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PREVALENCE AND ASSOCIATED MANAGEMENT APPROACHES OF NEEDLE-STICK INJURIES AMONGST PUBLIC SECTOR DENTAL PRACTITIONERS, SOUTH AFRICA

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Abstract: Needle Stick Injuries (NSI) exposes dental practitioners to infectious disease-causing blood-borne pathogens, which can adversely affect employee performance, health, wellness, morale, productivity, and service delivery. Public sector dental practitioners provide primary dental services to low-income individuals and communities and are constantly at risk of experiencing occupational injuries. A quantitative, cross-sectional prevalence study was conducted in City of Johannesburg metro, South Africa. The study received university ethics approval (REC-873-2021) and site approval (GP_202101_023). Purposive study sample size was pre-determined and consisted of 36 public sector dental practitioners from the 26 public dental clinics in the metro. Data was collected using a piloted self-administered questionnaire. The data management and analyses were performed using SPSS software. Descriptive analyses and bivariate (chi-square) tests were performed to assess the association between various socio-demographic, behavioural, clinical, and managerial factors and NSI status. The prevalence of NSIs was 47.2% (n=17). Most NSIs occurred whilst changing local anaesthetic ampules (35%), and during needle recapping (29%). Only 38.9% of participants reported to have occupational injury guidelines in their clinics, and only 41.7% reported to have Post-Exposure Prophylaxis (PEP) guidelines (which were found to be outdated). Only one variable, response to injury, was a significant predictor of NSI status ($p<0.05$). No significant associations were observed between other socio-demographic, behavioural, clinical, and managerial factors and NSI status. The study thus draws attention to high-risk activities and behaviours, as well as shortcomings in the workplace including the common practice of needle-recapping, a low rate of needle incineration, a low injury reporting rate, and inadequate knowledge regarding PEP. Recommendations for control measures to prevent and manage NSIs were summarised using the Hierarchy of Controls.

Keywords: needle-stick injuries, healthcare workers, dental practitioners, occupational injuries

1. Introduction

Needle-stick injuries remain an occupational hazard affecting millions of healthcare workers and continues to be reported despite existing universal guidelines (King and Strony, 2023). A needle stick injury (NSI) is an accidental skin-penetrating stab wound from a hollow-bore needle that is contaminated with another person's blood or body fluid (Pavithran *et al.*, 2015). The injury can be superficial or deep. According to Moyo *et al.* (2022) and the World Health Organisation (WHO, 2019), NSIs are the primary source of occupational exposure to blood and the primary cause of blood-borne infections among HCWs globally accounting for 2 out of 35 million healthcare workers (HCWs), including dental practitioners experiencing percutaneous exposures to infectious diseases each year.

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Such exposure takes place at primary healthcare clinics which offer the first line of access to basic healthcare services, which is free for all in South Africa (SA). Since 1994, access to primary healthcare facilities in SA has improved, however, the quality of healthcare at this level has declined (Jobson, 2015). Although the public sector makes it possible for low-income individuals to access free primary healthcare that would otherwise be inaccessible to them, the public sector is riddled with shortcomings such as poor infrastructure, lack of resources, poor quality of care, long waiting times, rushed appointments and poor disease control and prevention practices (Young, 2016).

It is in these setting where dental practitioners perform procedures which routinely require the use of needles and sharp instruments, and are often directly exposed to blood, saliva, and the bacterial flora of the oral cavity (Bromberg & Brizuela, 2023). These are all contributing factors to the hazardous nature of the dental setting for blood-borne infections. The prevention of NSIs is essential and challenging, however, NSIs can be managed by practicing current and universally accepted standard precautionary measures. In the context of this study, dental practitioners refer to dentists and dental therapists. Modern dentistry has been cited as the least hazardous of the all the healthcare therapist occupations, however, many risks still provide challenges to the occupation exposing dental practitioners to various occupational hazards, including interactions with anxious and uncooperative patients and financial pressures.

Dental practitioners in the public oral health sector are faced with such shortcomings, with most clinicians treating more than 20 patients per day. There is no ideal dentist-to-patient ratio as there are many factors to consider, however, the recommended number of patients per dentist is between eight and twelve patients (Department of Health, 2024). These patients are to be individually consulted with and examined, and treatment can consist of extractions, fillings, cleanings and the treatment of pain and sepsis. Many of these procedures require local anaesthetic, administered via intra-oral injections using needles. Contaminated needles may transmit viral infections such acquired immunodeficiency syndrome (AIDS) and Hepatitis B, and bacterial infections such as Syphilis and Tuberculosis (TB). These infections pose as occupational hazards and a serious risk to health and are potentially life-threatening. Occupational hazards are crucial determinants of employee performance, morale, and productivity. With 80% of the population being dependent on public facilities for their health needs, patient experience, patient satisfaction and service delivery (on a large scale) stand to be affected. Whilst occupational injuries are impossible to completely eradicate, it is important to understand how these injuries occur, the impact they can have on dental practitioners in the public sector, and how they can be mitigated and effectively managed.

NSIs remains an ongoing problem for dental professionals due to high-risk activities. The health, wellness, and safety of dental practitioners in the public health sector is critical to achieving dental health service delivery goals. These occupational hazards serve as a negative catalyst for achieving such goals, and therefore it is important to identify and mitigate. This paper will focus on occupational needle-stick injuries (NSIs) in public dental clinics, specifically its prevalence, and whether existing management practices are aligned with current guidelines and protocols. This is important because such occupational injuries may impact on employee health and wellness, productivity, and service delivery

(Ofoegbu, Olawepo & Ibojo, 2013). Thus, allowing the study to add to existing body of literature on NSI prevalence and management amongst public sector dental practitioners.

2. Materials and Methods

2.1 Study design and study setting

The study followed a descriptive, cross-sectional prevalence design, by means of a survey to determine the prevalence of NSIs and the availability of preventative measures at the various dental public sector clinics. Descriptive cross-sectional studies characterise the prevalence of a health outcome in a specified population where prevalence can be assessed at one point in time (point prevalence) or over a defined period (period prevalence), commonly used in public health studies (Alexander *et al*., 2015).

The study setting was City of Johannesburg Metropolitan Municipality which manages the local governance of Johannesburg, Gauteng, South Africa. Johannesburg is divided, with the poor concentrated in the southern suburbs, and in the peripheries of the north. The City of Johannesburg Metropolitan Municipality is divided into seven regions, namely, region A to G. The towns that comprise these regions include, A) Diepsloot, Midrand and Ivory Park, B) Northcliff, parts of Sandton and Rosebank, C) Roodepoort, D) Soweto, Doornkop, Diepkloof and Meadowlands, E) Alexandra, parts of Sandton and Rosebank, F) Inner City and Johannesburg South, and G) Ennerdale, Orange Farm, Lenasia, Eldorado Park and Protea (City of Johannesburg, 2025). Each region is operationally responsible for the delivery of health care, housing, sports and recreation, libraries, social development, and other community-based services. There are 26 public dental clinics in the Johannesburg metro region, with a total of 38 dental practitioners using needles and syringes in their daily practice (32 dentists and 6 dental therapists). These clinics are generally located in impoverished areas, where service delivery is in high demand. These clinics are spread out among the seven regions of Johannesburg (regions A-E) and provide free primary oral health services to communities. Services include dental extractions, fillings, cleanings and the treatment of sepsis and abscess.

The public dental clinics in the Johannesburg metropolitan municipality are some of the busiest, and the most burdened. High patient loads, poor infrastructure, lack of resources, rushed appointments, levels of stress among clinicians, and poor disease control and prevention practices are all risk factors that could potentially cause NSIs. This made this setting ideal to investigate the prevalence of NSIs among public sector dental practitioners.

2.2 Study Population and Sampling Strategy

The target study population was pre-determined and limited to the public-sector dental practitioners in the Johannesburg region. The eligibility criteria specify the characteristics that participants in the study population possessed to be included in the study. These included being a Health Professions Council of South Africa-registered dentists and dental therapists occupying permanent positions in the Department of Health, Gauteng and working in public sector clinics in the Johannesburg metro region. These individuals share a common role, with the same job descriptions, and are more-or-less exposed to the same occupational risk factors. To investigate the prevalence of needle-stick injuries amongst public

sector dental practitioners in this region, it was necessary to study this specific group. Purposive study sample size was pre-determined and consisted of 36 public sector dental practitioners from the 26 public dental clinics in the metro.

2.3 Data Collection and Data Analysis

A self-administered questionnaire was designed to assess the prevalence of NSIs, to identify risk factors, and to assess knowledge and awareness of dental-HCWs. The questionnaire consisted of 40 closed-ended questions, which were distributed to clinics in sealed envelopes for completion by dental practitioners. The questionnaire was piloted with 5 participants (public sector dental professionals from the West Rand region), to improve and refine the data collection tool. The participants were provided with an information letter and a consent form to enable an informed decision for participation in the study. Most completed questionnaires were returned to the researcher in the same envelopes, and some were emailed in PDF format. The Statistical Package for the Social Sciences (SPSS, version 27) was used to capture, categorise, and code the quantitative data, as well as to run the necessary tests for analyses.

Descriptive statistics, such as frequencies, were used to summarise the data. Prevalence was measured by dividing the number of cases of NSIs, by the total sample population. The risk factor (independent) variables included years of practice, needle recapping practices, use of PPE, patient loads, availability of incinerators and sharps disposal containers. The outcome (dependent) variables were NSI status (prevalence), the nature of the injury, the cause of the injury and the response to being injured.

Since all the variables were categorical, non-parametric (chi square) tests were used to determine whether any associations existed between the independent and dependent variables (determined by *p*-values<0.05).

2.4 Ethical Considerations

Scientific and ethical approval was obtained from the Higher Degrees Committee of the University of Johannesburg - MPH HDC-01-76-2020, the Research Ethics Committee of the University of Johannesburg - REC-873-2021 and the Johannesburg District Health Research Committee - GP_202101_023. Participants were invited to participate, and informed consent was requested (and obtained) formally in writing. No participant was coerced or forced to partake in the study. Anonymity was protected by ensuring that a subject's identity cannot be linked with personal responses. Participants were not requested to include their names on the questionnaire, and all information collected was respected and kept confidential.

3. Results

A total of 37 questionnaires were distributed, 36 of which were collected, giving a response rate of 97.3%. All the questionnaires collected were useable, and there was minimal missing data. All the

participants responded to the questionnaire (36 responses, giving 100% response rate). Table 1 outlines the socio-demographic profile of the respondents in relation to gender, age and professional level.

Table 1: Participants socio-demographic profile of dental practitioners

Variables	n (%)
Gender	
Male	12 (33.3%)
Female	24 (66.7%)
Age Group	
20 – 29 years	3 (8.3%)
30 - 39 years	10 (27.7%)
40 - 49 years	12 (33.3%)
>50 years	11 (30.6%)
Profession level	
Dentist	31 (86.1%)
Dental Therapist	5 (13.9%)
Years of practice	
<10 years	10 (27.8%)
10 – 20 years	14 (38.9%)
>20 years	12 (33.3%)

Figure 1 illustrates the prevalence of NSIs among respondents. At least 17 of the participants reported to have experienced a needle-stick injury in the past 5 years, demonstrating a prevalence of 47.2%.

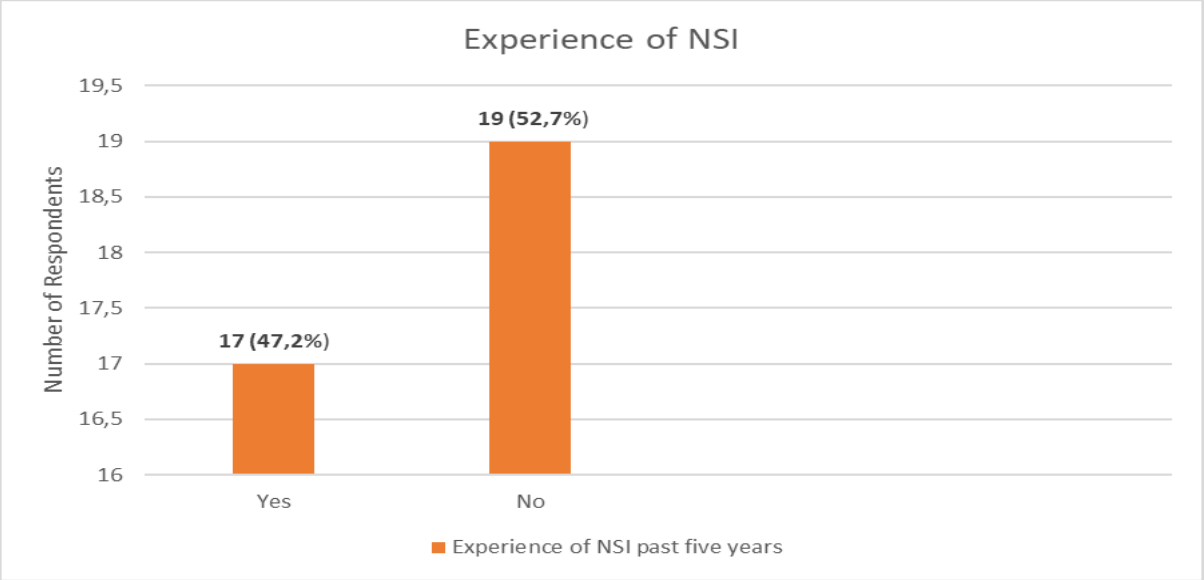

Figure 1: Prevalence of NSI in the past five years

Participants were asked to disclose the nature of their injuries. All the participants who had needle-stick injuries responded to the question (17 responses, at 100% response rate). Figure 2 illustrates the nature of the NSIs among respondents. Of the 17 participants who reported to have experienced a needle-stick injury in the past 5 years, 5 (29%) reported deep injuries, whilst 12 (71%) reported superficial injuries.

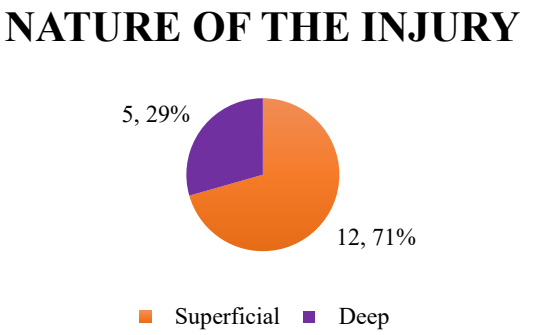

Figure 2: Nature of the needle-stick injuries experienced by respondents

Figure 3 illustrates the reported cause of the NSI occurrence among respondents. Of the participants who reported to have experienced a needle-stick injury, the majority, 6 (35%) reported to have been injured whilst changing the local anaesthetic ampule, followed closely by recapping used needles, 5 (29%). Only 1 (6%) injury occurred during the disposal of a used needle.

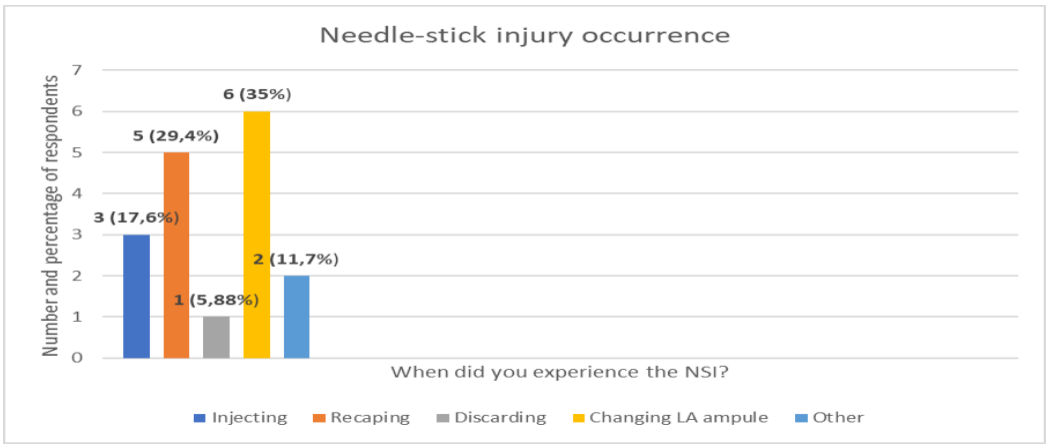

Figure 3: Needle-stick injury reported occurrence

Participants were asked to disclose their response to being injured. Figure 4 illustrates the response to injury among respondents. Upon being injured, most participants, 15 (88.2%) immediately washed the wound with soap and water, and fewer participants, 2 (11.8%) first reported the injury to a supervisor.

Figure 4: Participants response to needle-stick injury

Table 2 provides a summary of the outcome variables in the study and includes frequencies and percentages. The statistical significance of relationships among the outcome variables was determined using non-parametric methods. The level of significance was set (*p*-value) at 0.05.

Table 2: Summary of study outcome variables

Variables		**Total**	***p*-value**
	n	%	
NSI prevalence			0.868
Yes	17	47.2%	
No	19	52.8%	
Nature of injury			0.143
Superficial	12	70.6%	
Deep	5	29.4%	
Occurrence of injury			0.281
Injecting	3	17.6%	

Recapping	5	29.4%	
Discarding	1	5.9%	
Changing the LA ampule	6	35.3%	
Other	2	11.8%	
Response to injury			**0.002**
Immediately Reported to Supervisor	2	11.8%	
Washed Wound with Soap and Water	15	88.2%	

As indicated by the results, for NSI prevalence, nature of the injury and how the injury occurred, the $p>0.05$, which indicates that there is insufficient evidence to conclude that the observed distribution is different to the expected distribution. This indicates that no relationship exists between each of these categorical variables. However, the response to injury, $p<0.05$), indicates that there is sufficient evidence to conclude that the observed distribution is different to the expected distribution, and that a relationship exists between the categorical variables.

Table 3 outlines the respondent reporting of the availability of occupational injury and post-exposure prophylaxis (PEP) guidelines.

Table 3: Availability of occupational injury and PEP guidelines

Characteristics	**Total**		**Needle-stick injury status**				Chi Square p-Value
			Yes		No		
	n	%	n	%	n	%	
Total	36	100%					
Updated occupational guidelines							0.066
Yes	14	39.9%	6	42.9%	8	57.1%	
No	15	41.7%	5	33.3%	10	66.7%	
I don't know	7	19.4%	6	85.7%	1	14.3%	
Updated Post-Exposure Prophylaxis Guidelines							0.280
Yes	15	41.7%	6	40.0%	9	60.0%	
No	16	44.4%	7	43.8%	9	56.3%	
I don't know	5	13.9%	4	80.0%	1	20.0%	

4. Discussion

This study's NSI prevalence of 47.2% is higher than the prevalence in other studies, such as that of AlDakhil *et al.* (2019) and Moodley and Naidoo (2015), which determined a prevalence of 29.8% and

24%, respectively. The prevalence found in this study is more consistent with findings from a study conducted in Pakistan, which determined a prevalence of between 30% and 73% (Pervais *et al*., 2018). Similarly, Garus-Pakowska *et al.* (2018) also found that most injuries were superficial. Regarding both superficial and deep injuries, our study's findings are higher than that of Garus-Pakowska *et al* (2018), who conducted a study in urban and rural areas of Poland, finding 63% of dentists in the rural reported superficial injuries and 58.8% of dentists in the urban reported superficial injuries. From the rural sample, 15.1% of dentists reported deep injuries and from the urban sample, 17.6% of dentists reported deep injuries. This was similar to a study conducted by Liyew *et al* (2020), where superficial and deep injuries were 33% and 18.6%, respectively.

Like this study, Moodley and Naidoo (2015) reported that 33.3% of the injuries owed to accidents with the dental syringe and needles with most injuries occurring when the needle was being withdrawn from the patient's mouth, while recapping the needle and when removing the used needle from the syringe. There are however contrasting findings regarding recapping and NSIs. Like this study, Pervais *et al.* (2018) reported that 33% of NSIs occurred during needle recapping. Jan *et al.* (2014) found that 16% of NSIs resulted from needle recapping, and Malik *et al.* (2014) reported that 88% of NSIs occurred during recapping.

In addition, 82.4% of this study's NSIs occurred during the dental procedure, and 5.9% occurred after. This is inconsistent with Moodley and Naidoo (2015), who reported that 66.7% occurred during, and 25% occurred after the dental procedures. This study's finding is significantly higher than a study conducted by Liyew *et al.* (2020), which revealed that 51% of exposed participants wash with water after exposure. A study conducted in Zagazig University, Egypt, reported that 100% of exposed participants used antiseptic after exposure, and 50% let blood flow (Liyew *et al.,* 2020). Maurya et al. (2017) reported that 91.67% of injured participants immediately washed the wound with soap and water, and 55.2% reported NSIs.

Regarding reporting, 76.5% of participants reported being injured, whilst 23.5% did not. This finding is significantly higher than that of other studies such as that by Sharma et al (2018) reported that 56.52% of participants did not report NSIs. Only one other study by Moodley and Naidoo (2015) reported a high reporting rate of 81%. The high incidence of reporting in this study could be owing to knowledge and awareness regarding blood-borne pathogens and associated health conditions associated with NSIs. The low incidence of reporting indicates that participants in our study may have a negative attitude toward reporting NSIs to relevant authorities. Due to under-reporting of NSIs, the actual rate of NSIs is likely to be underestimated. Although blood-borne infectious diseases can have serious and dangerous health implications, however, the low risk of transmission through NSIs (0.3% HIV, 3% HBV), could

also make dental practitioners complacent as most exposures may never develop into infections caused by HBV, HIV, and HCV (Anbari, 2020). Other possible reasons for not reporting include if the source patient is HIV negative or being unaware that injuries must be reported. This may be probably why reporting is low in other studies.

The available guidelines in dental clinics across the region titled "Post Exposure Prophylaxis FOR DENTISTS" were not dated but placed on the notice boards of most clinics. The "Post Exposure Prophylaxis FOR DENTISTS" guidelines recommend the following actions in the immediate management of the exposed area: 1) wash the exposed site with water, 2) wash the skin with soap and water, and rinse, 3) do not panic, 4) do not put the pricked finger in the mouth, 5) do not squeeze the wound to encourage bleeding, 6) do not scrub the wound, 7) do not use any antiseptics/detergents on the wound. There are no further instructions regarding the management of NSIs, besides for guidelines regarding PEP for HIV.

According to King and Strony (2023), emergency care must be given to HCWs with NSIs with the site of the injury thoroughly rinsed with saline or water to clean the wound. King and Strony (2023) further highlights that all NSIs should be followed with a medical history and a physical examination of the injured practitioner and furthermore to complete blood work, electrolytes, and baseline liver function studies. Additionally, once the initial workup is completed, an infectious disease expert should be consulted to determine the need for PEP as outlined by the CDC in a 3-Step Risk Assessment in the evaluation of HIV which are 1) to determine the exposure code, 2) to determine the HIV status of the source patient, and 3) to decide on a treatment plan (King and Strony, 2023). Many dental practitioners not having updated guidelines on occupational injury and PEP is thus a matter of public health concern as highlighted in this study.

5. Conclusion

NSIs are a serious occupational health hazard in dental settings, and places dental practitioners at risk of transmission of blood-borne pathogens. Research into the prevalence and management of NSIs amongst dental practitioners in South Africa is lacking, therefore a study to focus into the matter was of importance to bridge the gap in existing knowledge. The prevalence of NSIs among dental practitioners in this study was high, which demonstrates that percutaneous injuries are an ongoing challenge in dental settings. This signifies an urgent need to address certain clinical behaviours, to provide public sector clinics and dental practitioners with adequate resources and updated guidelines, and to implement ongoing training and educational programmes for all dental-HCWs to improve health literacy. Acknowledging the study limitation regarding the focus on dental professionals practicing in

the Johannesburg metro region and that the sample size was small, the results still draw attention to high-risk activities and behaviours, as well as shortcomings in the workplace, enabling recommendations to reduce the incidence of NSIs.

Recommended control measures to prevent and manage NSIs are summarised using the Hierarchy of Controls which are presented from most effective to least effective. The most effective control measure being the complete elimination of the hazard. This includes the elimination of any unnecessary intra-oral injections and/or sharps-dependent procedures. Following are administrative and workplace controls, which include the implementation of work-place policies that limit hazard risk (clearly displayed on notice boards in clinical areas), and the provision and implementation of universal precautions regarding blood-borne pathogen exposure. Finally, the least effective control measure in place should be the availability and proper use of Personal Protective Equipment (PPE), by dental practitioners which includes double gloves as an added layer of protection on the hands. The results of this study may encourage public healthcare sector industry in developing solutions for vulnerable and at-risk dental professionals (and possibly other healthcare workers).

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Declaration of Interest Statement

The authors declare that they have no conflict of interests.

Authors Disclosure

This article includes content that overlaps with research originally conducted as part of Dirushka Naidoo's master's dissertation titled 'Prevalence and Associated Management Approaches of Needle-stick Injuries amongst Public Sector Dental Practitioners, in Johannesburg, South Africa', submitted to the Faculty of Health Sciences /Department of Environmental Health, University of Johannesburg in 2022. The dissertation was supervised by Charlotte Mokoatle. Portions of the data, analysis, and/or discussion have been revised, updated, and adapted for conference publication. The original thesis is publicly available at: https://ujcontent.uj.ac.za/esploro/outputs/graduate/Prevalence-and-associated-management-approaches-of/9913222007691. The author affirms that this submission complies with ethical standards for secondary publication, and appropriate acknowledgement has been made of the original work.

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