African Journal of Inter/Multidisciplinary Studies 2023 | *5(1): 1-15* | *DOI: https://doi.org/10.51415/ajims.v5i1.1135*

RESEARCH ARTICLE:

Assessing Infection Control Knowledge and Compliance of Cardiovascular Perfusionists in Theatre at a Private Hospital in Kwazulu-Natal, South Africa

Elizabeth Laura Naidoo[1], Francis Akpa-Inyang[2], Myenderan Keith Odayan[3] and Jamila Adam[4]

Received: 22 December 2022 | **Revised:** 22 March 2023 | **Published:** 30 March 2023

Abstract

Infections acquired in a hospital (HAI) often referred to as nosocomial infections are related with increasing morbidity and death among patients that are hospitalised and are predisposed to an elevated risk of infection by health workers (HCWs). The need to maintain an effective infection prevention and control program is therefore essential for quality health care. This study sought to assess the knowledge and compliance of infection control practices of Cardiovascular Perfusionists in theatre at a private healthcare facility in KwaZulu-Natal (KZN) in the city of Durban. We conducted a qualitative study based on in-depth interviews with 12 Cardiovascular Perfusionists (CP) who were purposively selected from private sector. The interviews lasted between 20 to 25 minutes and were transcribed, and then thematic analysis were applied using NVivo. The study found that there is a need for Clinical Technologist specialising in Cardiovascular Perfusion to undergo training in infection control and prevention practices at the higher education and training level. Subsequently, the study reveals that Cardiovascular Perfusionists have a good overall understanding of pathogens and the implications thereof. The study also notes that there is considerable compliance to infection control practices in theatre irrespective of the knowledge pertaining to infection control and prevention policies. We concluded that there is an overall good knowledge and understanding regarding infection control practices, although many felt that there exists an inequitable application of infection control policies due to professional biases.

Keywords*: infection control; knowledge; compliance; cardiovascular perfusionist; KwaZulu-Natal*

Introduction

Cardiovascular Perfusion is a category of the profession Clinical Technology. These are specialists that operate a heart-lung machine as well as play a supportive role during coronary artery bypass and related procedures in theatre and form part of the surgical team. The purpose of this study was to assess if these professionals are knowledgeable and compliant with infection prevention and control practices in theatre. According to the National Department of Health (NDOH), infection and prevention programmes are essential in order to prevent healthcare-associated infections (HCAI) or antimicrobial resistance (NDOH, 2020). Because the Cardiovascular Perfusionist (CP) is present in theatre for the full duration of any cardiac and other blood salvaging-related procedures, it is essential to understand their contribution and implications to infection control and prevention practices. There is currently no study that shows if CPs implement their knowledge and compliance with infection control policies or contribute to hospital-acquired infections or antimicrobial resistance in surgical site or related procedures within the operating room.

According to the International Society for infectious diseases, among patients that undergo surgical procedures, approximately two to five percent experience surgical site infections (SSIs) (Roy, 2018). In poor and middle-

[1]Durban University of Technology, laura.raju@yahoo.com
[2]Durban Univeristy of Technology, francisa@dut.ac.za
[3]St. Augustine Hospital, keith@yebo.ca.za
[4]Durban University of Technology, adamjk@dut.ac.za

income nations, SSIs are the most common cause of health-related infection. SSIs are the second-most prevalent form of adverse events in high-income countries (HICs) of hospitalized patients, but are surpassed by medicine mistakes. Since SSIs are usually acquired during the operation while the incision is open, attention needs to be given to certain infection control practices in the operating room (Roy, 2018). The PI is a Cardiovascular Perfusionist in private practice in KwaZulu-Natal in Durban Central and has observed there is increased pressure on CPs, and the implications of possible post-operative infections in the Intensive Care Units. In addition, it was observed that the hospital's infection prevention and control development programs, such as hand washing procedures and the wearing of protective equipment required for infection prevention and control, were not implemented consistently among the other healthcare workers within the theatre environment. Patel *et al*. (2016), postulate that hand hygiene compliance of nurses is higher than that of doctors. This arises from the ideology that the doctor is always correct. However, such a strategy of thought can be used to the benefit of hand hygiene programs, and it can be particularly effective when combined with education on hospital-acquired illness rates and antibiotic stewardship to provide a more complete approach to patient management (Patel *et al*., 2016).

Patel *et al*. (2016) further suggest that implementing visual reminders, constant observation and availability of policies and resources play a critical role in infection control compliance (Patel *et al*., 2016). Subsequently, the researcher identified that the hospital that is frequented by the participants in this study are not given access to infection control prevention policies. These observations created the need to assess if Cardiovascular Perfusionists indeed are knowledgeable and comply with infection prevention control practices in theatre.

Methodology

A qualitative research design was used to explore the knowledge and compliance of infection control practices of Cardiovascular Perfusionists by conducting online, semi-structured interviews. The interviews were conducted online due to the current COVID-19 pandemic, where much consideration was given to social distancing and modes of virus transmission. The interviews lasted no more than 20 minutes. Prior to conducting the main study, a pilot study was pursued to ensure that the interview questions were relevant, that the participants had clear engagement with the questions, and that no modification or questions were added to the interview guide. The researcher found that the actual description of the professions differed in the procedures carried out; however, the theatre environment was the same, and only a few questions pertaining to the difference in practice of the participants had to be rephrased slightly in order to be more applicable to the main study. The study was conducted by means of a purposive sample of Cardiovascular Perfusionists. The interviews conducted were limited to only those that practise in the private sector. Participants were chosen based on their ability to provide the necessary information. The interviews were transcribed and then encoded by a statistician. The rationale for selecting this strategy was that the researcher was seeking knowledge about the factors that influence the knowledge and compliance of Cardiovascular Perfusionists in the private sector regarding infection prevention and control techniques. Subsequently, these participants would therefore be able to contribute valuable information.

Compared to quantitative research, qualitative research seeks to attain distinct sorts of applicability or transferability (Bryman, 2012). As a result, it deviates from conventional probability sampling methods. Non-probability sampling can take several forms, including convenience, quota and purposeful sampling (Kumar, 2011). Drawing on the concepts of Parahoo (2014), a purposive sampling approach was utilised in this research. This means that participants were deliberately chosen based on their ability to provide the necessary information. The rationale for selecting this strategy was that the researcher was seeking knowledge about the factors that influence the knowledge and compliance of Cardiovascular Perfusionists in the private sector with infection prevention and control techniques (Parahoo, 2014). By virtue of their previous experience, these participants would be therefore able to contribute. In this study, the purposive sampling approach used was not random, and used all the cardiovascular perfusionists working in private practice in central KwaZulu-Natal, and who signed a consent form. It attempted to ensure that all aspects of job functions were represented. Participants were contacted via an e-mailed letter, invited to join the study, accompanied by a letter of information. The participants'

e-mails were obtained online. Interviews were conducted with those who had offered their services voluntarily. In total, 12 cardiovascular perfusionists were interviewed.

Various methods of data collection methods exist, namely direct and indirect data collection. Direct data collection requires the use of interviews, observation, diarising the interview session, or even an open-ended questionnaire (Lopez and Whitehead, 2013). The method of direct data collection by interviews was exercised in this study. Firstly, letters of information pertaining to the study were sent to all participants. A letter of informed consent had also been obtained prior to commencing with the interviews. Data were gathered through individual semi-structured, online interviews with Cardiovascular Perfusionists, as the researcher wished to obtain personal, unbiased input from them. Data were transcribed verbatim, and then sent to a statistician to develop codes from suitable themes and subthemes arising from the interviews. With qualitative research, the data acquired are typically text based. According to Wong (2008), the process of data analysis can be defined as a process that simplifies, summarizes, and gives meaning to data that have been acquired (Wong, 2008; Akpa-Inyang, 2017). It is an extensive exercise exploring meanings, experiences and thoughts that pertain to the research being conducted (Akpa-Inyang and Chima, 2021).

The process of interpreting data obtained from a qualitative study entails coding or categorizing the information. Essentially, it involves making sense of massive volumes of data by simplifying the volume of the raw information, then recognizing relevant patterns or themes, finally extracting insights from data, and ultimately constructing a coherent collection of evidence. The themes were identified by the use of repetitive words from participants, commonly used terms, or keywords, or even comparing or contrasting the text acquired (Ryan and Bernard, 1998; Akpa-Inyang and Chima, 2021). The most crucial stage in the qualitative process of data analysis is coding or categorizing the data. Coding and data analysis are not considered synonymous, despite the fact that coding is an important part of the qualitative data analysis process. Coding is simply the process of dividing a large amount of raw information or data and categorizing it. Ethical approval was acquired from the Institutional Research and Ethics Committee of the Durban University of Technology (ethics clearance number IREC 105/20). Consent was obtained from each participant and no personal details were obtained on the consent. All participants were assigned pseudonyms for the process of thematic analysis.

Results

This section detailed the profile of the participants in terms of their qualifications and job descriptions.

Table 1 shows the number of participants and the assigned pseudonyms given to each of the participants. The participants who participated in the interviews were 12 in number.

Table 1: Pseudonyms of participants

Participants	Assigned pseudonyms
1	EN
2	DJ
3	DP
4	KC
5	KP
6	KP2
7	SKC
8	SS
9	TH
10	VM
11	AG
12	AP

The data in Figure 1 indicate that the overwhelming majority (91.7%) hold a Bachelor of Clinical Technology (BTech: Clinical Technology), while one of the participants had a National Diploma qualification in Clinical Technology. It was uncovered that special consideration was given to those with the National Diploma in Clinical

Technology, due to the age in the profession and experience in the field, and could therefore contribute to the research. This is what the participant said:

> *"You know, when I qualified there was no clinical technology, I'm one of the very first Perfusionists in South Africa, I'm so old. So, I haven't done a bachelor's degree, what actually happened is that the Health Professions Council, decided to do a grandfather clause because of people like me, Ya, so that's my highest qualification, Ya, when I studied, there was only the nurses' college and ML Sultan, that's where we learned."* (SKC).

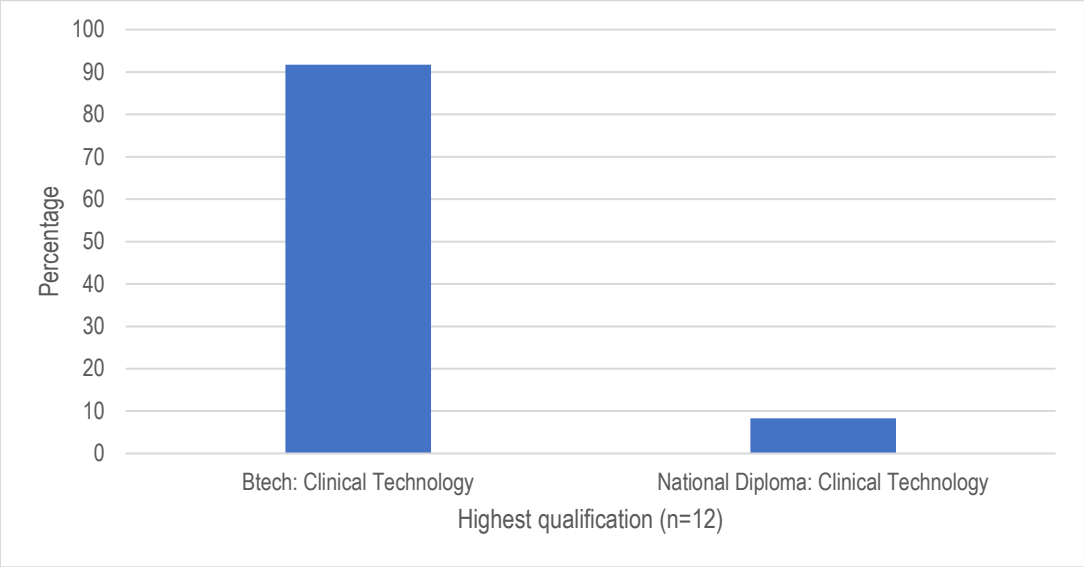

Figure 1: Graph depicting participants' highest level of education

Table 2: Themes and subthemes extracted from study findings

Theme	Subtheme
Infection control and prevention (5 subthemes)	• Understanding of infection control • Familiarization with hospital infection control policies and protocols • Familiarization with infection control and practices in theatre • Hand hygiene techniques • Training on infection control
Knowledge of healthcare-associated hospital infection (3 subthemes)	• Common disease • Vulnerable patients • Method of preventing and controlling hospital associated infection
Awareness of healthcare-associated hospital infection (2 subthemes)	• Cross-contamination • Post-operation infection
Cardiovascular perfusion procedure (2 subthemes)	• Involvement in CVP procedure • Involvement in catheterization
Precautions followed in cardiological surgery (3 subthemes)	• Setting up pump • Handling of biowaste • Use of personal protection gear

Infection control and prevention: Infection control is becoming a global concern due to hospital-acquired infections (HAI) surfacing from multidrug-resistant bacteria occurring in patients post-operatively, typically within

a month of admission at the hospital. This theme explores the participants' understanding as well as compliance with infection control and prevention.

Understanding of infection control and prevention

All the participants interviewed appeared to understand infection prevention and control. Participants' understanding of infection control entails the prevention of cross-contamination through hygiene practices, cleanliness, and sterility in the work environment.

An excerpt from the interviews is summarized below:

> *"Infection control is basically ways in which you prevent the spread of infections, especially since we work in theatre and most areas in theatre become sterile areas once the surgical procedure begins."* (KP2)

> *"Well, it is about how to make sure that the theatre environment is kept in an aseptic manner so that there is no spread of any infections."* (AG)

For some, their understanding of infection control entails maintaining cleanliness through proper hand hygiene practice.

> *"Well, it's to do with how we maintain cleanliness in the theatre, like with hand washing, and with like the red boxes and contaminated items that need to go in those red boxes and stuff like that."* (VM).

> *"I think that is the hygienic manner in which you carry out yourself in theatre and how you operate around the sterile areas."* (SS)

> *"In theatre, I think it involves how you practise hygiene. Like to prevent cross-infections from you and to the patient, and like how to maintain sterility in theatre."* (TH).

While it can be drawn from the above narrative that the participants have a strong understanding of and value the importance of infection prevention and control, Participant SKC's statement, however, appears to suggest that the level of infection prevention and control practices among Clinical technologies have waned over time.

> *"Oh my, in my days the nuns were actual nurses. And infection control was a very big thing. They were very strict, sometimes we felt like they will whip out a stick and beat us if we didn't listen. Ya, you guys have it all easy."* (SKC).

Familiarization with hospitals' infection control policies and protocols

Of critical concern, which requires urgent attention, was uncovering that many of the participants claimed not to be familiar with hospitals' infection control policies and protocols.

> *"Actually, no, I haven't, I just assume that it's the same as from the time we were in training like I told you earlier we were just explained to, on how to carry out ourselves in theatre. And like what we can touch or what we can't touch, yah." (Participant EN).*

> *"Actually, no I haven't thought to do that, because we kind of just found out how to carry ourselves out in each hospital."* (Participant DJ).

> *"No, I haven't."* (Participant DP).

Familiarization with infection control and practices in theatre

As mentioned above, all the participants interviewed were not familiar with infection control and practices in the theatre.

> *"No, I haven't, there's nothing in theatre, so I'm assuming it's like kept away somewhere."* (Participant SS).

Others attribute their lack of familiarization with theatre policies on infection control and practices to knowing what to do and what is expected of them in the theatre.

> *"No, I haven't, I think because it never occurred to me to, because I felt like I know about how to behave in theatre, but also I don't think it's anywhere that we can see it."* (Participant AG).

> *"No, I haven't, I didn't see the need to because I pretty much follow whatever is expected of me in theatre."* (Participant KP).

> *"Nope, I pretty much have a basic understanding of how to carry myself out in theatre, because it's similar in all hospitals I think."* (Participant DP).

Hand hygiene techniques

Hand hygiene is closely related to the prevention and control of infection in the hospital. Consistent with this, Participants EN and DP stressed the importance of hand hygiene in the prevention of the spreading of diseases and viruses.

> *"Hand hygiene is important, especially in the prevention of the spread of diseases and viruses. So, like washing your hands will be important in this aspect. I am aware of the scrub technique, but I haven't ever done it. It looks long to do."* (Participant EN).

> *"Well, hand washing is important to prevent the spread of any infection, I mean, we all know that disease can be spread by the touching of surfaces, and I mean we hear that all the time, with COVID now, we can see how important hand washing is to prevent the spread of it. When it comes to hand washing techniques, I'll be lying to you if I said that I did the proper scrub technique."* (Participant DP).

Despite the above acknowledgement of the importance of hand washing, both participants regrettably noted to fall short when it comes to scrubbing techniques.

Training on infection control

Among the 12 participants, it was uncovered that 8 indicated never to have been previously formally trained in infection control. This is worrisome and requires urgent attention by the hospital management, given the public health importance of adequate infection control practices.

> *"No, I haven't."* (Participant KP).

> *"No, I have t been to anything like that."* (Participant DP).

Despite the absence of formal and or professional training on infection control practices, two participants acknowledged that there was an orientation on infection control and that senior colleagues as well as the nurses also gave lessons on it.

> *"No, no programme but the nursing staff and my seniors taught me about infection control when I was training, but not as a lesson, just like while we were in theatre."* (Participant KC).

> *"No, that I can remember, ehh, I just know that when we got to the work environment, we had like an orientation of what the practices in theatre are, but there was never like a formal programme."* (Participant EN).

> *"Ehhm, not that I can think off, Whatever I know I just picked up along the way, like when you go into theatre then the scrub sisters usually tell you what they expect of you. And then you just use logic and basic knowledge of hygiene."* (Participant SS).

Participants KP2 and TH, while noting that there was no formal training, also admitted to having attended a COVID-19 training workshop organised by Netcare.

> *"No, but recently Netcare had a COVID training on donning and doffing, and I attended that, but other than that I've never been."* (Participant KP2).

Despite the lack of formal training, it can be gathered from the above narrative that senior colleagues, as well as the nurses, have made efforts to teach some of the participants infection control practices.

Even though participants claimed not to be familiar with the infection control and practices policies in both the hospital and in theatre, it was uncovered that they still complied with infection control practices. The reason some of them gave to prove compliance was that they have been practising for many years and no single case of contamination was reported from their work (Gammon *et al*., 2008).

> *"I think that I comply with the policies, because like in my 15 years in the private sector I have never been addressed regarding me causing any contamination or anything like that. So, I think I am pretty compliant."* (Participant EN)

Participants DP and KC's statements suggest that they were not too sure about complying with infection control. This is evident in the use of the words, "*I hope I comply*" (Participant KC) and, "*I think I do*" (Participant DP).

Knowledge of healthcare-associated infection: In the quest to combat HAIs, particularly in developing countries, knowledge of HAIs among healthcare workers becomes highly critical. Thus, this theme explores the participants' knowledge of healthcare-associated hospital infections.

Common diseases in hospital

Generally, HAI or nosocomial infections are not present or could be incubating at the time of admission to a hospital. From the interview, the common HAI the participants revealed include Carbapenem-resistant Enterobacteriase (CRE), Hepatitis, and COVID-19 virus.

> *"Yes,* [pause]*, one that we hear of often in theatre is CRE, also like hepatitis, viruses, bacteria, [pause] ya. I think that's about some of what I can think of for now."* (Participant EN).

> [Stammers] *"COVID is one, and CREs, that's quite common, also other bacterial infections and viruses, like hepatitis, urinary catheters also cause infections."* (Participant DJ).

> *"Yes, COVID is the most common, because it spreads between staff and patients, also I know that sometimes patients get urinary catheter infections, and I am sure like all other types of viruses and bacteria."* (Participant DP).

From the above, it can be gathered that urinary catheters are listed as among one of the frequent HAI.

Vulnerable patients

While the risk for HAI may depend on the infection control practices, this could also be aggravated by certain predisposing factors in patients. Sydnor and Perl (2011) reveal factors to include immunosuppression, older age, length of stay in the hospital, and/or multiple underlying comorbidities. Consistent with this, it was uncovered from the interview that patients with poor immunity and a compromised immune system, comorbidities, diabetes, and hypertension had higher risks of HAI.

> *"Mmh, I think like diabetics or people who have poor immunity."* (Participant EN).

> *"Ehh, I think those that have a compromised immune system, maybe those that have comorbidities, like diabetes and hypertension."* (Participant DJ).

"I think patients that have comorbidities, like diabetes, well that would the ones that come for bypasses that would be most vulnerable." (Participant KP2).

"I think patients that have weak immunity, you know like some that are already sick from various diseases. Also, not just be sick but they may have comorbidities like diabetes." (Participant VM).

From the above, one could conclude that diabetes is a recurring risk cited, that nearly all the participants considered may be associated with being susceptible to acquiring HAI.

Method of prevention and controlling healthcare-associated infections

This subtheme explored methods of preventing and controlling HAI. From the interview with the participants, it was uncovered that hand washing, the use of gloves, sanitizing and wiping instruments are the main method of prevention and controlling HAIs followed by them.

(a) Hand hygiene

It was uncovered from the interview that participants' practised hand hygiene as a way of preventing and controlling HAIs.

"Ehh, I make sure that the pump is wiped down and clean before I start setting up the tubing. I ehh, also make sure that I have washed my hands before I start, or sometimes I spray my hands with alcohol spray first. Also like, we have caps on the tubing, so when I set up I make sure all these caps are screwed on properly. Ehh, also I make sure that I do not touch any of the connectors when connecting tubing. Ehh, ya." (Participant EN).

"I think like you have mentioned, it would be hand washing and sanitising." (Participant DP).

"Preventing infection, I think will be with regard to like your hand washing and maybe wiping down the equipment and machines, controlling it, I'm not sure, because in theatre there are so many people, so I don't know how you can control that." (Participant KC).

"I am not sure what the most effective way is, but I think that hand washing will play an important part in prevention." (Participant AG).

From the above narrative, one could deduce that participants' practise hand hygiene procedures, which include washing of the hands and sanitizing. Moreover, and according to Sartelli (2021), appropriate hygiene of surfaces and equipment which patients and healthcare workers touch is essential in reducing patients' exposure to HAI. A similar sentiment was shared by three of the participants, who voiced that wiping down machines and equipment is also important.

"I think hand hygiene plays a critical role, but also I think that wiping down machines and equipment is also important, because the machines lie in theatre the whole time, patient after patient. So, I think that is important to prevent infections from spreading." (KP2).

"I think that hand washing is important, also when we setting up our equipment we should be precautious that we don't expose any of the openings on the tubing and the reservoir. Also, we can make sure that our machines are clean and wiped down." (Participant SS).

"I think that it is important to maintain sterility in theatre. Like, try not to go to the areas that are sterile while the surgical procedure is on. Another important thing is to make sure that we wipe down our machine and equipment before and after the procedure because oftentimes, blood and fluids splash on the machine." (Participant TH).

(b) Cleaning of environment

Apart from proper hand hygiene and wiping down of instruments, the importance of a clean environment was also mentioned during the interview. According to the statement by participant VM:

> *"You know, washing your hands is very important, but also, you need an overall clean environment, as I mentioned earlier, you know those red bins, and sharps containers and also the linen bags, are all important in theatre. You know you have to look at all this first before we can say what is effective or not."* (Participant VM).

The above view further is supported by Sartelli (2021), who states that the sanitization of the environment has been another crucial aspect of the COVID-19 containment.

(c) Use of gloves

Another measure that should be noted in the prevention and control of HAIs is the use of gloves.

> *"Ehh, I think to wash your hands, or maybe wearing gloves."* (Participant DJ).

> *"I think that would be hand washing. Or even like wearing gloves, or sanitising frequently."* (Participant KP).

Participant SKC alerted as a cautionary measure that HAIs are not absolutely preventable, but nonetheless admitted that it could be controlled to some degree if healthcare workers followed the rules in the theatre.

> *"I don't think it's absolutely preventable, but you can control it to some degree, you know following rules in theatre would be one way."* (Participant SKC).

Awareness of healthcare-associated hospital infection: According to Akanbi *et al*. (2017), the rampant cases of HAIs are associated with the hospital environment. Hence, strong awareness of HAIs among healthcare workers is critical in prevention and control. This theme explores the participants' level of awareness of healthcare-associated hospital infections. As illustrated in Figure 13, the theme is discussed under two emerging subthemes, namely cross-contamination and post-operation infection.

Cross-contamination

In the hospital setting, close contact between healthcare workers and patients is unavoidable, even in situations where hygiene is critical. This may increase the likelihood of cross-contamination between healthcare workers and patients and vice versa. This is illuminated in the statement below.

> *"Risks, I think it would be passing some form of infection from me to the patient or from the patient to me."* (Participant KP2).

From the above second narrative by participant KP2, one can see the importance of sterilizing surgical instruments. This is because surgical site infections may be linked to ineffective decontamination of surgical instruments.

Post-operation infection

Although the WHO has put into place infection control guidelines, private hospitals create their own policies and guidelines that are suitable for the respective area and country (Dramowski, 2020). However, the possibility still exists that not all healthcare practitioners adhere to infection control practices, which therefore may be a contributing factor to HAI or SSI postoperatively (WHO 2013). From the interview transcript, all the participants refuted any suggestion that they contributed to post-operation infection.

Cardiovascular perfection procedure: This theme explores cardiovascular perfectionist activities that may contribute to the risks of HAIs. The theme is discussed under two subthemes, namely involvement in Cardiovascular procedure and involvement in catheterization.

Involvement in Central Venous Pressure (CVP) Line Insertion Procedure

In terms of involvement with the CVP, it was uncovered that the participants were not directly involved in the insertion of the CVP. From the data analysed, the only part the participants played in the procedure was setting up the transducer and monitoring the reading of the pressures.

> *"No, the only thing for me to do with the CVP is making sure it is reading on the monitor, so I don't have anything to do with inserting it."* (Participant KC).

Participant DJ revealed that the anaesthetist and anaesthetic nurse are usually responsible for inserting the CVP.

> *"No, the anaesthetist and the anaesthetic nurse usually work together when inserting a CVP, I have no direct contact with this procedure."* (Participant DJ).

As such, the participants' participation in the procedure only comes after the anaesthetist has catheterised the patient. This is illuminated in the statements below.

> [Pause] *"Yes, not exactly like directly, but like we set up transducers, and then we connect up the cvp so that we can monitor it. But like this is only after the anaesthetist inserted it in an aseptic manner, then they cover it with a dressing, yah, then only do we connect it to the monitor."* (Participant EN).

Involvement in Catheterization

In terms of the participants' involvement in urinary catheterization, it was uncovered that none of them became involved in the procedure.

> *"No not at all."* (Participant DP).
>
> *"No."* (Participant KC).

Precautions to follow for Cardiothoracic Surgery: This theme explores the participants' knowledge of healthcare-associated hospital infections.

Setting up pump

Setting up of pump or, in other words, the heart-lung machine, is the only direct contact the participants make during the cardiothoracic surgery. Given the need to prevent and control the HAIs at all fronts, it was essential to know the process followed in setting up the pump. According to Participant DJ, it is vital that the connectors are not touched, and hands are washed before starting the setup. This may be a way to limit the contamination of the equipment.

> *"Like I mentioned before, I ensure that the caps on the reservoir are screwed on so that nothing is exposed, don't touch the connectors, oh and wash your hands before you start setting up. So, I Think that's about it."* (Participant DJ).

Another safety measure during setting up is the use of sterilized blades. This is reflected in the statement below.

> *"You know, the problem is that we don't like to have a dedicated room where we can set up, so it's a bit difficult because you know our tubing packs are open while the patient and nurses and stuff are in the theatre. So, the only thing we can do is like while setting up, one of the main things we were taught to do is to make sure that we use a sterile blade if we are cutting tubing, because you know sometimes the tubing is very long."* (Participant DP).

Participant DP also stressed the importance of tightly securing the caps to eliminate contamination.

> *"And also, we make sure that those small caps on the reservoir is screwed on tightly because usually, those can fall off and not only cause air bubbles to get into the circuit but also cause contamination of the blood. I mean that's about it we can do."* (Participant DP).

Handling of Bio-waste

This section of the study explored how participants handle bio-waste.

> *"The hand wash items are always available, the gloves and aprons, but the bins for hazardous waste is problematic because there isn't a proper one in place."* (Participant DJ).

> *"Yes, Hand wash and cleaning agents are always found in abundance, but not bins for biohazardous wastes, we are always begging for things to put our bypass circuit in."* (Participant KC).

> *"There's always hand wash, we don't have like dedicated bins for disposing of our circuits."* (Participant KP2).

Participant DP shared a similar concern as above on the lack of appropriate waste handling.

> *"Yes, there is hand soaps, disinfectants and stuff like that but, I have to complain about the disposal of waste methods. There's like no proper bins, there are red packets but I mean you can't cram the whole circuit in there without tearing the packet and stuff, you know/"* (Participant DP).

The use of the personal protective gear

It is generally assumed in the literature that hand and/or environmental hygiene and/or single-room isolation in combination with personal protective equipment could reduce HAIs. Au *et al*. (2021) reveal that the practice of hand hygiene, the use of gloves, and respiratory protection are the important elements of infection control and practices. From the interview, it was uncovered that participants' use personal protective gear such as apron, gloves, googles, and masks to protect themselves from HAIs.

> *"Honestly, before COVID started, I have never worn an apron or gown, even gloves or visors all the time, I used to wear my mask, but not all the other stuff, but honestly, since COVID, I have been wearing full-on PPE all the time when in theatre. Ehh, although I must say, we were not supplied all the relevant PPE, we bought our own. We only used to get masks and aprons as well as gloves. Oh yea, we also wear shoe covers and cover our hair all the time. Ya."* (Participant EN).

> *"Ehh, so the protective gear that I wear is just a mask and gloves, I sometimes wear a visor, but only if we are doing any PUI patients or CRE patients. But when COVID started, then I've been wearing my visor more frequently because some patients were coming in negative and then testing positive like a few days later. Ehh, with regard to the provisions of PPE, yes we do have access to gowns and gloves and masks, but when COVID hit, then we had to purchase our own N95 masks, but it seems to be settling down again, and the hospitals are becoming fully stocked with PPE again."* (Participant DJ).

Equally relevant, it was uncovered that COVID-19 had improved on the practices of the use of personal protective gear. This is reflected in the statements below.

> [Stammers] "*Actually, I never used to before COVID, I think I only used to use a mask, gloves and maybe an apron if the patient was HIV positive or something, but other than that nothing really, However, when COVID started then I started to wear my goggles, an N95 mask, or KN95, apron, gown, and gloves. I think that's about it."* (Participant SS).

Discussion

While the World Health Organization and the Centres for Disease Control and Prevention have recently issued guidelines for the prevention of surgical site infections (WHO, 2015), it is evident that knowledge, attitude, and awareness of infection prevention and control measures are frequently insufficient, and there is a significant gap between the best evidence and clinical practice with regard to the prevention of HAIs. For instance, Sartelli (2021) states that healthcare workers can prevent the spread of microorganisms, including those that are resistant to antibiotics and are becoming difficult, if not impossible, to treat by cleaning one's hands (Sartelli, 2021). Despite the acknowledgement of the importance of hand washing, some participants regrettably noted to fall short when it comes to scrubbing techniques. The World Health Organization (2015) on hand hygiene approach defines the five key moments when healthcare workers should perform hand hygiene to include before touching a patient, before clean/aseptic procedures, after body fluid exposure/risk, after touching a patient, and after touching patient surroundings. Furthermore, Sartelli (2021) asserts that appropriate hygiene of surfaces and equipment which patients and healthcare workers touch is essential in reducing patients' exposure to HAI.

This study further discovered the importance of using disposable nonsterile gloves. According to Moran and Heuertz (2017), the use of disposable nonsterile gloves in the hospital is second only to proper hand washing. Moran and Heuertz (2017) argue that since handwashing is not practised consistently, the use of gloves is warranted to reduce contamination during patients' contact. However, it is essential that the correct disposal of gloves is required, as Moran and Heuertz (2017) suggest that hand gloves have the potential to harbour nosocomial pathogens. Therefore, it is of vital importance to state here that the use of gloves is not a substitute for hand hygiene, as improper use of gloves could increase the risk of HAIs transmission (Au *et al.*, 2021). According to the report by the WHO (2017), hospital-acquired infection (HAI) is the most frequent adverse event in healthcare-delivery systems. From a public health perspective, HAI is a major global public health concern that causes high mortality and rehospitalization rates and is associated with considerable preventable costs (Collins, 2008). This study examined the participants' knowledge of infection prevention and control. While many participants had a strong awareness of infection control, they were unfamiliar with hospital standards regarding infection control activities. This suggests that the hospital needs to do more to acquit all policies pertaining to the healthcare facilities to the healthcare workers in order to effectively enhance patient care in guiding the providers. Moreover, 80% of the participants indicated never to have been previously formally trained in infection control. This is worrisome and requires urgent attention by the hospital management, given the public health importance of adequate infection control practices.

However, in spite of this, participants asserted that they complied with infection control management practises and ascribed their adherence to the length of time they had been in practice without a report of contamination from their job. The study further discovered that Carbapenem-Resistant Enterobacteriaceae (CRE), hepatitis, and viruses, including COVID-19, were the most frequent HAIs in cardiothoracic surgery. It was also discovered that people with impaired immune systems, comorbidities, diabetes, and hypertension are the most susceptible to HAIs. This is corroborated by Friedrich (2019), who states that multidrug-resistant Escherichia coli and Carbapenem-resistant Enterobacteriaceae are becoming a problem of public health importance (Friedrich, 2019). Awareness of healthcare-associated hospital infections was investigated. Touching the spike during instrument setup was discovered to be a source of cross-contamination. Another significant concern for CPs is that the syringes they get may be a source of infection. In addition, it was suggested that nurses and physicians could be a source of infection. In researching the literature, it was discovered that this may occur if they wore surgical attire (Health, 2019) or handled gloves improperly. Additionally, cardiovascular perfusionists appear to have extensive knowledge of airborne infections. However, participant interviews suggest that their behaviours in the operating room did not result in a life-threatening post-operative infection.

Biowaste can be viewed as any medical waste generated from various healthcare-delivery processes such as dialysis, surgery, chemotherapy, autopsy, biopsy, and injections (Sapkota *et al*., 2014). The concern that is of most importance to healthcare workers is that medical waste could contain harmful microorganisms with the potential to infect patients, healthcare providers and the general public (Sapkota *et al*., 2014). As such, it becomes

extremely critical to explore how the participants managed and handled biowaste to limit the risks of HAIs. According to the statement attributed to participant DJ, disposing of hazardous waste appears to be poor. This is concerning, given the fact that hazardous waste could potentially transmit infectious diseases (Okada and Ito, 2000). The study further explored the handling of biowaste and revealed that inadequate provisions are in place for the disposal of blood-soiled goods following bypass surgery. This subject revealed that participants were concerned about the absence of consideration for waste management in bypass treatments. Subsequently, there was concern regarding the prohibition of wearing smartwatches, long sleeves, and inner thermal wear. From previous literature exposed in this study, it is evident that there is a lack of knowledge with regard to the matters pertaining to theatre etiquette, along with health worker discrimination, which requires further investigation and research. Mahommed and De Beer (2018) explain that poor infection control compliance correlates with the lack of infection control training at the tertiary institutions. A similar pattern is reflected in the excerpts taken from the interviews.

This study is significant, since it examined the knowledge and compliance with infection prevention and control of Cardiovascular Perfusionists, which had never before been examined. We have gained new knowledge and insights into the practices of CPs and their understanding of infection prevention and control, as well as the gaps in their knowledge. We now understand their barriers when it comes to compliance, particularly the mindset that they are singled out or related to infection transmission. It is also clear that there is a lack in the facilitation of disposal of medical waste, which contributes to the understanding that Cardiovascular Perfusionists are therefore knowledgeable in matters of cross-contamination and airborne pathogens although not scientifically explained during their interviews. Another key element or weakness to explore is that infection prevention and control as a subject has not been implemented at tertiary level in the Department of Health Sciences at the Durban University of Technology from where all the CPs received their training and education. The study has highlighted that practitioners are, therefore, reliant on the knowledge of their predecessors and that of the nursing staff within the private facilities where they practise. We also cannot ignore that, although the CPs did not receive any formal training or education in infection and prevention control practices, they did, in fact, comply with the procedures, and most do follow the directives of the theatre regulations that are set out. The CPs had also identified that the nursing staff themselves were not being compliant in their approach to infection prevention and control, and are therefore conflicted in their thoughts of infection prevention and control.

Conclusion

This study demonstrated that most of the participants had good overall knowledge and understanding regarding infection control practices, although many felt that there exists an inequitable application of infection control policies due to professional biases. Cardiovascular Perfusionists also exhibited compliance with infection control policies, regardless of how unreasonable they may have seemed. Since nosocomial infections contribute significantly to the morbidity and mortality of hospitalised patients, it is therefore essential that all healthcare staff should be exposed to infection prevention and control training. Further research is suggested to identify, following the infection prevention and control training, if healthcare workers have a positive attitude to the compliance thereof. It is also recommended that an improved nosocomial infection control measures for example, all the hospital wards' entrances/doors must have a wall-installed hand sanitizer, which will remind healthcare staffs of the need to wash their hands before and after patients' care delivery.

References

Akanbi, A. A., Kareem, T., Adedoja, A., Nyamngee, A., Muhammed, M. B., Abdulkareem, K. and Atata, R. F. 2017. Bacterial Contamination of Medical Doctors' White Coats as Contributing Factor to Hospital Acquired Infections. *International Journal of Biomedical and Chemical Sciences,* 11(1): 185-194.

Akpa Inyang, F. F. 2017. Southern African Traditional Values and Belief Systems and the Informed Consent Process in Biomedical Research: Perceptions of the San's Code of Ethics. Doctoral Dissertation, University of KwaZulu Natal.

Akpa-Inyang, F. and Chima, S. C. 2021. South African Traditional Values and Beliefs Regarding Informed Consent and Limitations of the Principle of Respect for Autonomy in African Communities: A Cross-Cultural Qualitative Study. *BioMed Central Medical Ethics,* 22: 1-17.

Au, J. L., Suen, P. K. and Lam, S. C. 2021. Observational Study of Compliance with Infection Control Practices among Healthcare Workers in Subsidized and Private Residential Care Homes. *BioMed Central Infectious Disease,* 21(75): 1-11.

Bryman, A. 2012. *Social Research Method.* Oxford: Oxford University Press.

Collins A. S. 2008. Preventing Health Care–Associated Infections. In: Hughes, R. G. ed. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville (MD): Agency for Healthcare Research and Quality (US), 3-13.

Dramowski, A. 2020. Infection Prevention and Control. Available: https://bettercare.co.za/learning-programmes/infection-prevention-and-control/ (Accessed 12 January 2021).

Friedrich, A. W. 2019. Control of Hospital Acquired Infections and Antimicrobial Resistance in Europe: The Way to Go. *Wiener Medizinische Wochenschrift*, 169: 25-30.

Gammon, J., Morgan-Samuel, H. and Gould, D. 2008. A Review of the Evidence for Suboptimal Compliance of Healthcare Practitioners to Standard/Universal 76. *Journal of Clinical Nursing,* 17(2): 157-167.

Health, C. O. 2019. Guidelines for Surgical Attire. Available: https://www.asahq.org/standards-and-guidelines/guidelines-for-surgical-attire (Accessed 22 September 2021).

Kumar, R. 2011. *Research Methodology a Step-by-Step Guide for Beginners.* New Delhi: Sage.

Lopez, V. and Whitehead, D. 2013. Sampling Data and Data Collection in Qualitative Research. In: Schneider, Z., Whitehead, D., Lo-Biondo-Wood, G. and Haber, J. Ed. *Nursing and Midwifery Research: Methods and Appraisal for Evidence based Practice*. Australia: Elsevier, 123-140.

Mahommed, S. and De Beer, J. 2018. Exploring the Challenges with Infection Control Practices among Managers in Intensive Care Units in South Africa. *South African Journal of Critical Care,* 34(1): 1-14.

Moran, V. and Heuertz, R. 2017. Cross Contamination: Are Hospital Gloves Reservoirs for Nosocomial Infections? *Hospital Topics*, 95(3): 57-62.

National Department of Health. 2020. National Infection Control Strategic Framework. Available: https://www.nicd.ac.za/wp-content/uploads/2020/04/National-Infection-Prevention-and-Control-Strategic-Framework-March-2020-1.pdf (Accessed 20 October 2021).

Okada, J. and Ito, K. 2000. Present Status of Nosocomial Infections and Biohazard of Medical Waste. *Japanese Journal of Clinical Pathology,* 112: 6-14.

Parahoo, K. 2014. *Nursing Research; Principles, Process and Issues.* England: Palgrave MacMillan.

Patel, B., Engelbrecht, H., McDonald, H., Morris, V. and Smythe, W. 2016. A Multifaceted Hospital-Wide Intervention Increases Hand Hygiene Compliance. *South African Medical Journal,* 106(4): 335-341.

Roy, M. C. 2018. Guide to Infection Control in the Hospital: The Operating Room. Available: https://isid.org/wp-content/uploads/2018/02/ISID_InfectionGuide_Chapter22.pdf (Accessed 12 January 2021).

Ryan, G. W. and Bernard, H. R. 1998. Techniques to Identify Themes in Qualitative Data. Available: http://www.analytictech.com/mb870/readings/ryan-bernard_techniques_to_identify_themes_in.htm (Accessed 06 October 2021).

Sapkota, B., Gupta, G. K. and Mainali, D. 2014. Impact of Intervention on Healthcare Waste Management Practices in a Tertiary Care Governmental Hospital of Nepal. *BioMed Central Public Health,* 14(1): 1-8.

Sartelli, M. 2021. COVID-19 Impact on the Understanding of Infection Prevention and Control Measures. Bangladesh *Journal of Medical Science,* 20(5): 171-174.

Sydnor, E. R. M. and Perl, T. M. 2020. Hospital Epidemiology and Infection Control in Acute-care Setting. Available: https://journals.asm.org/doi/10.1128/CMR.00027-10 (Accessed 24 January 2021).

WHO. 2015. Infection Prevention and Control in Healthcare. Available: http://www.who.int/csr/bioriskreduction/infection_control/en/. (Accessed 20 June 2020).

WHO. 2018. Global Guidelines for the Prevention of Surgical Site Infections. Available: https://apps.who.int/iris/bitstream/handle/10665/277399/9789241550475-eng.pdf?sequence=1andisAllowed=y (Accessed 10 January 2021).

Wong, L. P. 2008. Data Analysis in Qualitative Research: A Brief Guide to NVivo. *The Official Journal of Academy of Family Physicians of Malaysia,* 3(1): 14-20.