted 100% (Fig. 1 and Table 5). Gloves were removed in manner that limited self-contamination by about 89% of surgical personnel. Facemask was removed by touching only the straps by about 87% of surgical personnel. The majority of the items listed in the CDC checklist had a compliance rate of greater than 50%. The item with the lowest compliance rate was full eye protection covering, which was only applied by 16% of surgical personnel. The remaining personnel were not applied eye protection. Respirator was neither fits snugly to face below the chin nor was removed by pulling bottom strap overhead, followed by top strap after room exit during surgical procedures (Table 5 and Fig. 1).

Discussion

The overall compliance of surgical personnel's application of PPE was suboptimal. The low compliance of the surgical personnel for CDC checklist was due to the limited resources available at the

Table 2
PPE application standards and data source

No	Item	CDC target	Evidence	Data source
1.	Wearing apron	100	CDC	Direct observation
2.	Gown fully covers torso from neck to knees, arms to end of wrists, and wrap around back	100	CDC	Direct observation
3.	Gown tie in neck and waist	100	CDC	Direct observation
4.	Glove cover the wrist of the gown	100	CDC	Direct observation
5.	Eye protection fully covers eyes on all side	100	CDC	Direct observation
6.	Facemask covers nose and mouth	100	CDC	Direct observation
7.	Respirator fits snugly to face below the chin	100	CDC	Direct observation
8.	Gloves removed prior to room exit or before moving to a roommate	100	CDC	Direct observation
9.	Gloves removed in manner that limited self-contamination	100	CDC	Direct observation
10.	Gown removed prior to room exit or before moving to a roommate	100	CDC	Direct observation
11.	Gown removed in a manner that limited self-contamination	100	CDC	Direct observation
12.	Eye protection is removed by handling head band or earpieces	100	CDC	Direct observation
13.	Facemask is removed by touching only the straps	100	CDC	Direct observation
14.	Respirator is removed by pulling bottom strap overhead, followed by top strap after room exit	100	CDC	Direct observation

CDC, communicable disease control; PPE, personal protective equipment.

institution and training was not provided regularly for new surgical team members.

The application of PPE was highest in glove use over the gown (100%) and lowest in wearing of eye protector (16%). It is similar

Table 3
Data collection checklist

No	Item	Yes	No
1	Does apron applied		
2	Does gown fully covers torso from neck to knees, arms to end of wrists, and wrap around back		
3	Does gown tie in neck and waist		
4	Does glove cover the wrist of the gown		
5	Does eye protection fully cover eyes on all side		
6	Does facemask cover nose and mouth		
7	Does respirator fit snugly to face below the chin		
8	Does gloves removed prior to room exit or before moving to a roommate		
9	Does gloves removed in manner that limited self-contamination		
10	Does gown removed prior to room exit or before moving to a roommate		
11	Does gown removed in a manner that limited self-contamination		
12	Does eye protection is removed by handling head band or earpieces		
13	Does facemask is removed by touching only the straps		
14	Does respirator is removed by pulling bottom strap overhead, followed by top strap after room exit		

Table 4
Socio-demographic characteristics of study participants

Sociodemographic variable	Frequency (percentage), n (%)
Age (years)	
24–40	69 (69)
> 40	31 (31)
Sex	
Female	35 (35)
Male	65 (65)
Type of profession	
Nurse	34 (34)
Physician	66 (66)
Level of education	
BSc nurse	34 (34)
Resident	46 (46)
Senior surgeon	20 (20)

to a study done in Poland in which the highest compliance rate was observed during glove use (83%) and lowest rate in wearing of eye protector (9%)^[11]. Similarly, the proportion of surgeons in India worn eye protection was low due to visibility impairment caused by goggle fogging and glare. This is an important finding as failure to wear these goggles properly can lead to poor visibility and highlighting the need for increased compliance with PPE use among surgeons^[15].

In contrast to this result, study done in Asia the most appropriately used PPE were surgical face masks that account 88.7%^[16]. Protection of the mucous membranes of the eyes, mouth and nose from any procedure that involves splashing or spraying of blood, bodily fluids or bone chips is essential and therefore, any staff at risk of exposure to the above must wear appropriate PPE^[17]. It may be main reasons for noncompliance with PPE use was lack of availability or exhaustion from work.

Surgical personnel should always apply PPE according to the standards. A study conducted at a university in California on the risk of surgical personnel’s exposure to Patients’ blood during Surgery demonstrated that several factors were associated with an increased risk, including a blood loss of more than 300 ml, procedures lasting more than three hours, emergency procedures, major surgical procedures, procedures required for trauma or fractures, laparotomies, intra-abdominal gynaecologic procedures, vascular procedures, otolaryngologic procedures, and cutaneous abscess drainages^[18].

Strength and limitation of the study

This study was conducted to determine the compliance rate of surgical personnel’s adherence to the CDC recommendation. However, it didn’t show the outcomes linked with a failed compliance against the standards of practice.

Conclusion and recommendation

Compliance of PPE usage to CDC recommendation was sub-optimal. Proper use of PPE can help to reduce the risk of cross-contamination. Thus, regular monitoring and evaluation of PPE use can also help to identify areas of improvement and address any issues or challenges that may arise. By taking a comprehensive approach to PPE use in the operation room, healthcare facilities can better protect their staff and patients from the spread

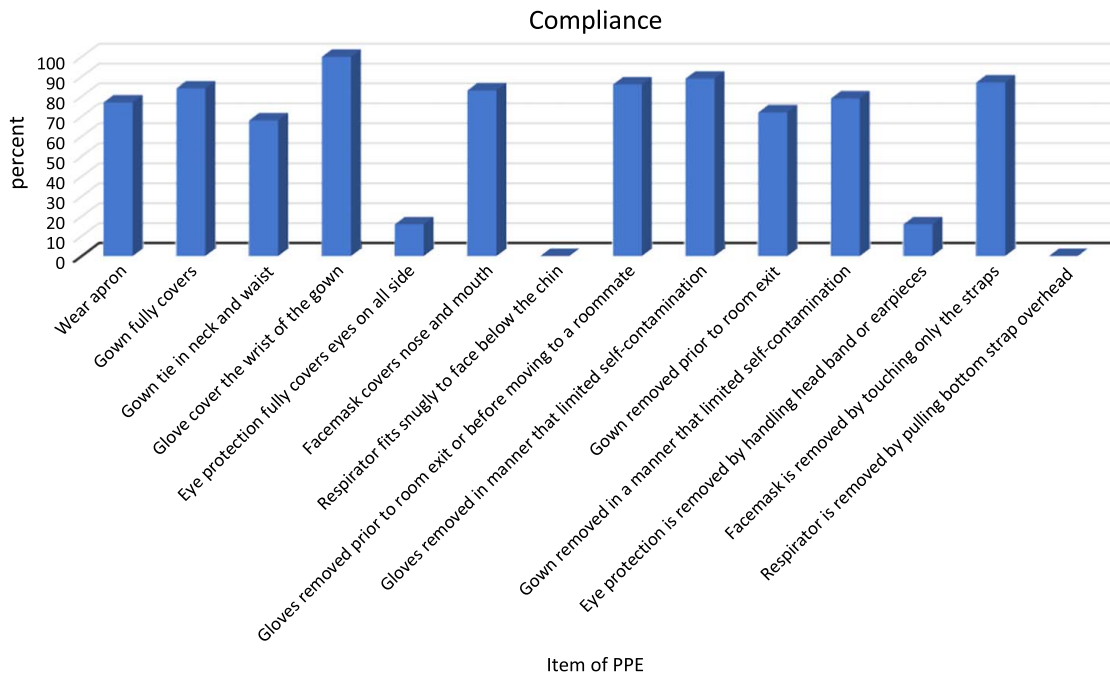


Figure 1. compliance of the criteria of CDC checklist. CDC, communicable disease control; PPE, personal protective equipment.

Table 5
Compliance of PPE usage

Recommendations	Fail to meet criteria	Met criteria n = 100	Compliance (%)
Wearing apron	23	77	77
Gown fully covers torso from neck to knees, arms to end of wrists, and wrap around back	16	84	84
Gown tie in neck and waist	32	68	68
Glove cover the wrist of the gown	0	100	100
Eye protection fully covers eyes on all side	84	16	16
Facemask covers nose and mouth	17	83	83
Respirator fits snugly to face below the chin	100	0	0
Gloves removed prior to room exit or before moving to a roommate	14	86	86
Gloves removed in manner that limited self-contamination	11	89	89
Gown removed prior to room exit or before moving to a roommate	28	72	72
Gown removed in a manner that limited self-contamination	21	79	79
Eye protection is removed by handling head band or earpieces	84	16	16
Facemask is removed by touching only the straps	13	87	87
Respirator is removed by pulling bottom strap overhead, followed by top strap after room exit	100	0	0

PPE, personal protective equipment.

of infections and other hazards. Donning and doffing must always be methodical and supervised by another staff member, especially during surgical emergencies. PPE should be used in accordance with infection prevention and control guidelines and the level of risk involved in the specific procedure.

Ethical approval

The study was approved by the ethical committee of the institution.

Consent

Written informed consent was taken from all study participants.

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Author contribution

F.T.D., B.A.A., N.S.E. and D.Y.F. were involved in the conception and design of the study, acquisition of the data, analysis and interpretation of data, drafting of the manuscript and approval of the final version of the manuscript.

Conflicts of interest disclosure

There is no conflict of interest among the authors of the article.

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Guarantor

Biruk Adie Admass, Fekadu Tadesse Diress, Nigussie Simeneh and Demeke Yilkal Fentie are all responsible for this work.

Availability of data and materials

The datasets used and analyzed during the study are available from the corresponding author on reasonable request.

Provenance and peer review

The data and material used to analyze the study are available from the corresponding author on request.

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