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Infection Prevention and Control Knowledge and Practices Among Healthcare Workers in Lobatse District Health Management Team (LDHMT) Facilities: A Call for an Educational Intervention

Kgomotso Mothibi

ABSTRACT

Background

Healthcare-Associated Infections (HAIs) are of significant concern to the health care system and a burden to the public health discipline. HAIs are associated with high morbidity and mortality, prolonged hospital stays, and long-term disability, and a massive financial burden for health systems. Limited knowledge and poor practices regarding infection control practices (IPC) among healthcare workers contribute to HAIs. Therefore, healthcare workers should be adequately knowledgeable on IPC and practice safe IPC activities. The study assessed IPC knowledge and practices among the healthcare workers at Lobatse District Health Management Team (LDHMT) healthcare facilities in Botswana.

Method

This study was restricted to Botswana 184 healthcare workers with direct patient care responsibilities at Lobatse healthcare facilities. A WHO and CDC approved questionnaire used to collect data. The questionnaire included questions on infection prevention and control (IPC) knowledge and practices. Data were analyzed with SAS 9.4 software. Bivariate and multivariate logistic regression analyses were conducted to identify factors associated with IPC knowledge and practices.

Results

About 50.6% of the participants practiced safe IPC activities, and 51.3% were adequately knowledgeable in IPC. IPC knowledge level and safer activities were significantly associated with older age, a bachelor's degree level and above level of education, working in a clinic, 25 or more

years of work experience, having been trained on IPC, and access to IPC guidelines and training in other health training institutes.

Conclusion

Policymakers at the hospital level should develop educational interventions to improve the participants' IPC knowledge level and practices in Botswana.

Infection Prevention and Control Knowledge and Practices Among Healthcare Workers in Lobatse District Health Management Team (LDHMT) Facilities: A Call for an Educational Intervention

BY

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AUTHORS STATEMENT

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CHAPTER I

Introduction

1.1 Background

Infection prevention and control (IPC) play a unique part in patient safety and quality health care delivery. IPC is defined by the World Health Organization (WHO) as a practical, evidence-based approach that prevents patients and healthcare workers from being harmed by avoidable infections (WHO,2016). It is also defined as policies and procedures applied in healthcare delivery settings to control and reduce the risk of the transmission of infections, hence decreasing the infection rate (Habboush Y. *et al*. 2020). All healthcare workers must be well knowledgeable about IPC and safe practices for their daily patient encounters. The IPC program's necessity in healthcare facilities is its unique position in preventing healthcare-associated infections(HAIs). Healthcare-associated conditions are infections that patients acquire during receiving healthcare services anywhere along the continuum of healthcare settings, including long-term care, home care, and ambulatory care (CDC 2018). Therefore, they are preventable and are considered an indicator of the quality of patient care and patient safety (Collins AS.2008). They are today by far the most common complications among hospitalized patients. HAIs are of significant concern to the healthcare system and a burden to the public health discipline. They are considered an adverse effect, an undesirable outcome, and associated with high morbidity and mortality (CDC 2018). Healthcare-associated infections have been proven to be associated with a prolonged hospital stay, long-term disability, the increased reemergence of drug-resistant microorganisms, the massive financial

burden for health systems, and the patients' families. The impact of HAIs is higher in low- and middle-income countries (LMIC) than it is in high-income ones, with a reported prevalence between 5.7 and 19.1% (Vhilar-Compte D., 2017). Studies have shown that though data on HAIs' burden is not limited in Africa, its burden is higher than in high-income countries (Nejad et al., 2011). In Botswana, the prevalence of HAI is still unknown as the IPC program is still at the infancy stage; hence there is no data on national or district HAIS rates and trends.

In every 100 inpatients, 10 are diagnosed with at least 1 HAI in LMIC compared to 7 in developed countries (CDC 2018). Even though the LMIC are most impacted by HAI's, high-income countries are also affected (Stone PW.,2010). The prevalence of these preventable infections in high-income countries is 7.6%, with an estimated 4131,000 patients affected by approximately 45,441,000 episodes of HAIs yearly in Europe and the USA, an estimated 1.7 million infections 99,000 associated deaths are reported (WHO 2011 & Burke JP.,2003). HAIs financial burden in the high-income countries accounts for €13–24 billion in extra costs per year in Europe and 16 million additional days of hospital stay. In contrast, in the USA, the loss is estimated at between US$28 billion to 45 billion. (Stone PW.,2010 & Arefian H., 2019). An estimated 100,000 cases of HAI were reported in the UK in 2000, and about 5000 related deaths in England. The impact of HAI's was also accounted for $1.4bn yearly in the UK (Mayor. S,2000).

The need for infection prevention and control programs in healthcare facilities is borne out of the need to prevent HAI and ensure a safer setting for patients, staff, and visitors and improve the delivery of healthcare services. The history of IPC is dated back to 1847 when the physician Ignaz Semmelweis found out that unclean hands of medical students were associated with a

high childbed fever rate (Noakes T.D et al.,2008 and Torriani, F., & Taplitz, R. 2010). A hand hygiene policy was then developed to ensure hand hygiene before delivering care in the obstetric clinic, reducing the mortality rate. In the US, by 1960, the IPC was already established in few hospitals following the Staphylococcus aureus epidemic (Dixon R.E 2011). As of November 29, 2019, every hospital and Critical Access Hospitals (CAHs) in the US is to develop an active IPC program which is to investigate infectious and communicable diseases. This requirement by the Centers for Medicare and Medicaid Services (CMS) is aimed at aiding in the improvement of the delivery of quality healthcare services and patient safety through the reduction of the development and transmission of HAIs and antibiotic-resistant organisms and reduction of the HAI associated burden (CMS,2018). Healthcare facilities in Botswana are currently undergoing a healthcare accreditation process by the Council for Health Service Accreditation of Southern Africa (COHSASA), aiming at quality improvement and patient safety. The accreditation program was rolled out to 18 hospitals and clinics in 2009. The accreditation requirements include IPC management as one of the standards; hence healthcare facilities, including Lobatse District Health Management Team (LDHMT) healthcare facilities, have boarded on preventing and control of HAIs. LDHMT facilities have not yet met the accreditation program's requirements as their compliance rate is still at an unsatisfactory level. Though the district has an IPC program, there is no available data on the trends and rates of HAI.

Infection prevention and control safe practices at a healthcare facility can be affected by a few factors, including knowledge on IPC, availability of a functional IPC program, availability of IPC guidelines and policies, training of staff and medical students on IPC, availability of personal protective equipment and infrastructure(WHO 2016, Assefa J. *et al*. 2020). Healthcare

workers being the first line of defense when it comes to HAI, must be knowledgeable on IPC practices. In studies conducted on the association between IPC practices, the burden of HAI and its associated factors, being knowledgeable on IPC was significantly associated with acceptable self-reported IPC practices (Zenbaba D. et al.,2020). The knowledge level and IPC practices among Healthcare workers in Sub-Saharan Africa health settings are still low, and in some countries is unknown. In Botswana, there is no data available on healthcare workers' level of IPC knowledge and adherence to IPC practices. In LDHMT healthcare facilities, to be precise, no study has been conducted on IPC knowledge and practices among healthcare workers.

The fundamental approach to preventing and controlling the spread of HAI and addressing patient safety and delivering quality healthcare services involves having a knowledgeable workforce on IPC principles and a safe healthcare delivery practice. Therefore, this study aims to determine the level of IPC knowledge and practices among LDHMT healthcare workers and their associated factors.

1.2 Study Objective

This study aims to determine the level of IPC knowledge and practices among LDHMT healthcare workers. It also aims to assess if there is a correlation between the level of IPC knowledge and execution of safer healthcare practices. The study's findings will be used to inform decision-makers at LDHMT on IPC and safer practices, improve the IPC programs running, and improve patient safety and delivery of quality healthcare services.

1.3 Research question

Does knowledge on infection prevention and control correlate with practices among LDHMT healthcare workers?

CHAPTER II

LITERATURE REVIEW

Medical care has become more complicated due to the innovation of sophisticated medical devices and technology. An increase in disease conditions becomes more complex; hence HAIs have become a common and great concern to the Public Health discipline. These, together with the emerging and re-emerging of infectious diseases, have had a negative impact on patient safety and the quality of health care delivery. Some health care associated infection are preventable; therefore, they are considered indicators of the quality of patient care and protection (Collins AS 2008).To address the issue of healthcare-associated infections and its impact on patient care delivery and patient safety, WHO set up an IPC unit within the WHO Service Delivery and Safety(SDS) upon the foundations and achievements of the Clean Care is Safer Care Program. The unit was mandated to provide an integrated IPC function at national and international capacity and implement safer practices during patient care delivery (WHO 2016).

An IPC program implemented in a healthcare setting is essential as it strives to prevent HAIs as well as help prepare for and respond to the infectious disease crises(WHO 2011).In 2009 WHO issued out the core components of IPC to address the limited availability of IPC evidence-based guidance and standards. These are to be in place at the national and acute healthcare facility level to contribute to the strengthening of the capability for the prevention of HAIs (WHO 2016, Storr J. *et al*. 2017). The core components include organization, monitoring, and evaluation of IPC programs, Surveillance of diseases, and compliance with IPC practices training of staff and a clean and safe environment(Seto WH. *et al*. 2010). In LMIC like Botswana, the IPC program faces several challenges, including lack of central regulations and guidance by the relevant ministries, lack of trained IPC officers, lack of support both financial and administrative and lack of resources.

The IPC program's effectiveness was first proven in a study conducted on the efficacy of Infection Surveillance and control programs on preventing HAI in 338 US hospitals between 1970 and 1976. The study's findings showed a 32% decrease in the rate of HAI among the hospitals with an intensive IPC program (Haley WR *et al*. 1985) and an 18% increase of HAI in the hospitals without the program. The scientific evidence of this study brought a change to hospital programs. In 1976 the Joint Commission mandated that all accredited hospitals have an IPC recommended by the Centers For Disease Control and Prevention (CDC). The IPC program's effectiveness was also evident in a study conducted in Russia Neuro-ICU from 2011 to 2016 (Ershova K. 2018). The study evaluated the efficacy of an IPC program concerning healthcare-associated infection prevention, and it was found that there was a decrease in the incidence of HAIs. The rate of respiratory infections decreased from 36.1% in 2011 to 24.5% in 2016, urinary tract infections also reduced from 29.07% to 21.33%, and the quality of healthcare-associated Ventriculitis and Meningitis(HAVM) also decreased from 15.97% to 7.78%. The patients' length of stay in the ICU was also reduced by 2.7% per year from 6778 to 5809 days. During the study period, there was a reinforcement of the best IPC practices and re-education of staff who are accountable for the reduction in HAI.

In the basics of IPC, there are two recommended precautions for preventing the spread of infections in a healthcare system. These are Standard and Transmission based precautions (Fig1.)

Standard precautions are defined as the necessary IPC level used as the least practices to all patients during care delivery irrespective of their infectious status (CDC 2018, WHO 2017). Standard precautions include hand hygiene, appropriate personal protective equipment (PPE), use of aseptic technique, respiratory hygiene, safe injection practices, secure environment, linen, and waste management (Siegel JD. *et al*. 2007). Healthcare workers must comply with the standard

precautions to prevent the spread of HAI. A study carried out on the compliance and awareness with standard precautions among primary healthcare workers in Local Government Areas of Borno State Nigeria found out that the level of knowledge and awareness was unacceptably below standard. About 13% (134) of the participants were knowledgeable about standard precautions, 131 (50%) were not familiar, and 96(37%) were reasonably knowledgeable. Adequate knowledge on standard precautions was associated with incorporating the subject in the nursing curriculum and on the job training. In contrast, poor knowledge was associated with a lack of training by the employer. A continuous education and training program on standard precautions for healthcare workers was recommended to improve their knowledge and compliance (Abdulraheem IS. et al. 2012).

In another study conducted among nurses in the Dialysis unit at Alexandria, Egypt on the application and level of knowledge of standard precautions, it was found out that nurses were not knowledgeable nor applied standard precautions during patient care (El-Enein A. et al. 2011). Of the 17 nurses,47.1% had heard about standard precautions, and only two knew that hands are the most important source of transmitting infections. Of the 992 observed opportunities for hand hygiene and PPE, none of the nurses complied. The nurses did not practice hand washing before and after patient care, nor did they use plastic aprons or face protection. In 55.3% of opportunities to change gloves, nurses did not change gloves; somewhat, they removed the nonsterile ones leaving the ones worn underneath. Seven out of 190 options for nurses to use hand soap and water or hand rub after removing gloves, nurses used hand rub. The authors recommended healthcare workers be trained on blood precautions before and during their service.

Transmission based precautions are those practices intended for patients with known or suspected to be infected with pathogens for which added precautions beyond standard precautions are needed

(Siegel JD. 2012). Isolating patients with suspected or known infectious diseases, together with other IPC practices, helps reduce the transmission of infection between patients and healthcare workers (WHO,2016). There are three types of transmission-based precautions: Contact, Droplet, and Airborne precautions (CDC, 2019). These categories can be used in solitary or in combination for those infectious agents with more than one transmission route. Transmission-based precautions are used at the initial patient contact based on their clinical presentation and the possible infectious agent. This approach is useful in emerging agents like SARS-COV, Pandemic influenza (Siegel JD 2012).

Healthcare workers (HCW) have a significant role to play in the spread of HAIs as well as its prevention and control. CDC has described them as the first line of defense against HAI and the cross-transmission of germs in healthcare settings. Because of this, they must have adequate knowledge about (IPC) and comply with the practices to better identify and mitigate HAI risks and occupational exposures. According to WHO, inadequate knowledge and application of necessary infection control measures have been recognized as factors that contribute to the development of HAI (WHO Fact sheet). Educating healthcare workers and reinforcing their knowledge has been identified as one of the measures necessary to ensure a higher understanding of the prevention of infectious diseases (Habboush Y. *et al*. 2020).

In a facility-based cross-sectional study conducted among healthcare workers in West Arsi District South East Ethiopia, workers' knowledge and practices towards infection prevention were found associated factors, a significant percentage of healthcare workers were not knowledgeable about IPC. The general safe IPC practices were considered below expectation. Of the 648 study participants,53.7% were familiar with IPC, and physicians were 85% less knowledgeable than nurses. The length of service of ten years and more, IPC guidelines, and IPC committee were more

knowledgeable about IPC among HCW. About 255 (36.3%) of the study participants reported safe infection prevention and control practices. Those who received IPC training were about 5.31 more likely to practice safer IPC than their counterparts, and those who had access to IPC guidelines were 3.34 more likely to execute safer IPC practices. The study recommended provision of on job continuous educational training on IPC and availing of IPC guidelines as interventions towards improving the knowledge level of HCW on infection prevention and control and safe practice (Geberemariyam, B. S *et al*. 2018).

A hospital-based cross-sectional study conducted in 2015 at Debre Markos Referral Hospital North West Ethiopia examined the IPC knowledge and practices. Its associated factors among HCW showed that most HCW are knowledgeable of infection prevention with fair practice rate. Of the 150 participants,84.7% were familiar with IPC, with 140 being aware that disinfection prevents HCAI's and 141 being aware of the use of antiseptics, and 132 understood that hospital equipment must be decontaminated before being sterilized. The findings of the study further showed that about 86(57.3%) participants executed acceptable practices, 66 participants reported that they perform hand hygiene with the use of soap and water before patient care, and 100 said that they wash hand with soap and water after patient care and contact with body fluids. Regarding Personal Protective Equipment (PPE),128 of the participants reported that they use gloves,140 use goggles,42 use mask, and 62 of them use gowns during patient care. The study reported a direct association between knowledge on IPC and educational status, working experience, and having taken training on IPC (Desta, M. *et al*. 2018). It was recommended that the HCW knowledge on IPC be made up to date through pre-service and in-service training, development of professionals' educational level, and continuous mentorship.

Knowledge and awareness of infection control among health care workers have been pointed out to be good in inpatient safety and reducing incidences of associated healthcare infections. In a descriptive cross-sectional study in Intensive Care Units (ICU) of a teaching hospital in Nigeria, it was found that knowledge and awareness of infection control among health care workers were good, but the practice was poor. Of the 80 participants, 69 were knowledgeable on the mode of infection among patients, sixty-one physicians, four nurses, and four physiotherapists were aware that hands are the most common mode of infection transmission. Forty-three participants had good knowledge of the 5 moments of hand hygiene, and 42 were knowledgeable on the six stages of hand washing. Concerning the IPC guidelines,22.5% were aware of the guidelines, and 73.7 were not aware of the guidelines within the ICU unit. Eleven participants reported to have been trained on IPC, and most agreed that IPC training programs would be helpful (Adegboye, M. B., et al. 2018). The authors recommended that the institution provide IPC educational programs to all HCW as well as avail IPC guidelines.

In an institution-based cross-sectional study conducted among 171 HCW in Wogdie District Ethiopia on assessing the level of IPC knowledge and its associated factors, it was found that a percentage of the participants had inadequate knowledge and unsafe practices. About 70.8% of the respondents were knowledgeable about IPC, and 55% had safe IPC practices. There was a direct association between knowledge of IPC and availability of IPC guidelines, having been trained on IPC, and work experience. The odds of being knowledgeable on IPC among those who had access to IPC guidelines was reported to be 3.7 higher than their counterparts without access to the guidelines. The odds of knowing IPC was also higher among those HCW who had training on IPC (2.19) and those who had more than 5 years' experience (1.52) than their counterparts. Training on IPC and the availability of water supply were associated with safe IPC practices. The odds of

having good IPC practices among the HCW who received training were 2.2 higher than those who were not trained. Those who worked in facilities with an insufficient water supply were 52% less likely to perform safe practices than those in facilities with a good water supply (Assefa J. *et al*. 2020). The authors recommended the provision of pre-services, on-the-job training on IPC, and availing of IPC guidelines as a way of improving knowledge on IPC among HCW.

CHAPTER III

METHODS AND PROCEDURE

3.1. Study Design and Setting

A facility-based cross-sectional study was conducted among Lobatse District Health Management Team (LDHMT) facilities. Lobatse is a town in the Southeastern part of Botswana, 75 Kilometers South of Gaborone's capital city, with a population of approximately 29,800. The LDHMT is made up of eleven government healthcare facilities with 253 health care workers. The healthcare facilities include Athlone hospital and surrounding clinics, namely Tsopeng, Woodhall, Motswedi, Peleng East, Peleng Central, Molapowabojang, Mogojogojo, Digawana, Lorwana, and Gopong.

3.2 Study Sample

Data was collected from different health professionals, including nurses, doctors, laboratory personnel, health care auxiliaries, dental therapist, and attendants. These healthcare workers have been chosen because of their direct clinical responsibility for patient care. The exclusion was those health care workers who do not have a direct clinical responsibility to patients.

A random sampling technique was used, which gave every participant an equal chance of being selected. A total of 184 participants were randomly selected from the list of eligible healthcare workers using a lottery method. The sample size was calculated using the EPI info Stat Calc. assuming a 95% confidence interval, and a 5% margin of error.

3.3 **Data Collection tool**

A self-administered, pretested, and an anonymous questionnaire was used to collect data from the study participants. The questionnaire was self-developed in English after reviewing the CDC and WHO guidelines and previous studies on the same subject. The questionnaire had 39 questions, and it included three sections, demographic characteristics, IPC knowledge, and practices. The questionnaire had mixed questions, closed-ended, and the three Likert scale. A trained data collector distributed the questionnaire. The questionnaire was tested for its readability using the Flesch-Kincaid test. The overall score was 10.2, indicating that professionals or university graduates can read it. The questionnaire was pretested on 5% of the study participants who did not participate in the actual study.

3.4 Variables used

Outcome Variable

The outcome variable of interest is the IPC knowledge level and practices of healthcare workers. Knowledge of IPC among healthcare workers was measured using 19 closed-ended questions with Yes or No responses. To assess knowledge, questions were asked regarding the use of personal protective equipment, hand hygiene, standard, and transmission-based precautions. Each response was scored by 0 or 1 for a wrong and correct response, respectively, and the overall score was categorized into adequately knowledgeable (score ≥ Mean 14) and inadequate knowledgeable (score mean <14).

Infection Prevention and Control Practices were measured using 10 questions with a 3 Likert scale responses (Always, Sometimes, and Never). The IPC practices of healthcare workers were

measured using questions on the adherence to hand hygiene practices, use of PPE, and the use of available guidelines that reduce the transmission of HAIs. A score of 3,2,1 was allocated to responses with always, sometimes, and never respectively. The overall score was categorized into safe (mean score ≥20.5) and unsafe practices (mean score < 20.5).

Independent Variables

The independent variables include the demographic characteristics (age, sex, level of education, length of service), profession type (medical doctor, physician, midwife, general nurse Family nursing practitioner), training institution, work station, and IPC availability guidelines being trained on IPC.

3.5 Data management and analysis

The responses were recorded in Microsoft Excel software and later transferred to SAS 9.4 software for analysis. Bivariate and multivariate logistic regression at a significance level of 0.05 was used to evaluate the statistical significance of the dependent and independent variables.

3.6 Ethical Considerations

Ethical clearance and support letters were obtained from the Georgia State University Ethical Review Board. Another ethical clearance was obtained from the Ministry of Health and Wellness in Botswana. The two ethical clearance letters were submitted to the Lobatse DHMT management. Permission was sought from the hospital superintendent. Informed consent was sought from the study participants before data collection. Participation in the study was voluntary and anonymous.

CHAPTER IV

RESULTS

4.1 Sociodemographic characteristics of the study participants

One hundred eighty-four healthcare workers among the Lobatse DHMT healthcare facilities were interviewed, of which majority ,67.93% was from the clinics. Among the participants :50.5% were females, and 48.9% were male. More than half (69.83%) of the participants were nurses. About 46.7% of the participants were 31-40 years of age , and 65.93% had between 6 and 15 years in service. A higher portion 65.93% of the participants were diploma holders, and about 64.8% were trained at the Institute of Health Sciences (Table1a). Approximately 61% (111) of the study participants received training on IPC, and 96.70% had access to the IPC guidelines.

4.2 Infection prevention and control knowledge level among healthcare workers

Table 2 shows the overall level of infection prevention and control knowledge among healthcare workers. About 51.3% (78) of the participants were adequately knowledgeable on IPC. Sixty -eight (50.4%) diploma holders and 59(50%) of those who trained in IHS were adequately knowledgeable on IPC respectively. Seventy -five (49.7%) participants with work experience between 5 and 15 years were adequately knowledgeable on IPC. About 51% of those who received training on IPC, and about 52.32% of those who had access to IPC guidelines were adequately knowledgeable on IPC . A total of 157 participants (85.3%) knew that hand hygiene is necessary before and after procedures, 177 (98.9%) were aware that hand hygiene decreases the risk of transmission of hospital-acquired pathogens, and 175 (96.15%) of the participants were aware that hand hygiene is performed even when hands are my are not visibly dirty before patient contact.

About 137 participants (76.5%) of the study participants were adequately knowledgeable on the importance of infection control measures, they knew that these measures could limit the spread of resistant microorganisms and reduce antimicrobial misuse, and 159(87.9%) were aware that the prevention of hospital-acquired infections is an essential part of a health care worker's role. The study participants were adequately knowledgeable about personal protective equipment. Almost all participants 98.9% were aware that the primary use of personal protective equipment (PPE) is to protect healthcare workers (HCWs) and reduce opportunities for transmission of microorganisms in healthcare facilities. As for the standard precautions, 135 (73.77%) participants were not knowledgeable about using these precautions and 48(26.23%) did not know that these were not only to be used in patients diagnosed with infectious diseases or knew when to use standard precautions. Almost all participants were adequately knowledgeable on what measures to use while dealing with Covid-19 patients and suspects : 163 (90.56%) knew that triaging, isolation, and a cohort of Covid-19 cases and suspects is one of the infection prevention and control measures for the control of the spread of Covid-19, and 156 : (87.2%) knew that implementing additional precautions droplet, contact, and, airborne is ideal for Covid-19 cases and suspects.

4.3 Practices of healthcare workers towards Infection Prevention and Control

In this study, 80 (50.63%) healthcare workers, including nurses and doctors, had safe practices towards infection prevention and control. Of the participants, 59(53.15%) and 97(55.11%) for those who had training on infection control and access to infection control guidelines, respectively, had safe practices. The majority of the participants 58.52% with good practices were diploma holders. As showing in Table 3 regarding hand hygiene, 156 :(87.2%) of the healthcare workers reports to practice five moments of hand hygiene every time during patient care, and 147 (80.77%) of the participants always follow hand hygiene steps when washing hands and using an alcohol-

based sanitizer. Regarding the use of personal protective equipment,149 :(83.71%) participants reported wearing a gown if skin or clothing is likely to be exposed to blood or body fluids, and 141(77.90%) reported to wear gloves whenever anticipating contact with blood, body fluids, non-intact skin, and contaminated items.

4.4 Factors associated with knowledge on Infection prevention

Table 4 shows both the bivariate and multivariate analysis of the factors associated with infection prevention and control knowledge among healthcare workers. In the bivariate analysis, the factors which were significantly associated with knowledge included; having access to the IPC guidelines, length of service, training at other training institutes, holding a bachelors or high qualification, age (41- 60) and above, and professional group including :(Healthcare assistants, Laboratory technicians and dental therapist).In multivariate analysis after controlling for other variables, having access to IPC guidelines, having been trained in IPC, length of service of >25 years, having been trained in other institutes and a professional group including(Healthcare assistants, Laboratory technicians, and dental therapist) were found to be significantly associated with knowledge on infection prevention and control. For this, the odds of being adequately knowledgeable in infection prevention and control were higher among those healthcare workers with access to the IPC guidelines than those without access (AOR=1.089;95% CI : 0.148-8.00). Those who have been trained on infection prevention and control were 1.23 times more likely to be knowledgeable on infection prevention and control than those who have not been trained on infection control (AOR=1.23; 95%CI:0.585-2.515). Healthcare workers with a work experience of more than 25 years had a higher odds of being knowledgeable on infection control than those who had work experience of 16-25 years (AOR= 5.88; 95% CI : 0.666-51.955). The study revealed that health professionals, including Healthcare assistants, Laboratory technicians, and dental

therapists, were more knowledgeable on infection prevention and control than nurses and doctors (AOR= 1.566:95% CI :0.555-4.421). Regarding the institute of training, those trained in other training institutes than the University of Botswana and Institute of Healthcare Sciences were more likely to be adequately knowledgeable on infection control (AOR= 1.552;95% CI:0.384-6.274) than participants who were trained elsewhere.

4.5 Factors associated with the practice of healthcare workers on Infection prevention

In the bivariate analysis shown in Table 5, factors including a workstation, educational status, gender, participants' age, institution of training, having been trained in infection control, and antibiotic stewardship availability were associated with safer infection prevention and control practices. However the results were not statistically significant. In multivariate analysis, age, the institution of training, educational status, workstation, work experience, and have been trained in infection control were significantly associated with safe infection control practices. The odds of executing safe infection control activities were higher among those healthcare workers who have been trained on infection control (AOR=1.269 ;95% CI:0.680-2.370) than those who have not received the training. Healthcare workers with working experience of more than 25 years were 1.26 (AOR= 1.258; 95% CI :0.222-7.142) more likely to practice safe infection control activities than their counterparts with fewer than 25 years. For the educational status, healthcare workers with an academic rank of bachelor's degree and above were 1.5 (AOR=1.518; 95% CI:0.444-5.187) more likely to practice safer infection control activities than those with a diploma and lower educational status. Those healthcare workers working in clinics were about 1.4 times more likely to practice safe infection prevention and control activities than their counterparts (AOR = 1.399, 95% CI:0.725- 2.7001). Health care workers aged between 41 and 60 years were 1.06 times more likely to practice safer infection control activities than those aged less than 41 years. Also,

healthcare workers trained in other training institutes were about 2 times more likely to practice safe infection prevention than those trained at the University of Botswana and Institute of Health Sciences (AOR = 2.080, 95% CI: 0.646 -6.698).

Table 1a

Sociodemographic Characteristics of the healthcare workers in the Lobatse DHMT, healthcare facilities Botswana

VARIABLE	CATEGORY	SAMPLE SIZE (n)	PERCENTAGE (%)
Gender	Male	90	48.9
	Female	93	50.5
Age	19-30	62	34.4
	31-40	84	46.7
	41->60	34	18.9
Profession	Nurse	125	69.8
	Doctor	23	12.9
	HCA	4	2.2
	Lab Technician	14	7.8
	Dental Therapist	9	5.0
	Physician	4	2.2
Length of service	≤5 Years	55	30.1
	6-15	96	52.5
	16-25	19	10.4
	>25	13	7.1
Education Level	Certificate	15	8.2
	Diploma	120	65.9
	Bachelors	43	23.6
	Masters	3	1.7
	Doctorate	1	0.6
Workstation	Hospital	59	32.1
	Clinic	125	67.9

Table 1b

Characteristics of healthcare workers in the Lobatse DHMT healthcare facilities Botswana

VARIABLE	CATEGORY	SAMPLE SIZE (n)	PERCENTAGE %
Access to IPC Guidelines	Yes	176	96.7
	No	6	3.3
Infection Prevention training	Yes	111	60.7
	No	72	39.3
Institution of training	UB	29	15.9
	IHS	118	64.8
	Others	35	19.2
Availability of an antibiotic stewardship	Yes	28	16.2
	No	145	83.8

*UB-University of Botswana, IHS-Institute of health sciences

Table 2

IPC Knowledge questions for healthcare workers in the Lobatse DHMT healthcare facilities

Knowledge Question	Category	Frequency	Percentage %
1.Hand hygiene with soap and water or an alcohol-based antiseptic decreases the risk of transmission of hospital-acquired pathogens	Yes	177	98.9
	No	2	1.1
2.The primary use of personal protective equipment (PPE) is to protect healthcare workers (HCWs) and reduce opportunities for transmission of microorganisms in healthcare facilities	Yes	181	98.9
	No	2	1.1
3. Sharp items should be disposed of in containers that are puncture-resistant, leak-proof, closable, and labeled with the biohazard symbol	Yes	180	99.5
	No	1	0.55
4. Masks protect against bodily fluid exposure when splashing occurs	Yes	158	87.3
	No	28	12.7
5. Infection prevention and control measures can limit the spread of resistant microorganisms and reduce antimicrobial misuse	Yes	137	76.5
	No	42	23.5
6.Gloves provide complete protection against acquiring/transmitting infection	Yes	54	29.5
	No	129	70.9
7.Prevention of hospital-acquired infections is an important part of a health care worker's role	Yes	159	87.9
	No	22	12.2

Table 2 (Continuation)

IPC Knowledge questions for healthcare workers in the Lobatse DHMT healthcare facilities

Knowledge Question	Category	Sample size(n)	Percentage (%)
8.If my hands are not visibly dirty, there is no need to wash my hands prior to patient contact	Yes	7	3.85
	No	175	96.15
9.Standard precautions are set of Infection Control practices used to prevent transmission of Healthcare Acquired Infections (HAI'S) and are only to be used in patients diagnosed with infectious diseases.	Yes	48	26.23
	No	135	73.77
10. Since gloves may prevent hand contamination, it is not necessary to wash hands after removing gloves	Yes	29	15.93
	No	153	84.07
11. When Standard Precautions alone cannot prevent transmission, they are supplemented with transmission-based Precautions	Yes	140	88.61
	No	18	11.39
12. Clean disposable gloves are worn during direct contact with blood/body fluids, mucous membranes, non-intact skin, or any other potentially infectious material	Yes	157	87.71
	No	22	12.29
13.N95 mask is needed when in contact with a suspect or a known TB patient	Yes	161	88.46
	No	21	11.54

Table 2 (continuation)

IPC Knowledge questions for healthcare workers in the Lobatse DHMT healthcare facilities

Knowledge Question	Category	Sample size (N)	Percentage %
15. There is no need to wash hands after doing procedures that did not involve bodily fluids	Yes	34	18.9
	No	149	81.4
16. All patients are sources of infection regardless of their diagnoses	Yes	151	82
	No	33	17.9
17. Hand hygiene is necessary only before procedures are performed	Yes	27	14.7
	No	157	85.3
18. Used and disposable PPE item is disposed of in a black garbage bag	Yes	90	49.7
	No	91	50.3
19. Implementing additional precautions (droplet and contact and, whenever applicable, airborne precautions) is ideal for suspected cases of COVID-19	Yes	156	87.2
	No	23	12.9
20. One of the Infection Prevention and Control measures for the control of COVID-19 spread include triaging isolation and cohort of cases and suspects	Yes	163	90.56
	No	17	9.44

Table 3

Factors associated with IPC Knowledge level among healthcare workers in Lobatse DHMT healthcare facilities

Characteristics	Knowledge level	
	Adequate	**Inadequate**
GENDER		
Male	42 (46.7)	49 (53.9)
Female	54 (58.1)	39 (41.9)
AGE		
19-30	36 (58.1)	26 (41.9)
31-40	36(42.9)	48(57.1)
41- >60	21(61.8)	13(38.2)
EDUCATION		
Diploma and below	68 (50.4)	67 (49.6)
Bachelors and above	26 (55.3)	21 (44.7)
INSTITUTION		
UB	15 (51.7)	14 (48.3)
IHS	59 (50.0)	59 (50.0)
Others	20 (57.1)	15 (42.9)
LENGTH OF SERVICE (YEARS)		
≤5 -15	75 (49.7)	76 (50.3)
16-25	11 (57.9)	8(42.1)
>25	10 (76.9)	3 (23.1)

*UB -University of Botswana

*IHS -Institute of Health Sciences

Table 3 (continuation)

Factors associated with IPC Knowledge level among healthcare workers in Lobatse DHMT healthcare facilities

Characteristics	Knowledge level	
	Adequate	**Inadequate**
PROFESSION		
Nurses, Doctor, Physician	78 (43.58)	74 (41.34)
HCA, LabTech, Dental Therapist, Dental Attendant	17 (9.50)	10 (5.59)
TRAINING ON IPC		
Yes	57 (51.4)	54 (48.7)
No	38 (52.8)	34 (47.2)
AVAILABILITY OF IPC GUIDELINES		
Yes	92 (52.3)	84 (47.7)
No	2 (33.3)	4 (66.7)
WORKSTATION		
Hospital	32 (54.2)	27 (45.8)
Clinics	64 (51.2)	61 (48.8)
AVAILABILITY OF ANTIBIOTIC STEWARDSHIP		
Yes	13 (46.4)	15 (53.6)
No	78 (53.8)	67 (46.2)

Table 4

Bivariate and multivariate logistic regression of factors associated with IPC knowledge level of healthcare workers in Lobatse DHMT healthcare facilities, Botswana

Characteristics	COR (95%CI)	AOR (95%CI)
IPC GUIDELINES		
No access	**REF**	**REF**
Have access	2.19 (0.391-12.267)	1.089(0.148-8.011)
IPC TRAINING		
Did not receive training	**REF**	**REF**
Received training	0.944 (0.52-1.710)	1.23(0.585-2.515)
ANTIBIOTIC STEWARDSHIP		
Not Available	**REF**	**REF**
Available	0.744 (0.331-1.675)	0.477(0.173-1.316)
LENGTH OF SERVICE		
≤5 -15	**REF**	**REF**
16-25	1.393 (0.531-3.657)	1.748(0.387-7.884)
>25	3.378 (0.894-12.759)	5.882(0.666-51.955)
WORKSTATION		
Hospital	**REF**	**REF**
Clinic	0.885 (0.476-1.647)	0.790(0.368-1.697)
INSTITUTION OF TRAINING		
IHS	**REF**	**REF**
UB	1.071 (0.475-2.415)	1.102(0.275-4.26)
OTHERS	1.33 (0.623-2.853)	1.552 (0.384-6.274)
EDUCATION		
Diploma and below	**REF**	**REF**
Bachelors and above	1.22(0.626-2.376)	0.955(0.224-4.080)
PROFESSION		
Nurses, Doctor, Physician	**REF**	**REF**
HCA, LabTech, Dental Therapist, Dental Attendant	1.613(0.694-3.748)	1.566(0.555-4.421)
GENDER		
Female	**REF**	**REF**
Male	0.619(0.346-1.109)	0.675(0.337-1.353)
AGE		
19-30	**REF**	**REF**
31-40	0.542 (0.279-1.052)	0.441(0.201-0.967)
41- >60	1.167(0.496-2.746)	0.421(0.105-1.685)

Table 5

Infection prevention practice questions for healthcare providers in health in Lobatse DHMT healthcare facilities

Practice question	Category	N (%)
1.How often do you practice 5 moments of hand hygiene during patient care	Always Sometimes Never	145 (83.82) 28 (16.18)
2.How often do you follow the hand hygiene steps	Always Sometimes Never	147 (80.77) 35 (19.23)
4.How often do you discard sharp material in a sharp's container	Always Sometimes Never	169 (94.41) 10 (5.59)
5.I wear a gown if skin or clothing is likely to be exposed to blood or body fluids	Always Sometimes Never	149 (83.71) 26 (14.61) 3 (1.69)
6.I wear gloves when touching blood, body fluids, non-intact skin, and contaminated items	Always Sometimes Never	141 (77.90) 38 (20.99) 2 (1.10)
7. How often do you Perform hand hygiene when Moving from dirty areas to clean areas on the same client	Always Sometimes Never	110 (60.77) 71 (39.23)
8. How often do you recap, bend, or manipulate needles in any way for disposal.	Always Sometimes Never	112 (62.57) 54 (30.17) 13 (7.26)
9.How often do you use aseptic technique when preparing and administering medications	Always Sometimes Never	148 (82.68) 25 (13.97) 6 (3.35)
10.Use respiratory hygiene and cough etiquette to reduce the transmission of respiratory infections within the facility.	Always Sometimes Never	146 (86.39) 19 (11.24) 4 (2.37)

Table 6

Factors associated with IPC practices among healthcare workers in Lobatse DHMT healthcare facilities

Characteristics	IPC Practices	
	Safe	**Unsafe**
GENDER		
Male	48 (53.33)	43 (47.25)
Female	53 (56.99)	40 (43.01)
AGE		
19-30	38(61.29)	24(38.71)
31-40	42 (50.00)	42 (50.00)
41- >60	19 (55.88)	15 (44.12)
EDUCATION		
Diploma and below	79 (58.52)	56 (41.48)
Bachelors and above	20 (42.55)	27 (57.45)
INSTITUTION		
UB	19 (65.52)	10 (34.48)
IHS	69 (58.47)	49 (41.53)
Others	12(34.29)	23 (65.71)
LENGTH OF SERVICE (YEARS)		
<5-15	82 (54.30)	69(45.70)
16-25	12 (53.16)	7(36.84)
>25	6 (46.15)	7 (53.85)

*UB -University of Botswana

*IHS -Institute of Health Sciences

Table 6a

Factors associated with IPC practices among healthcare workers in Lobatse DHMT healthcare facilities

Characteristics	IPC PRACTICES	
	SAFE	UNSAFE
PROFESSION		
Nurses, Doctor, Physician	80(52.63)	72(47.37)
HCA, LabTech, Dental Therapist, Dental Attendant	19(70.37)	8 (29.63)
TRAINING ON IPC		
Yes	59 (53.15)	52(46.85)
No	42 (58.33)	30 (41.67)
AVAILABILITY OF IPC GUIDELINES		
Yes	97 (55.11)	79 (44.89)
No	4 (66.67)	2 (33.33)
WORKSTATION		
Hospital	37 (62.71)	22 (37.29)
Clinics	64 (51.20)	61 (48.80)
AVAILABILITY OF ANTIBIOTIC STEWARDSHIP		
Yes	15 (53.57)	13 (46.43)
No	78 (53.8)	67 (46.21)

Table 7

Bivariate and multivariate logistic regression of factors associated with IPC practices of healthcare workers

Characteristics	COR (95%CI)	AOR (95%CI)
IPC GUIDELINES		
No access	**REF**	**REF**
Have access	0.789 (0.188-3.319)	0.810 (0.149-4.409)
IPC TRAINING		
Did not receive training	**REF**	**REF**
Received training	1.553(0.915-2.638)	1.269(0.680-2.370)
Antibiotic Stewardship		
Not Available	**REF**	**REF**
Available	1.398 (0.683-2.859)	0.971(0.533-1.771)
Length of service		
≤5 ,6-15	**REF**	**REF**
16-25YRS	1.136 (0.488-2.642)	0.841(0.229-3.090)
>25 YRS	1.785(0.656-4.858)	1.258(0.222-7.142)
Workstation		
Hospital	**REF**	**REF**
Clinic	1.447(0.833-2.514)	1.399(0.725-2.700)
Institution of training		
IHS	**REF**	**REF**
UB	1.058 (0.514-2.176)	0.786(0.241-2.563)
OTHERS	2.169 (1.107-4.252)	2.080(0.646-6.698)
Education		
Diploma and above	**REF**	**REF**
Bachelors and above	1.878 (1.039-3.394)	1.518(0.444-5.187)
Profession		
Nurses, Doctor, Physician	**REF**	**REF**
HCA, LabTech, Dental Therapist, Dental Attendant	0.386(0.181-0.821)	0.431(0.172-1.082)
Age		
19-30	**REF**	**REF**
31-40	1.535(0.854-2.759)	1.017 (0.522-1.981)
41->60	1.849 (0.878-3.896)	1.059(0.321-3.500)
Gender		
Male	**REF**	**REF**
Female	1.225(0.733-2.049)	0.971(0.533-1.771)

CHAPTER V

DISCUSSION

Being adequately knowledgeable in infection prevention and control and practicing of safer IPC activities is important in preventing and controlling the spread of health care associated infections in a healthcare setting. This study assessed the level of knowledge and practices on infection control and their associated factors among healthcare workers in LDHMT facilities. The findings of this study provided an important baseline information about infection control knowledge and practices among healthcare workers in Lobatse DHMT healthcare facilities.

The findings of the study showed that 53.07% of the healthcare workers were adequately knowledgeable on infection control . The study participants 90.56%) were knowledgeable on the IPC Covid-19 prevention measures including isolation, triaging and cohort of cases and suspects to reduce the spread of Covid-19.These findings were like those of a study conducted in Arsi District, South East Ethiopia (Geberemariyam, B. S et al 2018) which found out that 53.7% of the healthcare workers were knowledgeable about infection prevention. The findings of this study also showed that those healthcare workers with access to IPC guidelines, having been training on IPC and had more than 25 years of work experience were more likely to be adequately knowledgeable on IPC. This was also found to be consistent with a study by Geberemariyam, B.S et al 2018,who found out that healthcare workers were more likely to be adequately knowledgeable on IPC if they worked ten years or more (AOR = 3.41; 95% CI: 1.22, 9.55); had infection prevention guidelines available (AOR = 2.44; 95% CI: 1.45, 4.12);and had training on IPC (AOR = 5.02; 95% CI: 1.45, 8.59).The findings were also in line with those in a study by Desta, M. Et al 2018,a direct association between adequate knowledge on IPC and working experience of more than 10 years

(AOR=4.03 ;CI: 1.229–5.68) was reported. On the other hand, the findings were lower than that of the study conducted in Gondar referral hospital in Ethiopia(Yazie, T.D etal 2019) and of a study conducted in Wolaitta Sodo Otona Teaching and Referral Hospital (Hussen SH *et al* 2017) which reported 230 (81.6%)and 269 (99.3%) of the participants to be adequately knowledgeable on infection control respectively. The possible explanation for this difference may be due to a difference in the study settings , training opportunity, study sample, differences in health related policies and guidelines and personal characteristics of the study participants .The studies in comparison were conducted in referral and teaching hospitals whereas this study was limited to district hospital and small clinics. Working in a referral or teaching hospital gives the healthcare workers an opportunity to trainings which might increase their knowledge on infection control.

Regarding the infection control practices, about 55.0% of the participants reported safer infection control practices of which 50.63% were Nurses, Doctors and Physicians. Nurses were found to report better knowledge about safe infection control practices than their other health care counterparts. Almost all the nurses 98.33% reported to always practice hand hygiene during patient care. The findings of this study are in line with those of the study conducted in Addis Ababa by Sahiledengle, B. *et al* (2018).The nurses in their study also reported to practice a better safe IPC practices than other healthcare professionals . After controlling for potential confounding variables, availability of IPC guidelines, being trained on IPC, length of service, training from other institutions were found to be significantly associated with practicing safe infection prevention activities. The findings of the study were the same as those from a study conducted by Geberemariyam, B.S *et al* (2018) who found that healthcare workers who received IPC training were about 5.31 times more likely to practice safer IPC (AOR=5.31;95% CI:2.42-11.63) than their

counterparts and those who had access to IPC guidelines were 3.34 more likely to execute safer IPC practices (AOR=3.34;95% CI:1.65-6.67).

Healthcare workers with an educational level of bachelors' and above reported safe practices of infection control than their counterparts with a lower educational status. The reason for this could be because as one attains higher level of education his experience and skills is improved hence safer practices. A working experience of greater than 25 years was found to be significantly associated with the practice of safe IPC activities, this was the same as the findings in studies by Kelemua Gulilat K.& Tiruneh. G ,2014, and by Geberemariyam, B.S et al (2018) they found that those with length of service of 10 years and above and 15 years and above were more likely to be adequately knowledgeable on IPC (AOR=1.49:95% CI:0.82-2.0) and (AOR=3.17:95% CI:0.47-21.24) respectively than those with less years of service. The reason for this association could be because as the length of service increases the more experienced, they get hence improve their IPC practices.

In this study, 40 -60 years and above healthcare workers were 1.05 more likely to practice safer IPC activities (AOR=1.059;95% CI:0.321-3.500) than those with less than 40 years. This is comparable to the findings in the study by Destal *et* al (2018) ,they found that those aged 30 years and above were 2 times more likely to practice safer IPC activities (AOR=2.04;95%CI:1.279-4.579). This association could be explained by the fact as one's age advances, length of service also increases which in turn perfect and improves their practices.

This study also showed that healthcare workers who worked in clinics were 1.4 times more likely to practice safe infection control practices (AOR=1.399;95%CI:0.725-2.700) than their counterparts in the hospital. This association could be because majority of the participants in the

clinics received training on IPC and they had access to IPC guidelines. The findings of the study also showed that healthcare workers who trained in other health training institutes were 2 times more likely to practice safe IPC activities (AOR=2.080;95%CI:0.646-6.689) than those who trained at University of Botswana and Institute of Health Sciences.

5.1 Study Strengths and Limitations

This study is a facility based cross sectional study that used self-reported data collected from participants using a questionnaire. Efforts were made to minimize weaknesses of the study; random sampling technique was used to give all the healthcare workers a chance of being chosen into the study. This study has limitations, the findings of the study can only be generalized to healthcare workers with direct responsibility to patient care and only to government healthcare facilities with the Lobatse DHMT. Cross sectional study design was used which cannot be used to establish a relationship between the explanatory and the outcome variables. Self-reporting bias might be one of the limitations in this study as the participants were self-reporting their practices and were not cross-checked through observing the actual practices hence participants could possibly over report or under report their practices.

5.2 Conclusion

The findings showed an adequate knowledge level on IPC with safe practices of IPC activities among a portion of healthcare workers in Botswana. Although a larger portion of participants reported adequate access to IPC guidelines and training a few were knowledgeable in IPC practice activities.The results of this study calls for IPC knowledge and practices improvement interventions in Botswana.The provision of pre-service and re-education through in-service trainings on IPC, regular educational programs and developing professionals' educational level by

LDHMT policy makers is recommended.Theses recommendations include continuous supervision in order to assure adherence to IPC guidelines by healthcare workers in Botswana.

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Appendix

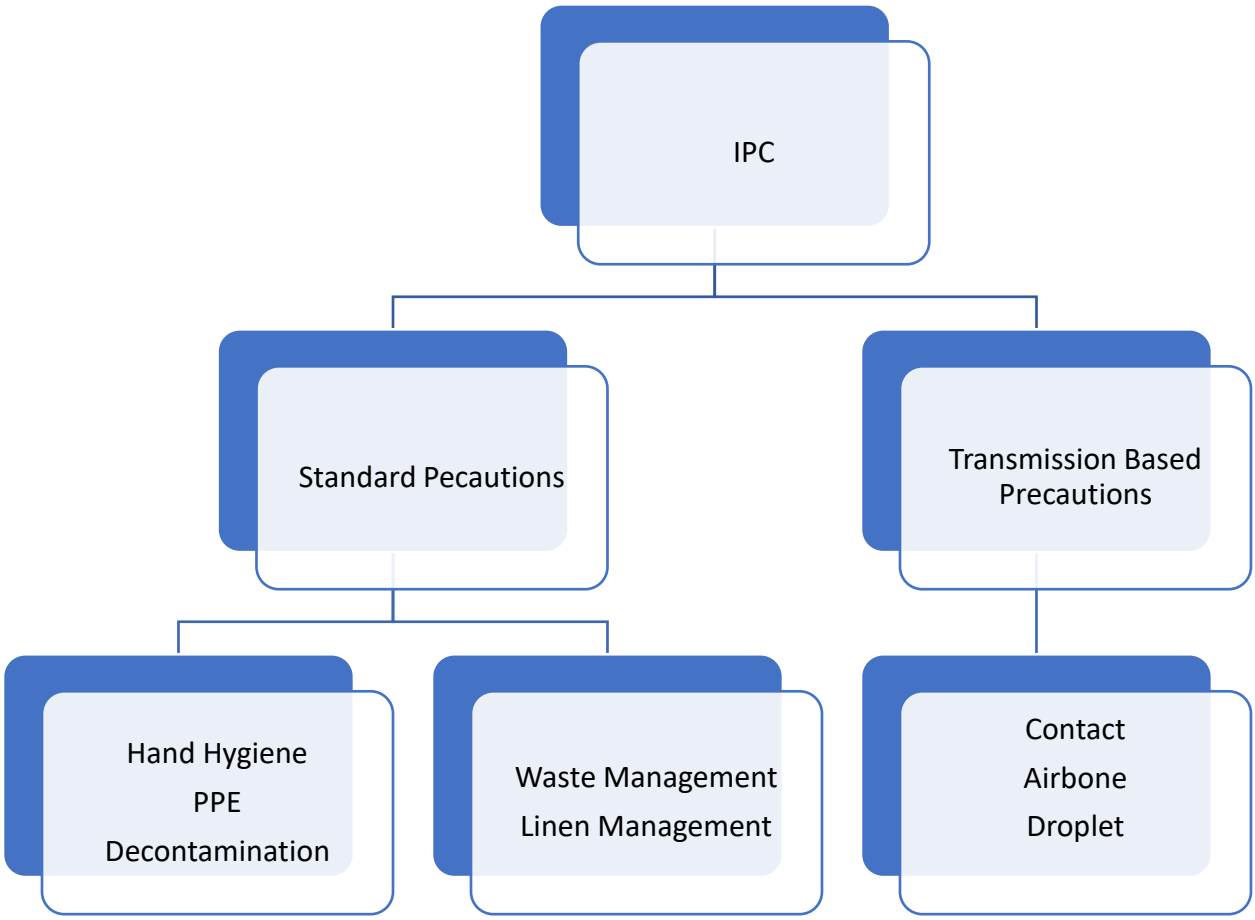

Figure1: Infection Prevention and Control principle