

EVALUATION OF AN OCCUPATIONAL HEALTH AND SAFETY PROGRAM FOR CLINICAL DENTAL STAFF IN SRI LANKA

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ABSTRACT

OBJECTIVE:

Clinical Dental Staff (CDS) are vulnerable to Occupational Health and Safety (OHS) risks, particularly in resource-constrained Low and Middle-Income Countries (LMICs). There is limited contextually relevant research available to guide the stakeholders in LMICs to manage OHS risks. To strengthen the evidence base, a co-designed, multi-component OHS program for CDS was piloted at the Institute of Oral Health (IOH) in Sri Lanka.

DESIGN:

Mixed-method, pre-post study was conducted in three phases between June 2020 and July 2021. Phase I comprised a baseline assessment to identify OHS gaps, using a questionnaire, focus groups, interviews and observational checklists, involving Dental Surgeons (n=46), Nursing Officers (n=16) and Health Care Assistants (n=78). Phase II involved the development and implementation of targeted interventions, which were developed with the consensus of project participants. Phase III evaluated post-implementation impact after three months.

SETTING:

Institute of Oral Health (IOH), Sri Lanka

MAIN OUTCOME MEASURES:

Knowledge, attitudes, practices and satisfaction of CDS and occurrence of OHS events and complaints.

RESULTS:

Initial assessment revealed several challenges, including a lack of OHS-related staff awareness and training, inadequate reporting mechanisms and insufficient institutional guidelines. The interventions implemented included: OHS guideline creation, OHS training programs, knowledge sharing workshops, the establishment of an OHS management focal point, introduction of reporting mechanisms, welfare facility improvements, staff Hepatitis B vaccination and psychosocial support programs. The Phase III findings demonstrated significant improvements in staff knowledge, attitudes, practices and satisfaction with selected OHS measures. However, CDS satisfaction with welfare facilities and psychosocial support did not significantly improve.

CONCLUSIONS:

This study revealed that focused and co-designed OHS interventions effectively enhance the knowledge, attitudes, practices and satisfaction of CDS. CDS reported post-implementation reduction in OHS incidents and complaints. The study highlighted the importance of stakeholder engagement and the use of co-designed multiple interventions in improving OHS in resource-constrained settings.

KEYWORDS

occupational health, occupational safety, hospital dental staff, sri lanka, mixed-methods, pre-post implementation study

INTRODUCTION

Occupational Health and Safety (OHS) is the science of anticipating, recognising, evaluating and controlling workplace hazards that could impair health and well-being [1]. Occupational threats include long-term and short-term risks that can lead to chronic and acute health outcomes [2]. Chronic conditions may cause permanent physical impairments [3], while acute health outcomes result in immediate injury, infection or toxic exposure, leading to productivity losses and medical costs [4, 5].

Globally, workplace accidents and illnesses affect employee health, with over 340 million incidents reported annually [6]. Despite prevention measures, approximately 4% of the world's annual gross domestic product is lost due to OHS risks [6]. In the United States, employers spend USD 170 billion annually on occupational injuries, illnesses and managing health outcomes [7]. These incidents contribute to staff turnover, absenteeism, migration and early retirements [8]. A systematic review by Robson et al. (2007) reported that only 13 studies assessed OHS management system effectiveness. Despite methodological limitations, all studies reported positive outcomes from OHS interventions.

Poor OHS reporting and weak surveillance hinder hazard identification, management, and risk in the healthcare industry [9]. Underreporting remains a major barrier to reducing OHS risks [10]. A Canadian study found that developing databases, adapting risk assessments and implementing interventions improved OHS outcomes and were cost beneficial. Evidence indicates that negative OHS outcomes are mostly preventable through maintenance systems, timely reporting and regular monitoring [11]. This is particularly true in Low- and Middle-Income Countries (LMICs), where OHS is often neglected in healthcare workforce training and organisational practice [12, 13].

OHS RISKS ASSOCIATED WITH CLINICAL DENTAL STAFF

Clinical Dental Staff (CDS) face different occupational risks, including physical (radiation, pressure systems), chemical (mercury, anaesthetic gases, latex), biological, psychological, ergonomic and mechanical risks [14, 15]. Needle stick injuries are frequently reported and stress is a significant hazard, with dentistry perceived as highly stressful [14]. Musculoskeletal issues, especially backache are common in dentistry.

SRI LANKAN HEALTHCARE CONTEXT

Sri Lanka faces challenges in OHS provision, such as no national standardised OHS system, leading to inconsistent practices [16], inadequate screening, insufficient staffing and lack of surveillance systems [17]. Poor reporting mechanisms likely underestimate OHS incidents. Most CDS do not attend OHS awareness sessions despite being exposed to hazards [18, 19], further increasing their risk of injury.

Adverse OHS outcomes among dental staff are high in LMICs, including Sri Lanka due to limited preventative measures [20]. Although improvements have been recommended, research remains limited [21]. This project aimed to implement and evaluate integrated OHS measures for CDS in the Institute of Oral Health (IOH), Sri Lanka, a premier, specialised dental hospital.

METHODS

This pre-post pilot study was conducted in three phases (June 2020 to July 2021). Phase I involved an initial baseline assessment of OHS measures using a questionnaire, focus groups, interviews (semi-structured) and an observational checklist. Phase II developed and implemented interventions targeting OHS gaps identified in Phase I. Phase III, conducted three months after the conclusion of Phase II, re-administered the Phase I tools to evaluate outcomes. The study setting was the IOH, as it is a leading dental hospital in Sri Lanka serving Colombo and the nearby regions.

Ethical approval was obtained from the Ethics Review Committee of the Post Graduate Institute of Medicine, Sri Lanka (ERC/PGIM/2020/136). Administrative permission was granted by the Ministry of Health and the unit heads of the IOH.

PHASE I – BASELINE ASSESSMENT

Baseline OHS processes were assessed by including all staff categories, through a questionnaire, focus groups, interviews and an observational checklist. The study instruments were developed using international and domestic literature [11, 19, 22, 23], reviewed by OHS experts, validated for face and content and piloted at a separate hospital before revision [24]. Focus group discussions with Dental Surgeons (DSs), Nursing Officers (NOs) and Health Care Assistants (HCAs) explored experiences and perceptions of OHS. Sessions (around 90 minutes) continued until thematic saturation [25]. Interviews (40-60 minutes) were conducted with senior staff, including the deputy director, consultants and unit heads, to explore deficiencies and suggestions for improvement. The observational checklist assessed welfare facilities (toilets, rest areas, PPE), vaccination coverage and adherence to OHS guidelines.

All focus group and interview transcripts were thematically coded and analysed (25). Questionnaire Likert responses were dichotomised into 'satisfactory' or 'unsatisfactory.' Composite scores were created for knowledge, attitudes, practices and satisfaction. Quantitative analysis (SPSS v22) generated descriptive statistics. McNemar's test was used to assess pre- and post-change differences.

PHASE II – INTERVENTION DEVELOPMENT AND IMPLEMENTATION

Phase I findings were collated and presented to all project stakeholders at consultative meetings at IOH. A strengths, weaknesses, opportunities and threats (SWOT) analysis approach was used to identify gaps in existing OHS processes at IOH and to set target priorities [26]. Strategies were developed with the TOWS matrix [26], considering feasibility and acceptability. Consensus among stakeholders finalised the OHS interventions, which were then implemented at IOH.

PHASE III – FOLLOW-UP EVALUATION

Three months post-implementation, the similar assessment tools were re-administered to the same staff groups to evaluate changes in OHS practices.

RESULTS

PHASE I – BASELINE ASSESSMENT

The questionnaire responses were collected from 140 participants, including 46 DSs (32.9%), 16 NOs (11.4%) and 78 HCAs (55.7%). The mean age was 37.04 years, and the majority (N=99; 70.7%) were female. The mean service period of participants was 11.05 years. Six focus group sessions were completed with 56 personnel, comprising 22 DSs, six NOs and 28 HCAs. Interviews were conducted among 11 staff members, including the deputy director of the IOH, the medical officer planning, five consultants, three DSs and an in-charge NO. The observational checklist was systematically completed across all areas, encompassing the four clinical units (outpatients department, orthodontic, restorative and community dental unit), as well as ancillary spaces.

PHASE II – INTERVENTION DEVELOPMENT AND IMPLEMENTATION

Targeted OHS strategies were developed through consultative and SWOT analysis meetings at the IOH and engagement with IOH stakeholders, including CDS (3 consultants, 10 DSs, two NOs, 16 HCAs) and five administrative staff members. To

provide additional clarity on the intervention development process, consensus was reached through a combination of methods, including brainstorming potential interventions, prioritising options based on feasibility and impact and voting on the most promising strategies. The stakeholder group agreed on the final selected interventions, which included the development of OHS guidelines, knowledge and awareness workshops, appointing an OHS focal point within the institution, improving staff Hepatitis B vaccination rates and improving welfare facilities and psychosocial support services for staff. Each of these elements is briefly summarised below.

Development of OHS guidelines:

New guidelines were developed to outline the workplace safety procedures. They included the following key components: best practice OHS for dental care, hazard identification and risk assessment, incident reporting and investigation, and training and awareness. The guidelines were made available in paper and electronic form and disseminated through various channels, including staff meetings, training sessions and management committee meetings, then stored for further reference in the online staff resource and in a paper version in all staff department facilities.

Knowledge and awareness workshops:

Staff education and training were conducted to promote awareness and understanding of OHS and the new guidelines among CDS in IOH. Four in-person sessions, each lasting four hours, were conducted across four weeks. The sessions were delivered interactively to engage staff in identifying hazards or risks and developing solutions.

Establishment of an OHS focal point officer:

- A. An IOH staff member was appointed as a dedicated OHS officer aimed at streamlining reporting mechanisms. The purpose was to enhance the effective implementation of the OHS guidelines by actively engaging with staff and systematically gathering information for informed, proactive decision-making. This included conducting comprehensive hazard assessments and investigating incidents.

Improving Hepatitis B vaccination:

A staff vaccination campaign was implemented to improve the Hepatitis B vaccination coverage. This involved establishing mechanisms to identify non-vaccinated employees and prompting referral, establishing mechanisms to check the Hepatitis B antibody levels and ensuring the vaccination supply chain.

Improved welfare activities:

Collaborative efforts were exerted to enhance the quality of drinking water facilities and food in the staff canteen, upgrade the quality of rest and changing rooms and ensure availability of personal protective equipment.

Improving psychological support:

Confidential counselling and support services were made available to staff members experiencing work-related stress or other psychosocial issues. These services were complemented by four support awareness sessions conducted in parallel with the OHS education awareness programme.

QUALITATIVE RESULTS

Phase I: Pre-interventional assessment

Thematic analysis of focus group and interview data uncovered several OHS challenges within IOH. These included staff reporting the absence of specific OHS training for most CDS, a lack of established reporting mechanisms and the absence of institutional guidelines or written documents in the workplace. Additionally, respondents reported that slow progress in upgrading dental equipment, infrastructure and welfare facilities further exacerbated these challenges. Analysis of open-ended questions highlighted that staff felt there was an increasing workload across all staff categories, contributing to occupational stress. The findings also highlighted the need to improve the Hepatitis B vaccination status and enhance the psychosocial support available to staff.

Phase III: Post-interventional assessment

Based on the findings of focus groups, it became evident that the knowledge and awareness sessions were beneficial for CDS. The established focal point officer and reporting mechanism led by the medical officer – planning successfully

promoted effective coordination and communication among various units within the IOH. The focal point officer served as the central point of contact, ensuring that all units worked cohesively and collaboratively and that information flowed throughout the IOH. The reporting mechanism facilitated regular updates from each unit, allowing for timely additional support where necessary. The analysis of interview data revealed that staff reported a substantial improvement in OHS and fewer workplace injury complaints after implementing the multi-component project. Participants expressed satisfaction with the implemented measures. Overall, the qualitative data collected through focus groups and interviews during the evaluation phase suggested that the strategies implemented had been effective at improving OHS within the IOH and the well-being of CDS.

QUANTITATIVE RESULTS

Participants' knowledge

There was a significant improvement in the knowledge of participants ($p < 0.05$) following the implementation of interventions (Table 1). There was a decrease in the number of participants who reported having 'unsatisfactory OHS knowledge' and an increase in those reporting 'satisfactory OHS knowledge' in all three categories: knowledge of occupational hazards, knowledge of the prevention of adverse health outcomes and knowledge of protective measures.

TABLE 1: PARTICIPANTS' KNOWLEDGE OF OHS

	Pre-intervention		Post-intervention		p-value McNemar's test
	N=140		N=140		
	N	%	N	%	
Knowledge of occupational hazards in clinical dentistry					
Satisfactory	69	49.3	93	66.4	p=0.002
Unsatisfactory	71	50.7	47	33.6	
Knowledge of the prevention of adverse health outcomes due to occupational hazards in clinical dentistry					
Satisfactory	47	33.6	103	73.6	p=0.000
Unsatisfactory	93	66.4	37	26.4	
Knowledge of the protective measures related to OHS among staff					
Satisfactory	31	22.1	77	55.0	p=0.000
Unsatisfactory	109	77.9	63	45.0	

Participants' attitudes

Participants' attitudes were evaluated in three domains: occupational hazards, preventing adverse outcomes and protective measures, which illustrated a significant improvement ($p < 0.05$) (Table 2).

TABLE 2: PARTICIPANTS' ATTITUDES ON OHS

	Pre-intervention		Post-intervention		p-value McNemar's test
	N=140		N=140		
	N	%	N	%	
Attitudes on occupational hazards					
Satisfactory	79	56.4	95	67.9	p=0.002
Unsatisfactory	61	43.6	45	32.1	
Attitudes on the prevention of adverse health outcomes					
Satisfactory	66	47.1	83	59.3	p=0.040
Unsatisfactory	74	52.9	57	40.7	
Attitudes on the protective measures					
Satisfactory	63	45.0	90	64.3	p=0.001
Unsatisfactory	77	55.0	50	35.7	

Participants' practices

There was also a significant ($p < 0.05$) improvement in staff practices in relation to OHS measures and the reporting of OHS hazards to hospital management (Table 3). However, there was no significant improvement ($p > 0.05$) in practices related to managing occupational psychological risks despite an increase in participants reporting satisfactory practices.

TABLE 3: PARTICIPANTS' PRACTICES RELATED TO OHS

	Pre-intervention		Post-intervention		p-value McNemar's test
	N=140		N=140		
	N	%	N	%	
Practice of control measures					
Satisfactory	57	40.7	82	58.6	p=0.007
Unsatisfactory	83	59.3	58	41.4	
Reporting of OHS hazards to hospital management					
Satisfactory	69	49.3	93	66.4	p=0.002
Unsatisfactory	71	50.7	47	33.6	
Management of occupational psychological risks					
Satisfactory	64	45.7	73	52.1	P=0.150
Unsatisfactory	76	54.3	67	47.9	

Participants' satisfaction

The most noticeable improvement was staff satisfaction with the level of adherence to guidelines, satisfaction with reporting mechanisms, awareness of OHS and vaccination status (Table 4 and Figure 1). However, the improvement in satisfaction regarding welfare facilities and strengthened psychosocial support did not show a significant statistical difference ($p > 0.05$, Table 4).

FIGURE 1: RADAR CHART COMPARING PRE- AND POST- CHANGES IN STAFF SATISFACTION LEVELS ASSOCIATED WITH IMPLEMENTED INTERVENTIONS

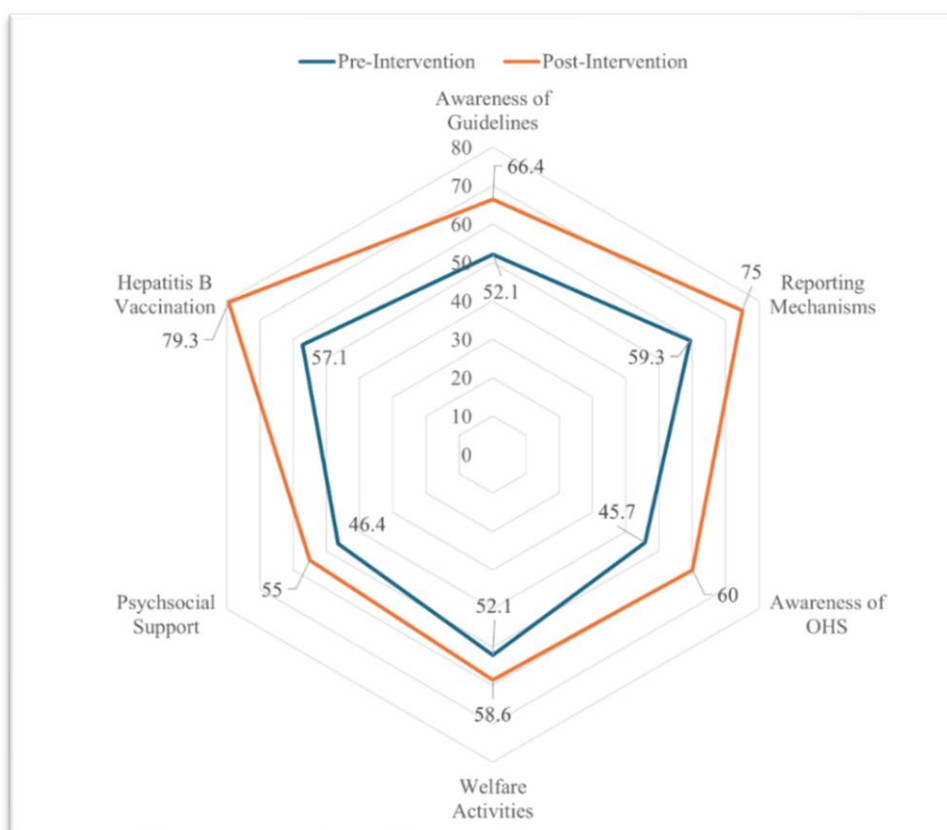


TABLE 4: PARTICIPANTS' SATISFACTION WITH OHS MEASURES

	Pre-intervention		Post-intervention		p-value McNemar's test
	N=140		N=140		
	N	%	N	%	
Adherence to OHS guidelines					
Satisfactory	73	52.1	93	66.4	p=0.019
Unsatisfactory	67	47.9	47	33.6	
Reporting mechanism for OHS					
Satisfactory	83	59.3	105	75.0	p=0.007
Unsatisfactory	57	40.7	35	25.0	
Awareness of OHS					
Satisfactory	64	45.7	84	60.0	p=0.002
Unsatisfactory	76	54.3	56	40.0	
Welfare facilities in IOH					
Satisfactory	73	52.1	82	58.6	p=0.163
Unsatisfactory	67	47.9	58	41.4	
Strengthening of psychosocial support in IOH					
Satisfactory	65	46.4	77	55.0	p=0.088
Unsatisfactory	75	53.6	63	45.0	
Hepatitis B vaccination at IOH					
Satisfactory	80	57.1	111	79.3	p=0.000
Unsatisfactory	60	42.9	29	20.9	

Welfare facilities, Hepatitis B vaccination and status of OHS guidelines

As indicated in Table 5, improvement in Hepatitis B vaccination and OHS guideline compliance increased from 60% to 80% and 25% to 100%, respectively. Hepatitis B vaccination rate resulted in a significant improvement (p=0.000) in satisfaction. However, the availability of welfare facilities only improved from 58% to 67%, which was not statistically significant.

TABLE 5: AVAILABILITY OF WELFARE FACILITIES, HEPATITIS B VACCINATION AND STATUS OF OHS GUIDELINES

Criteria	Pre-interventional percentage	Post-interventional percentage
Welfare facilities	58.34%	66.7%
Hepatitis B vaccination	60%	80%
Adherence to OHS guideline	25%	100%

DISCUSSION

There is limited published research available to guide the design and implementation of effective OHS risk management interventions in LMIC clinical dental settings [21]. This mixed-methods study strengthened the evidence base by evaluating a holistic package of co-design OHS measures in the leading Sri Lankan specialist dental hospital. The key findings were that staff OHS knowledge, attitudes, practices and satisfaction significantly improved without any significant association to the age or service period, as a result of targeted, mutually supportive OHS interventions implemented with CDS. The implemented intervention package included the development of and adherence to new guidelines on OHS, knowledge and awareness sessions, streamlined reporting mechanisms and increasing Hepatitis B vaccination coverage. As a result of these strategies, staff reported that fewer OHS complaints and injuries occurred at the IOH following the implementation. A discussion of each of the key findings of this study are presented below to situate them within the context of relevant international literature and clarify their implications for research, policy and practice.

OHS GUIDELINES:

OHS guidelines are crucial for systematically identifying and mitigating dentistry-related occupational hazards [19]. By developing a guideline based on current necessities, safe practice for CDS is more effective, resulting better patient outcomes, improved cost-effectiveness and the ability of authorities to identify the priority areas and research gaps [27, 28]. Kwak and colleagues [29] emphasise the importance of considering end-users in guideline development to achieve effective implementation and institutionalisation. Stakeholder participation in the change process in this study significantly contributed to the development of effective guidelines, which led to an increase adherence and optimised protective and preventive OHS measures among CDS. Regular training, continuous stakeholder involvement and periodic updates of guidelines are essential to ensure sustained compliance, especially in clinical settings with high personnel turnover [30]. The guideline highlighted important areas and priorities, as identified by staff and resulted in significant satisfaction among participants. The implications of these findings extend to policy by reinforcing the need for regulatory bodies to support continuous updates to OHS guidelines. In clinical practice, fostering an environment of ongoing education and stakeholder engagement can improve long-term adherence [31, 32]. For research, these findings underline the importance of investigating the impact of evolving clinical settings on guideline compliance and exploring strategies for overcoming barriers to sustained implementation.

KNOWLEDGE AND AWARENESS TRAINING:

The study reported that employee training is important for minimising adverse health outcomes of occupational hazards, similar to other studies [33]. The need for awareness sessions was identified as a key requirement for CDS, as almost 90% of staff reported that they did not receive any OHS training. This was in contrast to Nigerian dental staff, where all CDS were aware of occupational exposure to hazards and the majority had attended on-the-job trainings [34]. Despite initially low awareness levels, the training sessions led to substantial improvements across all measured parameters, demonstrating that targeted education can make a significant impact among CDS.

OHS FOCAL POINT OFFICER:

Introduction of a dedicated OHS officer and a formal reporting mechanism for OHS is an essential component in promoting evidence-based decision-making, which significantly improved the participants' satisfaction with reporting mechanisms. Strengthening occupational injury and surveillance systems is a timely requirement, as outlined in the occupational safety and health policies [17]. Importantly, institutional focal points may reduce the underreporting of occupational hazards, a challenge commonly observed in developing or resource-constrained settings.

STAFF PSYCHOLOGICAL SUPPORT:

Lee and colleagues [35] found that CDS commonly experience work-related stress and occupational burnout. In this study, CDS at the IOH reported experiencing higher stress in their duties. Despite the implementation of awareness sessions aimed at promoting stress management at both individual and institutional levels, significant improvement remained elusive. A study conducted in India also identified occupational-related stress as a key concern among the CDS [15], indicating that this issue is widespread. The participants in this study did not report a significant increase in their satisfaction with the psychosocial support provided by IOH. One possible reason may be the project team's limited scope and poor administrative authority, which prevented more intensive interventions.

The integration of mixed methods in this project strengthens the evaluation process and facilitated the design and delivery of an evidence-based, multi-component intervention [36]. Before implementing strategies, a detailed assessment of existing OHS processes was conducted using a range of methods. The findings were critically examined in the context of international and domestic literature [21]. Importantly, these findings underscored the effectiveness of a multi-method approach in both implementing and evaluating interventions, as it enables a deeper understanding of complex issues and supports the development of more targeted and impactful solutions.

To achieve improvement in OHS, it is crucial to engage stakeholders in developing and implementing OHS programmes [37]. Stakeholder engagement and co-design strategies have been identified as successful approaches for driving healthcare improvement [38]. When CDS and other relevant stakeholders participate in the development and

implementation process, OHS programmes can be tailored to specific contexts and the needs of end-users. In this project, stakeholder participation was instrumental in prioritising interventions and achieving measurable improvements. SWOT analysis and the TOWS matrix were effectively used to guide the development of context-specific OHS interventions [39]. These approaches provided practical guidance, strengthened institutional capacity and enhanced the delivery of OHS training. Embracing a scientific approach that considers administrative feasibility, acceptability and time availability is crucial for the successful advancement of healthcare initiatives [10].

STUDY LIMITATIONS

The generalisability of the findings was limited by only having one research site. However, as the leading specialist dental hospital in Sri Lanka, the findings are likely to be relevant for informing practice at comparable facilities across the country and in other LMICs. The short interval between pre- and post-assessments may have hindered a comprehensive assessment of the research project's sustainability and/or impact. Additionally, the involvement of an external team in the intervention introduces potential challenges to its sustainability despite the significant outcomes achieved. Ensuring the continuity of these improvements is essential for maintaining occupational safety within the dental workforce. The authors are working with policy and industry collaborators to examine the feasibility of conducting further research to evaluate whether the findings were sustained. As for most global research conducted during the study period, disruptions resulting from the COVID-19 pandemic in Sri Lanka also affected the implementation of certain activities, such as follow-up evaluations and post-intervention data collection.

CONCLUSIONS

The results indicate that the package of interventions designed and implemented within this project significantly improved clinical staff's knowledge, practices and satisfaction with OHS measures, with a reduction in OHS incidents reported by staff post-implementation. The study demonstrated that integrating multiple interventions can effectively enhance OHS outcomes, despite being conducted at a single centre. This Sri Lankan intervention highlights the importance of stakeholder engagement and co-design as crucial within health service innovation and offers valuable insights for improving OHS in similar healthcare settings, particularly in LMICs. Future research should examine the long-term impacts of the project and the extent to which the co-design approach used can produce similarly positive outcomes in other facilities across Sri Lanka and specialist dental hospitals in other LMICs.

AUTHORSHIP

CJ contributed to the initial conceptualisation and design of the study. IS supervised the project and was actively involved in conceptualisation throughout all stages. CJ, IS and DD contributed to data analysis and interpretation. CJ drafted the initial manuscript. IS, RH, DD, CM and AR critically reviewed and revised the manuscript for important intellectual content. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring its accuracy and integrity.

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