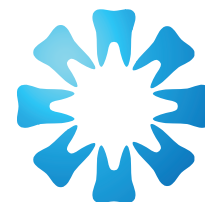


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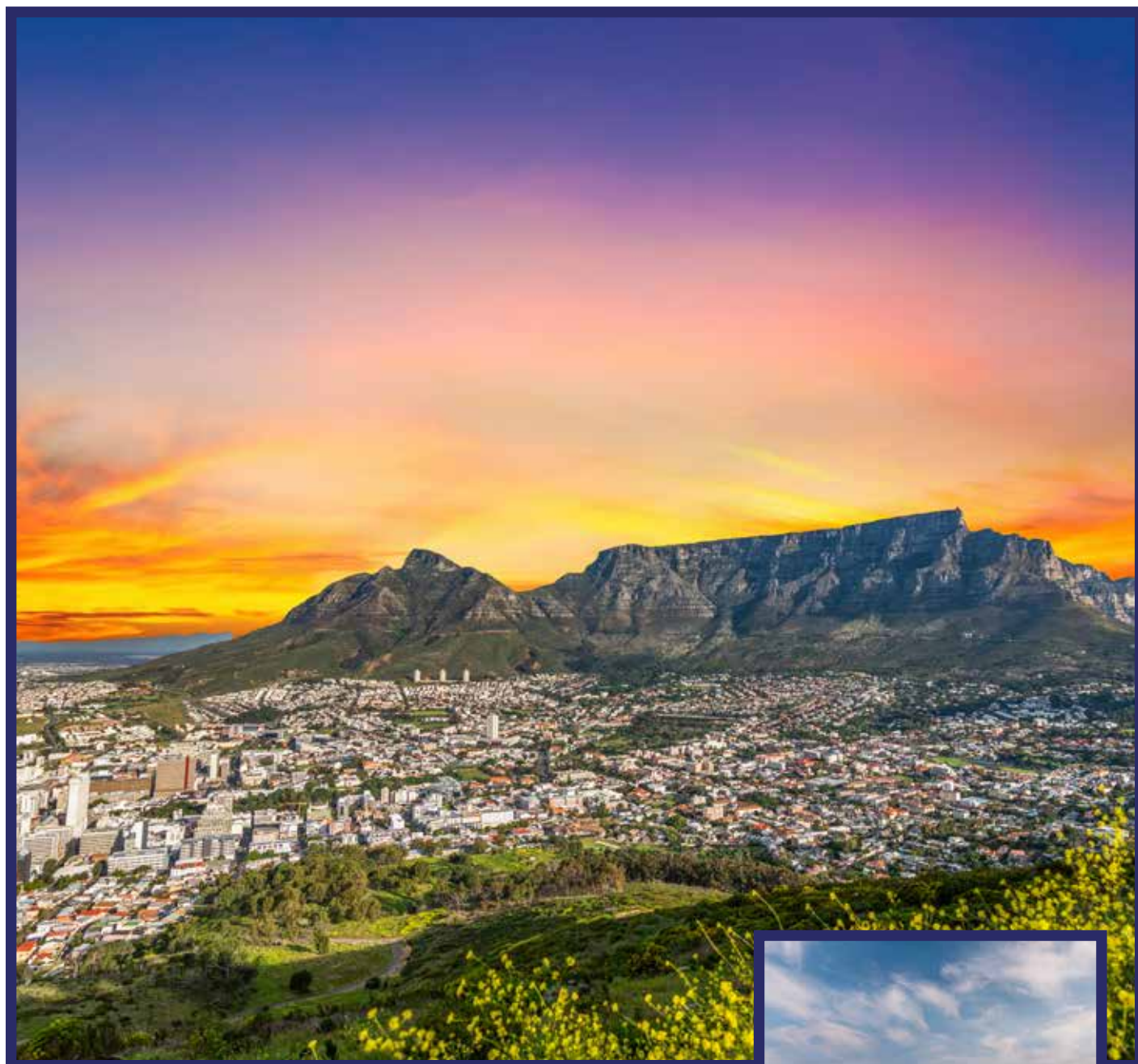


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Table Mountain rises above Cape Town as one of South Africa's most recognised natural landmarks. Its flat summit stands about 1,085 metres above sea level and forms part of Table Mountain National Park. The mountain is rich in fynbos plant species, many found nowhere else. Visitors reach the top by hiking or cableway and enjoy wide views of the city, ocean, and surrounding peaks.



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Dentistry in the age of visibility: The instagram smile and the rise of the dental celebrity

SADJ MAY 2026, Vol. 81 No.4 P223-P228

Prof NH Wood, Managing Editor, SADJ – BChD, DipOdont(MFP), MDent(OMP), FCD(SA), PhD

INTRODUCTION

At some point, dentistry became extraordinarily photogenic.

The modern smile now lives far beyond the mouth itself. It appears in reels, selfies, close-up transformation videos, luxury practice feeds, whitening montages, influencer collaborations, and carefully curated “smile reveal” moments filmed beneath perfect lighting and edited for maximum effect. Teeth are no longer simply restored, aligned, or rehabilitated. Increasingly, they are displayed, performed, and circulated within digital culture as visual symbols of health, beauty, success, youthfulness, and aspiration.

And dentistry has adapted remarkably quickly.

The profession now occupies a curious position at the intersection of healthcare, aesthetics, branding, entertainment, and social media visibility. Clinicians who once built reputations quietly through years of practice, mentorship, referrals, and professional contribution may now build enormous audiences through algorithms and content creation. Practices function not only as healthcare environments, but as visual identities. Patients arrive carrying filtered reference photographs and aesthetic expectations shaped as much by Instagram and TikTok as by biology or function.

In many ways, this transformation has been positive. Dentistry has become more accessible, more visible, and more engaged with the public than ever before. Educational content reaches millions of viewers. Oral health conversations circulate widely. Innovation, creativity, and entrepreneurship have flourished in ways that would have seemed unimaginable only a decade ago.

Yet visibility changes professions.

The systems that govern digital culture reward attention, immediacy, transformation, and performance, qualities that do not always align comfortably with the slower, more careful, and biologically restrained realities of healthcare. As dentistry increasingly enters the attention economy, important questions begin to emerge around professionalism, authenticity, expertise, ethics, and the changing meaning of success within the profession itself.

This editorial does not argue against social media, aesthetic dentistry, or modern professional branding. Nor does it romanticise an earlier era of dentistry that was somehow purer or less commercial. Rather, it reflects on a profession undergoing visible cultural transformation, one in which smiles have become content, dentists have become

personalities, and clinical practice increasingly unfolds within systems designed not merely to inform, but to capture attention.

Because perhaps the most interesting question facing dentistry today is no longer simply how we treat teeth.

It may be how the age of visibility is quietly reshaping the profession itself.

The smile becomes content

There was a time when the dental photograph served a largely clinical purpose. Images documented pathology, recorded treatment outcomes, and assisted in education or communication between professionals. Today, however, the photograph has evolved into something far more culturally powerful. Increasingly, the modern smile exists not only in the mouth, but on screens, cropped, filtered, illuminated, edited, posted, liked, and endlessly compared.

Dentistry has entered the age of visibility.

The contemporary patient no longer encounters dentistry solely through the consulting room or referral network. Instead, the profession now exists within the architecture of social media platforms, where smiles circulate as aesthetic currency and dental treatment is increasingly woven into broader cultures of lifestyle, beauty, status, and self-presentation. Before-and-after transformations populate Instagram feeds. Veneer cases unfold through time-lapse videos. Whitening procedures appear between fitness influencers and skincare advertisements. Algorithms reward visual impact, immediacy, and aspiration, qualities with which aesthetic dentistry aligns remarkably well.

And the public has responded.

Patients now arrive carrying not only clinical concerns, but curated visual references. Some bring celebrity photographs. Others arrive with filtered selfies or screenshots saved from TikTok and Instagram, asking whether a particular smile can be replicated. Increasingly, aesthetic expectations are shaped less by anatomy or function than by digital exposure and aspirational imagery. In some consultations, the discussion begins not with pain or disease, but with aesthetics, symmetry, brightness, proportions, and “the look.”

None of this is inherently problematic. Dentistry has always occupied a space that intersects health, appearance, identity, and confidence. Aesthetic rehabilitation can profoundly improve self-esteem and quality of life, and advances in materials and digital technologies have dramatically expanded what clinicians can achieve conservatively and predictably. In many respects, the growing public interest

in oral aesthetics reflects broader societal shifts toward self-curation and visual communication.

But social media has altered more than patient expectations. It has also changed the environment within which dentistry itself is performed.

Smiles have become extraordinarily visible objects. And visibility changes behaviour.

Procedures that translate well visually, veneers, whitening, aligners, composite bonding, facial aesthetics, naturally attract disproportionate attention online. Highly aesthetic cases become shareable content. Clinical outcomes become part of personal branding. The operatory increasingly doubles as a content studio, complete with mounted cameras, curated lighting, editing software, and carefully staged reveal moments. In some corners of the profession, the line between clinical documentation and digital performance has become increasingly difficult to distinguish.

The rise of the “Instagram smile” therefore reflects something larger than cosmetic dentistry alone. It signals the profession’s entrance into the attention economy, a world in which visibility itself carries professional, social, and commercial value. And once visibility becomes valuable, dentistry inevitably begins to change around it.

Dentistry enters the attention economy

The emergence of social media dentistry has not simply changed how the public sees the profession; it has changed how the profession increasingly sees itself.

Visibility, once incidental to clinical work, has become strategically valuable. Practices cultivate online identities with the same care once reserved for physical consulting rooms. Logos, colour palettes, typography, lighting, music, photography style, and even the aesthetic arrangement of instruments now contribute to a carefully curated professional

image. The modern dental practice is no longer judged solely by reputation, qualifications, or referral patterns, but increasingly by digital presence, engagement metrics, and visual appeal.

In many respects, this evolution is understandable. Dentistry operates within an increasingly competitive environment, and social media offers unprecedented opportunities for communication, education, accessibility, and practice growth. Clinicians can now reach audiences directly, demystify procedures, educate patients, showcase innovations, and build communities that would have been impossible only a decade ago. Some dental professionals have used these platforms exceptionally well, producing thoughtful educational content, combating misinformation, and making oral health more visible and approachable to the public.

But the attention economy functions according to its own rules.

Algorithms do not necessarily reward nuance, restraint, or long-term biological thinking. They reward visibility. Speed. Transformation. Novelty. A dramatic veneer case will almost always outperform a careful discussion on periodontal maintenance. A perfectly edited smile reveal generates more engagement than a conversation about caries prevention. The result is a subtle but important distortion: dentistry risks becoming increasingly represented online by the procedures that are most visually consumable, rather than those most central to long-term oral health.

Over time, this changes professional incentives.

Clinicians who are highly visible online may acquire influence disproportionate to traditional markers of expertise such as academic contribution, teaching experience, or research leadership. Followers become a form of social capital. Visibility begins to resemble authority. And while many



influential dental content creators are exceptionally skilled and ethical practitioners, the profession must still confront an uncomfortable reality: digital popularity and professional competence are not necessarily equivalent.

This has given rise to a distinctly modern phenomenon: the dental celebrity!

Unlike traditional professional recognition, which historically emerged through scholarship, leadership, mentorship, or clinical distinction accumulated over time, the contemporary dental celebrity may emerge rapidly through algorithms, aesthetic branding, and audience engagement. Some now command audiences larger than entire professional organisations. Procedures are filmed cinematically. Case reveals resemble lifestyle marketing campaigns. Educational content merges seamlessly with entertainment, branding, sponsorship, and aspirational culture.

Again, none of this is inherently negative. The democratisation of visibility has allowed younger clinicians, women, underrepresented groups, and innovative educators to gain platforms previously inaccessible within traditional professional hierarchies. Social media has, in some respects, flattened old gatekeeping structures within dentistry.

Yet it has also introduced new tensions.

Because once professional identity becomes partially dependent on visibility, performance inevitably follows. The pressure to remain relevant, aesthetically current, constantly engaged, and algorithmically visible may subtly reshape not only how dentistry is marketed, but how it is practised, photographed, presented, and even conceptualised.

And perhaps this is where the profession now finds itself: no longer simply providing care within a digital world, but increasingly performing aspects of dentistry within systems designed primarily to capture attention.

Veneers, filters, and aspirational faces

Perhaps nowhere is the collision between dentistry, beauty culture, and digital visibility more evident than in the modern obsession with the perfect smile.

For decades, cosmetic dentistry existed largely within the boundaries of clinical rehabilitation and aesthetic refinement. Today, however, smiles increasingly function as social signals, markers of youthfulness, success, desirability, wellness, and even status. In the age of high-definition cameras and permanently front-facing smartphones, the smile has become intensely public. It is photographed constantly, scrutinised endlessly, and compared algorithmically against idealised digital standards.

And the standards themselves are changing.

Social media platforms have accelerated the global circulation of highly stylised aesthetic norms: ultra-white teeth, exaggerated symmetry, broad smile arcs, hyper-uniform incisal edges, and remarkably homogenised facial aesthetics. Filters smooth skin, alter proportions, whiten teeth, and subtly reshape faces in ways that increasingly blur the boundary between enhancement and unreality. Patients are no longer simply comparing themselves to celebrities. They are comparing themselves to edited versions of ordinary people.

Dentistry now operates inside this visual ecosystem.

The result is a fascinating shift in the consultation itself. Increasingly, clinicians encounter patients who are not necessarily seeking treatment for disease, dysfunction, or discomfort, but for alignment with an aesthetic ideal they struggle to define but instantly recognise online. Terms such as “natural” and “perfect” are often used interchangeably, despite describing fundamentally different aesthetic philosophies. Some patients request smiles that appear less biologically plausible and more digitally optimised, as though designed not for the mouth, but for the camera.

This has placed dentistry in a uniquely complex position. On one hand, aesthetic dentistry can be transformative. Conservative cosmetic procedures, orthodontic treatment, bleaching, and restorative rehabilitation may significantly improve confidence, self-image, and quality of life. To dismiss patient aesthetic concerns entirely would be both simplistic and professionally insensitive.

Yet the profession must also navigate the consequences of increasingly aspirational and commercially amplified beauty standards.]

The global phenomenon colloquially referred to as “Turkey teeth” illustrates this tension vividly. Social media has normalised highly invasive full-mouth veneer or crown preparations through dramatic online transformations marketed as lifestyle upgrades rather than irreversible biological interventions. The aesthetic outcome is foregrounded; the long-term restorative implications are often less visible. Dentistry, which has historically emphasised preservation of tooth structure and minimally invasive care, now finds itself competing with digital cultures that reward immediate visual transformation over biological restraint.

And here lies one of the editorial's deeper questions: *What happens when aesthetic expectation begins to exceed biological wisdom?*

Because dentistry is fundamentally unlike many other beauty industries. Teeth are not infinitely replaceable surfaces. Enamel does not regenerate. Occlusion carries consequences. Restorations age. Complications accumulate over time. The clinician therefore occupies a uniquely difficult ethical space, simultaneously responding to patient autonomy, aesthetic desire, commercial pressure, and long-term biological responsibility.

The modern dentist increasingly works at the intersection of healthcare and identity construction. Patients may arrive seeking confidence, reinvention, visibility, or belonging as much as clinical treatment. And in an era where faces themselves have become curated public objects, the smile has emerged as one of the most symbolically powerful features of all.

Which perhaps explains why modern dentistry no longer merely restores teeth.

Increasingly, it is being asked to curate aspiration itself.

The Performative Practice

The modern dental practice has changed in ways that extend far beyond clinical technology.

Not long ago, the defining features of a successful practice were relatively predictable: clinical reputation, professional referrals, patient trust, and consistency of care over time. Today, many practices still embody these values, but they increasingly coexist alongside another set of expectations shaped by contemporary consumer culture and digital visibility.

Practices are now designed not only to function clinically, but to communicate aesthetically.

Reception areas resemble boutique hotels or wellness studios. Operatories are staged with carefully calibrated lighting. Branded coffee stations, fragrance design, curated playlists, minimalist interiors, and “Instagrammable” spaces have quietly entered parts of modern dentistry. Uniforms, logos, packaging, websites, and social media feeds are orchestrated with remarkable intentionality. In some environments, the patient experience is no longer simply clinical, it is immersive.

Again, none of this is inherently problematic. Thoughtful design, patient comfort, and positive experiences matter. Dentistry has long struggled with fear and anxiety, and welcoming environments may genuinely improve patient engagement and trust. The profession should not romanticise outdated clinical austerity as though sterile environments alone confer professionalism.

But the evolution remains culturally fascinating because it reflects a broader shift in how dentistry is positioned socially. Increasingly, dental practices operate simultaneously as:

- healthcare environments,
- aesthetic destinations,
- consumer experiences,
- and personal brands.

The language surrounding dentistry has evolved accordingly. Patients are sometimes referred to as “clients.” Treatments become “smile journeys.” Consultations resemble aesthetic planning sessions. Clinical outcomes are unveiled theatrically through reveal videos, reaction clips, and transformation montages set to carefully selected music. The profession, in some corners, has adopted elements once associated more closely with lifestyle marketing, hospitality, and influencer culture than with traditional healthcare.

And perhaps most interestingly, clinicians themselves increasingly participate in this performance. The contemporary dentist may now function simultaneously as:

- clinician,
- entrepreneur,
- photographer,
- videographer,
- educator,
- brand strategist,
- and online personality.

This multidimensional identity reflects the realities of modern practice ownership and communication. Yet it also introduces subtle pressures. The dentist is no longer simply expected to provide excellent care, but increasingly to remain visible, engaging, aesthetically current, digitally literate, and publicly relevant.

The consequences of this shift are complex. Visibility can create opportunity, accessibility, and innovation. But performative environments also alter professional behaviour. When procedures are routinely photographed, filmed, edited, and shared, clinical work may gradually become shaped not only by biological considerations, but by visual impact and audience engagement. Certain treatments become more attractive because they are more marketable. Some cases become content before they become healthcare.

And perhaps this is where the profession now encounters one of its most delicate tensions.

Because dentistry occupies a unique position: it is undeniably part healthcare, but increasingly part aesthetic culture as well. The challenge is not choosing one or the other. It is ensuring that, amid branding, visibility, and digital performance, the biological, ethical, and human foundations of the profession do not quietly recede behind the spectacle of the smile itself.

The Ethical Tension: Healthcare, Marketing, and Authenticity

The transformation of dentistry into a highly visible, digitally mediated profession has created opportunities that are undeniably powerful. Patients are more informed, practices are more accessible, and oral health conversations now reach audiences far beyond traditional clinical spaces. Educational content that once remained confined to lecture halls or conferences can now circulate globally within minutes. In many respects, this democratisation of communication has benefited both clinicians and the public.

And yet, visibility changes incentives.

Social media platforms reward attention, engagement, speed, and emotional reaction. Healthcare, by contrast, often depends upon nuance, restraint, uncertainty, and long-term thinking. The tension between these two worlds is subtle but increasingly important. Dentistry now finds itself operating at the intersection of professional ethics and digital performance culture, two systems that do not always reward the same behaviours.

This becomes particularly evident in the presentation of treatment outcomes online. Clinical cases shared on social media are rarely neutral documents of care. They are curated narratives. Angles are selected carefully. Lighting is controlled. Music is added. Emotional reveal moments are amplified. Before-and-after transformations compress months of biological adaptation and clinical complexity into seconds of visually satisfying content.

What becomes visible is transformation.

What often remains invisible is maintenance, complication, failure, uncertainty, or restraint.

This asymmetry matters because public perception of dentistry is increasingly shaped by these fragments of visibility. Patients may begin to perceive aesthetic transformation as routine, rapid, universally achievable, and largely risk-free. The algorithm naturally privileges extraordinary outcomes over ordinary maintenance, even though preventive and conservative care remain the true foundation of long-term oral health.

The ethical tension for clinicians is therefore not merely whether to participate in digital culture, but how to do so responsibly.

Where does education end and advertising begin?

At what point does professional visibility become performance?

Can clinical authenticity survive within systems designed primarily to reward engagement?

These are not simple questions, particularly because many clinicians navigate them thoughtfully and ethically. Some of the most valuable oral health education now occurs online. Skilled practitioners use social media to combat misinformation, advocate for evidence-based care, promote prevention, and improve public understanding of dentistry. The issue is not visibility itself. The issue is whether visibility gradually begins to reshape professional values in ways the profession does not fully recognise.

There is also an emerging question around professional identity. Historically, dentistry derived authority primarily from expertise, experience, mentorship, scholarship, and peer recognition. In digital spaces, however, authority may increasingly become entangled with aesthetics, charisma, production quality, and audience size. A highly followed clinician may exert extraordinary influence over patient expectations and professional trends irrespective of whether visibility accurately reflects depth of expertise.

This does not mean that social media has diminished professionalism. But it may have altered how professionalism is perceived publicly.

The profession therefore finds itself in a uniquely modern dilemma: it must remain relevant within rapidly evolving digital environments without allowing algorithms to become the primary architects of clinical culture. Because if visibility becomes the dominant currency of professional success, dentistry risks drifting toward a model in which what performs best online gradually acquires disproportionate influence over what is valued clinically.

And professions rarely change dramatically overnight. More often, they change quietly, one adaptation at a time, until eventually the culture begins to reward visibility more consistently than wisdom, performance more readily than restraint, and influence more visibly than expertise.

Can Professionalism Survive the Algorithm?

Perhaps the most important question raised by the digital transformation of dentistry is not whether social media is good or bad for the profession. That debate is already too simplistic. The more interesting question is whether the values that traditionally anchored professionalism can remain stable within systems increasingly governed by visibility, speed, branding, and algorithmic reward. Because algorithms do not merely distribute content. Over time, they shape culture.

What becomes repeatedly visible online begins to influence what is perceived as desirable, successful, modern, and professionally relevant. Young clinicians entering the profession are now exposed to a constant stream of highly curated dental identities: flawless aesthetic cases, luxury practices, rapid smile transformations, viral treatment videos, immaculate branding, and clinicians whose professional presence appears inseparable from performance and visibility.

And inevitably, this influences aspiration.

There was once a time when younger dentists primarily looked toward respected teachers, senior clinicians, textbook authors, and mentors as professional reference points. Increasingly, however, professional influence is mediated digitally. The contemporary role model may now be a clinician with exceptional online reach, highly aesthetic content, and strong personal branding. This is not necessarily problematic, many online educators contribute meaningfully to the profession. But it does raise an important question:

What qualities are becoming most rewarded and most imitated within modern dental culture?

Because visibility and expertise do not always evolve together.



Some of the most experienced, ethical, and clinically sophisticated practitioners remain almost entirely invisible online. Meanwhile, highly visible clinicians may exert enormous influence over aesthetic trends, treatment expectations, and professional culture despite relatively limited traditional academic or educational contribution. The algorithm, after all, cannot easily distinguish between entertainment, marketing, expertise, and evidence. It rewards attention with remarkable neutrality.

This creates subtle pressures within the profession itself. Dentists may begin to feel not only clinical pressure, but performative pressure:

- pressure to remain relevant,
- pressure to appear successful,
- pressure to produce content,
- pressure to curate a professional identity continuously.

And in perhaps one of the more curious developments of all, the profession increasingly documents itself in real time. Procedures are filmed. Reactions are captured. Smiles are revealed theatrically. Consultations become content narratives. Dentistry, once intensely private and clinical, has become unexpectedly public.

Yet amid all this visibility, one suspects that patients still seek something surprisingly traditional from their dentist.

- Not merely aesthetic transformation.
- Not perfect branding.
- Not cinematic whitening sequences filmed in slow motion.

But trust.

Patients still want clinicians who are thoughtful, competent, ethical, careful, honest, and genuinely invested in their wellbeing. And these qualities, interestingly, are often less visible online precisely because they are quieter, slower, and less performative. Wisdom rarely goes viral. Restraint rarely trends.

Perhaps this is the paradox now confronting modern dentistry: the profession has become extraordinarily visible at precisely the moment it must work hardest to preserve the quieter virtues upon which professional trust has always depended.

And maybe that is the real challenge of practising dentistry in the age of the algorithm, not learning how to become visible, but learning how to remain authentic while being seen constantly.

Conclusion

Perhaps every generation of dentistry eventually believes it is witnessing unprecedented change. New materials emerge. Technologies evolve. Techniques improve. Patient expectations shift. But the current transformation feels different, not simply because dentistry itself is changing, but because the environment surrounding the profession has changed so fundamentally.

Dentistry now exists within a culture of permanent visibility.

Smiles are photographed constantly. Treatments are consumed visually before they are understood biologically. Clinicians navigate a world in which professional identity increasingly intersects with branding, aesthetics, influence,

and algorithmic relevance. The profession has become more public, more performative, and more aesthetically amplified than at any other point in its history.

And yet, beneath the filters, ring lights, curated feeds, and cinematic smile reveals, dentistry remains something surprisingly unchanged.

Patients still arrive anxious. Biology still matters. Enamel still does not regenerate. Trust still takes years to build and moments to lose. The fundamentals of careful diagnosis, ethical judgement, restraint, technical excellence, and long-term care remain stubbornly resistant to algorithmic simplification.

This is perhaps why the current moment feels so fascinating. Dentistry now occupies two worlds simultaneously. One is the fast-moving world of visibility, content, aesthetics, and attention. The other remains the quieter world of healthcare, built on trust, judgement, responsibility, and professional integrity. Most clinicians now navigate both, often simultaneously, sometimes uncomfortably.

Importantly, this editorial is not nostalgic for a pre-digital profession. Social media has brought genuine benefits to dentistry: public education, professional connection, innovation, accessibility, creativity, and the democratisation of visibility itself. Many clinicians have used these platforms responsibly and brilliantly. The challenge is not visibility. It is remembering what visibility should serve.

Because if dentistry allows the algorithm to define success entirely, the profession risks slowly rewarding what is most watchable rather than what is most valuable. And the two are not always the same thing.

The irony, perhaps, is that the qualities patients value most in their dentists have changed remarkably little. Patients still seek clinicians who are careful, trustworthy, thoughtful, competent, reassuring, and honest. These qualities rarely trend online because they are subtle, cumulative, and deeply human. They are built quietly over years, not virally over weekends.

And maybe that is the enduring reassurance beneath all the noise of modern dental culture.

Long after the filters change, the platforms evolve, and the algorithms move on to whatever comes next, dentistry will still depend on something far older than visibility itself: the patient sitting in the chair, placing their trust in another human being.

RECOMMENDED READING

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AI in the Dental Surgery: From Diagnostic Aid to Practice Partner – A Strategic & Ethical Framework

SADJ MAY 2026, Vol. 81 No.4 P230-P242

Mr KC Makhubele – CEO, South African Dental Association

Beyond the Hype: The Practical Arrival of AI in Dentistry
Artificial Intelligence has transcended buzzword status and entered the tangible reality of dental practice. No longer a speculative future technology, it is an active clinical tool, offering capabilities that are simultaneously revolutionary and deeply practical. However, its integration demands more than a software purchase; it requires a profound understanding of its applications, limitations, and the complex ethical terrain it creates. For the South African dentist, the challenge is not *if* to adopt AI, but *how* to adopt it responsibly, professionally, and with a clear-eyed view of the legal and moral landscape.

CONCRETE APPLICATIONS: THE AI TOOL-BOX IN MODERN PRACTICE

The true power of AI lies not in replacing the clinician, but in augmenting human perception and analysis. Here is what it does today:

1. Enhanced Diagnostic Precision on 2D Radiographs

- **Caries Detection:** AI algorithms, trained on millions of annotated images, can identify demineralisation and proximal caries with sensitivity often surpassing the human eye, especially in early stages or in dense, overlapping anatomical areas. They serve as a powerful «second look,» reducing false negatives.
- **Periodontal Bone Loss Analysis:** AI can automate the measurement of bone levels around each tooth across full-mouth series, creating consistent, quantitative baseline data and tracking subtle changes over time that might be overlooked in a visual assessment.
- **Pathology Screening:** Algorithms are increasingly adept at flagging anomalies – from periapical lesions and root fractures to incidental findings like calcifications in soft tissue – prioritising them for the dentist's review.

2. Three-Dimensional Intelligence in CBCT & Digital Impressions:

- **Automated Anatomy Mapping:** In CBCT scans, AI can instantly segment and identify critical structures: the mandibular canal, mental foramen, maxillary sinuses, and tooth roots. This drastically reduces preoperative planning time for implants and surgical extractions and enhances safety.
- **Virtual Implant Planning:** AI can suggest optimal implant size, positioning, and angulation based on bone density, anatomy, and prosthetic goals, creating a data-driven starting point for the clinician's plan.
- **Orthodontic & Restorative Analysis:** On 3D intraoral scans, AI can perform automated tooth segmentation, occlusal analysis, and even predict tooth movement or propose restorative tooth preparations, standardising aspects of the digital workflow.

3. Administrative & Predictive Practice Intelligence:

- **Treatment Plan Support:** By analysing historical practice data, AI can suggest common treatment sequences or flag potentially missed diagnoses based on patterns in charting and radiographs.
- **Patient Communication & Scheduling:** AI-powered chatbots can handle initial FAQs and appointment requests, while predictive algorithms can forecast cancellations to optimise the appointment book.

THE CRITICAL QUESTIONS: NAVIGATING LIABILITY, DATA, AND ETHICS

Adopting AI without addressing these core issues is professionally perilous. The HPCSA and South African law provide the overarching principles, but the specifics are evolving.

1. The Liability Labyrinth: Who is Responsible for an AI Error?

The foundational principle is *inalienable clinician responsibility*. AI is a diagnostic aid, not a diagnostician. The HPCSA's ethical rules make the treating dentist ultimately liable for all clinical decisions.

- **Scenario:** An AI fails to flag a subtle osteolytic lesion on a panoramic radiograph, and the dentist, relying on the AI's «clear» assessment, also misses it. Who is liable?
- **Answer:** The dentist. The standard of care requires a dentist to personally review and interpret all diagnostic images. The AI's output is one piece of information in the clinician's decision-making process. The clinician must be able to understand the AI's limitations and override its suggestions. **Your indemnity insurer must be informed of your AI use, and your clinical notes should reflect your independent review (e.g., «AI-assisted caries detection software indicated potential caries on tooth 36; this was confirmed on visual and radiographic review»).**

2. The Data Dilemma: How is Patient Data Used to Train Algorithms?

This is a paramount privacy and ethical concern. Most AI companies use de-identified patient data to train their models.

- **Key Questions for Vendors:** Before purchasing any AI software, practices must ask: Was the training data used to develop this algorithm sourced with explicit patient consent? Is it **de-identified** (all personal and metadata removed) to POPIA and international standards? Where are the servers hosting this data located (data sovereignty)? Does your licence agreement grant the company rights to use your practice's data to further train their models?

- **The Local Imperative:** Algorithms trained predominantly on Northern European or North American populations may not perform optimally on the diverse skeletal, dental, and pathological presentations common in South Africa. This creates a clinical risk and an opportunity for locally developed, representative AI.

PROPOSING A SOUTH AFRICAN FRAMEWORK FOR ETHICAL AI ADOPTION

To guide safe integration, we propose a five-pillar framework for dentists and the broader profession:

Pillar 1: Validation & Context-Specificity

- **Action:** Before implementation, demand peer-reviewed, independent validation studies for any AI tool. Specifically, ask if it has been validated on a South African or similar demographic dataset. The onus is on the vendor to provide this evidence.

Pillar 2: Continuous Education & “AI Literacy”

- **Action:** Dentists must pursue CPD that explains not just how to *use* AI, but how it *works*—its strengths, failure modes (e.g., over-reliance on training data patterns), and biases. Understanding concepts like sensitivity, specificity, and confidence intervals for AI outputs is now part of clinical competence.

Pillar 3: The “Human-in-the-Loop” Protocol

- **Action:** Establish an in-practice protocol mandating that all *AI outputs must be verified and signed off by a qualified dentist*. AI should be a “co-pilot,” not an autopilot. This must be documented in clinical records.

Pillar 4: Transparent Patient Communication

- **Action:** Update informed consent processes. Patients should be told when AI is used as part of their diagnostic workflow, its role as an assistive tool, and that ultimate responsibility remains with the dentist. This builds trust and manages expectations.

Pillar 5: Professional Body Leadership (The SADA Mandate)

- **Action:** SADA must proactively:
 1. Engage the HPCSA to develop clear, anticipatory guidelines on AI use in dentistry.
 2. Create a vendor assessment checklist for members, covering liability, data privacy, and validation.
 3. Foster research partnerships to develop and validate AI tools on African data.
 4. Establish a forum for members to share experiences, report anomalies, and build collective wisdom.

Conclusion: The Augmented Dentist

The future belongs not to AI, but to the **augmented dentist** – the professional who wields these powerful tools with skill, scepticism, and unwavering ethical commitment. AI will not make the dentist obsolete; it will make the unskilled or uncritical dentist obsolete.

The goal is a synergistic partnership: AI handles pattern recognition at scale and superhuman consistency, freeing the clinician to focus on complex judgment, treatment planning, surgical skill, and the irreplaceable human elements of empathy, communication, and trust.

For the South African practice, thoughtful AI adoption is a strategic imperative. It elevates diagnostic standards, enhances patient safety, and streamlines practice economics. However, it must be built on a foundation of rigorous professional ethics, robust data stewardship under POPIA, and an unshakeable commitment to the dentist's role as the final, accountable clinical authority.

Embrace the tool. Uphold the principle. Lead the evolution. The most intelligent system in the surgery must always remain the informed, ethical mind of the dentist.



Dental practitioners' knowledge of healthcare waste management in the Greater Tshwane region

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T Mutibi,¹ HCL Gleimius,² J Oosthuysen³

ABSTRACT

Introduction

The healthcare waste management (HCWM) practices undertaken at dental healthcare facilities are of pivotal importance due to the infectious and hazardous nature of the waste generated at these facilities. Of particular importance is the risks associated with healthcare waste on the environment, including public health. Relevant knowledge of healthcare waste management regulations, with the emphasis on the individual responsibility of each dental healthcare team member, is paramount to ensure effective and efficient HCWM practices. The aim of the study is intended to contribute to the development of a HCWM plan specifically for dental healthcare facilities and as a basis for minimising risks to the health and well-being of the practitioners and people as well as the environment. The main aim of this study is to explore dental healthcare waste management to identify knowledge strengths, -weaknesses, and -opportunities in the dental healthcare facilities in the Greater Tshwane region.

Objective

To explore the dental health practitioners' knowledge of healthcare waste management.

Design

The study was based on a descriptive and cross-sectional explorative study.

Method

Data were collected from 52 respondents using a questionnaire, which probed their knowledge, towards HCWM. The study centred on public and private dental healthcare facilities in central, eastern, western and northern

Tshwane as well as one academic training institution in northern Tshwane.

Results and conclusions

The results were positively indicative that dental healthcare staff consider they have sufficient knowledge of HCWM.

Keywords

Waste management, dental healthcare workers, knowledge, dental practitioners/assistants

1. INTRODUCTION

The dental healthcare sector generates growing quantities of healthcare waste while rendering dental healthcare procedures at their facilities. This waste includes both general waste and healthcare risk waste (HCRW), which presents associated health- and environmental risks.¹ Healthcare risk waste generated at dental healthcare facilities, including sharps and other infectious waste, is classified as hazardous and poses a serious risk to human health and the general environment.² Unsafe management of hazardous waste may increase the risk of injuries and transmission of infectious agents.³ Specific guidance regarding why healthcare waste is a significant danger to society is stated in the Health Professions Council of South Africa's Booklet 12: Guidelines for the management of health care waste.⁴ Paragraph 5 reads as follows:

- 5.1 *Unsafe management of hazardous healthcare waste, particularly in its disposal, may increase the risk of needle stick injuries, transmission of infectious agents and expose unsuspecting parties to unnecessary and entirely preventable risks. The severity of the risk associated with such exposures may be difficult to quantify, and such exposures should be prevented.*
- 5.2 *Healthcare waste entering the normal domestic waste stream will end up being disposed of in municipal landfill sites. When healthcare waste is placed in landfills or buried, contamination of groundwater may occur and may result in the spread of infectious pathogens, such as E-Coli, and unacceptably high Chemical Oxygen Demand (COD) readings.*
- 5.3 *Many smaller landfill sites are not fenced off and have poor security. This results in unwanted tip-face picking and scavenging. If healthcare waste is disposed on such a site, there is a risk of exposure to people scavenging on the sites.*
- 5.4 *The irresponsible and illegal dumping of hazardous healthcare waste in South Africa, as intermittently reported in the media, is a matter of serious concern. It also places an unacceptably high financial and human resources burden on health authorities to manage the problem.*
- 5.5 *The burning of healthcare waste as opposed to incineration is not recommended as it pollutes the environment, especially through the formation of*

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dioxins. Incineration should only be used where it meets specifications that avoid secondary pollutant emissions.

The possibility of experiencing a healthy environment is unpleasantly affected when waste generation without proper management is encountered. Without appropriate knowledge and management of healthcare waste generated at dental healthcare facilities, the dental healthcare staff, people in the immediate vicinity, the waste handlers and the public at large can be adversely affected due to the production of toxins and cross-contamination caused by human pathogens from oral secretions.⁵ As far back as 2014, Govan confirmed that HCRW pose serious health and environmental risks, particularly due to the lack of available commercial treatment capacity.⁶ It is essential to use appropriate skills, tools and technology to manage waste everywhere, including the urban, rural, healthcare, industrial and mining environments. Hazardous healthcare waste management is a concern for every healthcare organisation.⁷

1.1 Risks associated with dental healthcare waste

In human lives good health and wellness are core essences.⁸ United Nations members in 2015, created 17 world Sustainable Development Goals, with Sustainable Developmental Goal #3 ensuring healthy lives and promoting well-being for all at all ages to eradicate all preventable diseases and premature deaths.⁹ Globally, about 5.2 million people, of which 4 million are children, die each year from waste related diseases.¹⁰ In 2009, there was an outbreak of hepatitis B in Gujarat, India due to the reuse of injection equipment as well as second-hand medical devices, especially syringes, being traded in, re-packed and sold illegally. Out of at least 240 cases, 60 lives were lost.^{11,12} Infectious waste management remains the biggest challenge in developing countries with re-occurring infectious diseases like diarrhoea and typhoid which demands effective healthcare waste management.¹³ Interesting concerns were raised in a study from Greece, stating dentistry pose a significant global environmental footprint due to carbon emissions and waste production.¹⁴

The reuse of materials at a healthcare facility has provoked much debate, in particular, concern over the reuse of single-use medical devices. In general, the use of non-disposable items for medical procedures should be encouraged, especially when sterilisation cleaning can be demonstrated to minimise infection transmission to acceptably low levels.¹⁵

Furthermore, a study on the management of HCRW, conducted by the World Health Organization¹⁶ in 2024, estimated that 2000 contaminated syringes, reused injections and equipment from healthcare facilities resulted in 2.6 million HIV infections, of which 5% were new infections and 21 million hepatitis B infections, of which 32% were new infections, as well as 2 million hepatitis C infections, of which 40% were new infections.¹⁷ The serious threat to the health, safety and lives of millions of healthcare workers and waste handlers who frequently come in contact with HCRW, and adverse incidents can be prevented if all staff handling HCRW are appropriately trained, and the management of healthcare waste is executed according to recommended guidelines and regulations.¹⁸

Dental healthcare workers have been identified to be at increased risk of cross-contamination with infection after needle-stick injuries. Their chances of infection with hepatitis B are 6 – 30% after a single needle-stick incident.¹⁶ Results

from a study at a Tertiary Hospital in the Northern Cape Province, South Africa revealed that HCRW is a major contributor to environmental pollution when healthcare workers, waste management, disposal services, and handlers at healthcare facilities incorrectly manage waste.¹⁹ Interesting results among lecturing staff were reported from China, indicating dentists with teaching qualifications had the highest risk of occupational exposure incidents, compared to dental students, dental assistants, and dental assistant students.²⁰ An occupational health report of a hospital in the Mpumalanga Province, South Africa, revealed an increase in the number of needle-stick injuries among hospital ward cleaners.²¹ Cleaners do not routinely use needles nor sharps, so it is not expected that they would experience such injuries. However, studies showed that cleaners are injured by needles incorrectly disposed of by healthcare staff.²¹ In 2000, sharps injuries to healthcare workers were estimated to have caused about 66 000 hepatitis B (HBV), 16 000 hepatitis C (HCV) and 200 – 5 000 Human Immunodeficiency virus (HIV) infections among healthcare workers.²¹ For healthcare workers, the infections that were caused by percutaneous occupational exposure to HBV, HCV and HIV was 37%, 39% and 4%, respectively.¹⁶ A rinsed but unsterilised syringe can still have a 1.8% chance of passing on HIV if used for an intravenous injection and 0.8% if used in the administration of an intramuscular injection.¹⁶

Nemutandani (2008)²² reported occupational exposure (78.4%) and sharp injuries (83%) among dental assistants at dental clinics in Limpopo due to a lack of formal or other structured training in HCRM.²² The occupational risk to dental assistants increased 9.9 times when compared to those for the semi-trained auxiliary nurses. The lack of training may therefore be a leading cause of occupational injury to dental assistants. Nemutandani further reported that two-thirds of the respondents were injured when removing and/or cleaning instruments and of the dental assistants, 65.3% obtained injuries from direct punctures.²² This study highlighted the fact that additional contributing factors can be attributed to the injuries to dental assistants, including the fact that dental facilities were understaffed and had increased workloads. The increased risk of sharps injuries is also highlighted on a global level.²³

The report on post-exposure management among dental assistants indicated that almost a quarter of the respondents (23%) failed to report exposures and injuries.²² Among the dental assistants who reported exposure incidents, the majority were only provided with wound cleaning (83%), while a small percentage (23.8%) were placed on antiretroviral treatment for post-exposure prophylaxis.²² Concerning results were reported among waste handlers from Ghana who were not vaccinated as recommended and managing infectious waste and sharps lacked, resulting in falls and sharps injuries.²⁴ In another study on the handling and transporting of HCRW, including sharps, at clinics in a rural health district in KwaZulu-Natal, approximately 50% of the respondents were unaware of the possibility of any post-exposure prophylaxis management or treatment.²⁵

The transmission of infection and its control is well explained by the “chain of infection”, which consists of an infectious agent, reservoir, portal of exit, mode of transmission, portal of entry and susceptible host. It is essential that healthcare workers understand the significance of each link and how the chain of infection can be interrupted. Hence, good HCRW management can be viewed as an infection control

procedure. Control measures for HCRW are most often directed at the mode of transmission stage in the chain of infection, although it is also important to note that breaking any link in the chain will prevent infection.²⁶

It is imperative for infection control to be seen as a key element in providing a safe environment for patients and staff within a dental healthcare facility.^{27, 28} Dental healthcare facilities are supposed to be places of caring/healing, but instead, can become places where infections are spread because of poor healthcare waste management.²⁹ Dental healthcare professionals are continuously in contact with traumatised tissue, saliva and blood, which increases the risk of disease transmission. It is estimated that one drop of saliva may contain up to 600 000 bacteria.³⁰ Therefore, at any dental healthcare facility, it is imperative for infection prevention and control to be part of healthcare risk management in providing a safe environment for patients, staff and the general public.²⁹ A risk associated with dental restorative materials is posed using dental amalgam, as it contains mercury. Mercury can corrode, has a low flame point and is a reactive, oxidizing explosive as well as being highly toxic, especially in its elemental form or as methylmercury. It may be fatal if inhaled and is harmful if absorbed through the skin or mucous membrane. Roughly 80% of the inhaled mercury vapour is absorbed into the blood through the lungs, which can then lead to the nervous, digestive, respiratory, immune systems and kidneys as well as the lungs being harmed.³¹ Adverse health effects from mercury exposure include tremors, a potent neurotoxic reaction that can affect the brain and spinal cord, kidney damage, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental disabilities during foetal development as well as attention deficit and developmental delays during childhood.²⁹ Recently Sudi and Naidoo reported on current complexities involving managing dental amalgam waste in South Africa and suggested improvements to dental amalgam waste management practices, considering dental amalgam is phased out in most developed countries.³¹ Amalgam separators should be installed in air/water lines, however high costs of modern technology present challenges.³¹

According to a survey conducted by the WHO in 22 developing countries in 2002, it was found that 18% – 64% of HCF did not use proper waste disposal methods and these practices are common in many developing countries.³² Legal reasons for Occupational Health and Safety (OHS) management relate to the preventative, punitive and compensatory effects of laws that protect workers' safety and health. OHS management can reduce the costs related to injury and illness among employees, including medical care, sick leave and disability benefits. OHS management can also enhance or tarnish a healthcare facility's reputation and its image among stakeholders.^{34, 35}

A combination of continuous education, the desire for lifelong learning and professional training, including the drive of all dental team members and relevant stakeholders are required for an efficient dental healthcare waste management (HCWM) system to be achieved. Relevant knowledge of healthcare waste management regulations, with the emphasis on the individual responsibility of each team member, is paramount to ensure effective and efficient HCWM practices.³⁶ A common problem associated with healthcare waste management is that sufficient budget and resources are often not available in public hospitals and therefore increasing

the risks and compromising compliance associated with waste management.¹⁰ Therefore, this study aims to explore dental HCWM knowledge strengths, -weaknesses, and -opportunities in the dental healthcare facilities in the Greater Tshwane region.

1.2 Inclusion and exclusion criteria

A convenience sampling strategy was followed. Thus, all participants willing to partake in the study and completed the questionnaire were included in the study. Inclusion: We conducted the study based on a voluntary basis – we did not have specific criteria except that the dental healthcare facility had to be in the Greater Tshwane region and perform routine oral healthcare procedures. Exclusion: Only respondents that could understand, speak and read fair English were selected.

2. MATERIALS AND METHODS

Healthcare waste management practices at dental healthcare facilities in the greater Tshwane region were explored. A questionnaire was used to collect data. Data analysis, reliability, validity, limitations and ethical considerations are also outlined. This study forms part of a larger study that also included attitude and practices toward HCWM. Only the knowledge toward HCWM was highlighted in this article.

2.1 Study location and sample size

South Africa has a total of 257 municipalities, 8 of which are metropolitan municipalities.³⁷ The City of Tshwane Metropolitan Municipality is the northern metropolitan municipality within the local government structure of the Gauteng Province, South Africa. While the Metropolitan area is centred on the city of Pretoria, a few surrounding towns and local authorities are included in the local government area. A convenience sampling strategy was followed and study only centred on public and private dental healthcare facilities willing and able to participate in central, eastern, western and northern Tshwane as well as one academic training institution in northern Tshwane.³⁷

Figure 1 shows the geographical map of Greater Tshwane, including some of the surrounding towns. The questionnaires were distributed within this study area.

2.2 Study design

The study was based on a descriptive and cross-sectional explorative study. A survey was conducted to investigate the relationship between risk factors and outcomes of interest, for a given population, with the purpose aimed at public health planning. The study was conducted in three phases:

Phase I Planning

- Review of the literature on dental healthcare waste management knowledge, attitudes and practices;
- Draft questionnaire to address healthcare waste management;
- Pilot of the questionnaire to assess the reliability and validity; and
- Finalise questionnaire

Phase II Administration of questionnaire

- Issue and administer the questionnaire to dental healthcare practitioners, assistants and facility managers at dental healthcare facilities to explore the knowledge, determine attitudes and evaluate the healthcare waste management practices of staff working at dental healthcare facilities.



Figure 1: Map of the City of Tshwane Metropolitan Municipality (Sourced from Metropolitan Municipality, 2025)³⁷

Phase III Data collection, analysis and interpretation

- Collect data;
- Capture the data in the questionnaire and then analyse; and
- Report and make recommendations to improve the current policies and evaluate the possibility of developing an integrated healthcare waste plan for dental healthcare facilities.

The three phases of the methodological approach to the research study design illustrated in Figure 2.

3. ETHICAL CLEARANCE AND CONFIDENTIALITY

Ethical clearance was obtained from the University of the Free State: Health Sciences Research Ethics Committee prior to collection of data (UFS-HSD2018/0782/2711). The study was approved by the Faculty and Institutional Research Committees of the Central University of Technology, Free State. To safeguard the respondent's information and privacy, the researcher observed standard professional and ethical principles. In addition, the Gauteng Department of Health (GP_201810_054) gave permission to conduct the research in the City of Tshwane.

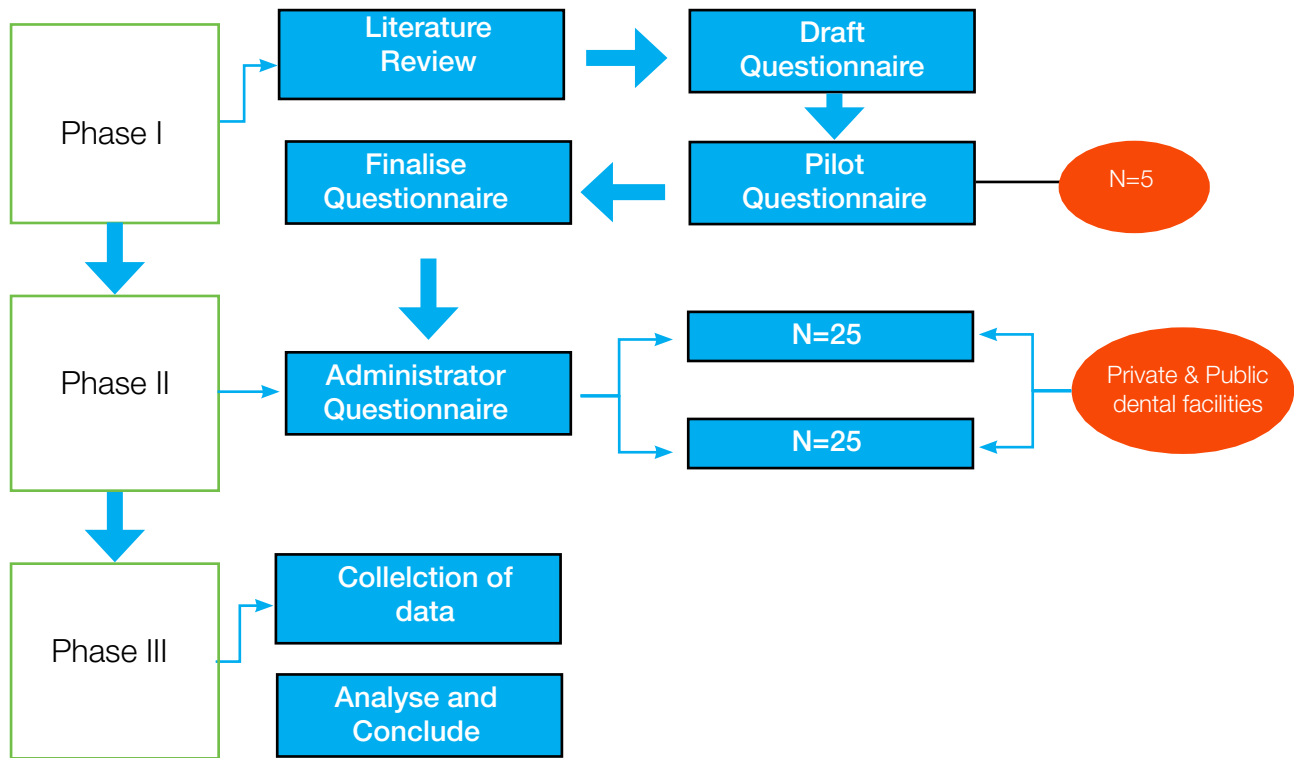


Figure 2: Three phases of the research study design

Confidentiality was recognised under all circumstances and all communication was conducted in English to ensure clarity and understanding of factual data.

4. ASSESSMENT QUESTIONNAIRE

The questionnaire was designed, using closed ended questions. The draft questionnaire was reviewed by five panel members, which consisted of the researcher's two supervisors, a waste management specialist, one dental practitioner and a person from outside the dental healthcare field. The purpose of the questionnaire review was to refine the questionnaire. The final validity and reliability of the questionnaire was established by a pilot study group.³⁸ The length of the questionnaire was identified as a possible constraint to participating in the study. Therefore, every effort was made to limit questions to a minimum without sacrificing crucial aspects of the knowledge required for dental healthcare waste management surveyed. The questionnaire was structured in such a manner that each section was reasonably short, and the response required just a tick in a block. A copy of the questionnaire is included under Supplementary Information: Appendix 1.

The results of the pilot study were not included in the results of the study but merely utilised to refine and improve the questionnaire. The data obtained in the pilot study was furthermore subjected to statistical analysis processes to measure the reliability and validity of the draft dental healthcare waste management questionnaire. The results of the statistical tests were used to make further refinements to the draft questionnaire.³⁸ The final instrument was then done electronically by utilising the QuestionPro® online survey software program to facilitate online participation and to ease the capturing of data from the hard copies as well as help in the transfer of data to MS Excel spreadsheets, PowerPoint and Word documents.

Several dental healthcare waste management themes were identified for the main framework of the questionnaire, including:

- Section 1: Demographic Information of Respondents.
- Section 2: Dental Healthcare Waste Management Training and Continuous Professional Development.
- Section 3: Classification of Dental Healthcare Waste (General, Chemical, Sharps, Infectious and Pathological).
- Section 4: Generation and Minimisation.
- Section 5: Segregation and Storage.
- Section 6: Waste Administration.
- Section 7: Transport.
- Section 8: Waste Disposal.
- Section 9: Waste Treatment.
- Section 10: General Views of Dental Healthcare Waste Management.

4.1 Administration of the questionnaire

Out of the 58 questionnaires issued, 6 started but did not complete the survey and 52 respondents eventually completed the survey. The questionnaire was distributed in two manners: the first batch of questionnaire were distributed electronically using QuestionPro® online survey software program Version 15 that was accessed online through the Central University of Technology (CUT) institutional licence from <https://www.questionpro.com/v15/> and the second batch were distributed in hard copies.

4.2 Study population

The study population comprised of healthcare professionals employed in both public and private at dental healthcare facilities across the Tshwane region. The participants were aged between 18 and 65.

5. RESULTS

5.1 Biographical information results

Information was obtained from 52 respondents, including dental assistants (42%), dentists (23%), dental therapists (10%), oral hygienists (6%), and other support staff, including a professional nurse in dental theatre (19%). Results from study in public healthcare facilities in Gauteng Province, South Africa stated healthcare facilities appoint a dedicated person, mainly environmental health practitioners, to manage healthcare waste.³⁹ In the current study the majority, approximately two-thirds of the respondents, were female in the 36 to 45 age range. The highest number of respondents were represented by dental assistants, followed by dentists (Table I). The facilities included in the research were Sefako Makgato Oral Health Centre, Kalafong Hospital, Folang Hospital (Pretoria West) and K.T. Motubatse Clinic as well as some private dental healthcare facilities that requested to remain anonymous and not have their practice names mentioned.

5.2 Knowledge of healthcare waste management at dental healthcare facilities

The knowledge of healthcare waste management at dental healthcare facilities referred to the participating respondent's understanding of the given topic or question. In this study, the participating respondents ranged from dentists, dental therapists, oral hygienists, dental assistants, and a nurse with formal Higher Education training to those dental healthcare staff members who had only received in-service training. Table II provides the frequency distribution and knowledge profile of the respondents, of whom 75% had formal University qualifications. It is, however, very alarming that despite these formal qualifications, almost the same percentage of respondents were unaware that examination gloves are insufficient as hand protective equipment when handling healthcare risk waste.

Table I: Study population distribution

Male Population	Female Population	Other	Dental Assistant	Dentist	Dental Therapist	Oral Hygienist	Other	Public Sector	Private Sector
21%	73%	6%	42%	23%	10%	6%	19%	51%	49%

Table II: Frequency distribution and knowledge profile of respondents

Question	Description	Options	Count (n)	Percentage (%)
Q13	Educational training received	In-service training	10	19.23
		University	39	75.00
		Other	3	5.77
Q14	Continuous Professional Development (CPD) activities	Yes	38	73.08
		No	12	23.08
		Other	2	3.85
Q15	Current knowledge of dental healthcare risk waste management	Average	30	57.69
		Above average	16	30.77
		Excellent	6	11.54
Q16	Refreshing knowledge on dental healthcare risk waste management	Formal training at university	8	8.00
		Employment place	22	22.00
		Other colleagues	11	11.00
		Reading books and journals	11	11.00
		Doing internet search	18	18.00
		Attending CPD events	23	23.00
		None	5	5.00
		Other	2	2.00
Q21	Various categories of dental healthcare risk waste generated	Yes	48	92.00
		No	1	2.00
		Not sure	3	6.00
Q23	Specific colour coding used to dispose of several types of dental healthcare risk waste	Yes	40	93.02
		No	1	2.33
		Not sure	2	4.65
Q24	Example of general waste	Used gauze	7	14.00
		Papers	43	84.00
		Used needles	0	0.00
		Not sure	0	0.00
		Other (used gloves)	1	2.00
Q25	Example of sharps waste	Fixer solution	0	0.00
		Papers	0	0.00
		Used needles	51	100.00
		Not sure	0	0.00
		Other	0	0.00
Q26	Example of infectious anatomical waste	Extracted tooth	46	88.00
		Papers	0	0.00
		Cotton used in patient's mouth	4	8.00
		Not sure	0	0.00
		Other (cotton)	2	4.00
Q27	Example of pathological infectious waste	Extracted tooth	27	52.00
		Papers	0	0.00
		Gauze used in patient's mouth	23	44.00
		Not sure	0	0.00
		Other	2	4.00
Q28	Example of chemical waste in dental healthcare facilities	Fixer solution	51	98.00
		Papers	0	0.00
		Used needles	1	2.00
		Not sure	0	0.00
		Other	0	0.00
Q29	Example of pharmaceutical waste	Expired medication	50	98.00
		Used needles	1	2.00
		Cotton used in patient's mouth	0	0.00
		Not sure	0	0.00
		Other	0	0.00
Q30	All healthcare risk waste generated in facility is hazardous	Yes	42	81.00
		No	9	17.00
		Not sure	1	2.00
Q34	Examination gloves is sufficient hand protective equipment when handling healthcare risk waste	Yes	35	67.00
		No	16	31.00
		Not sure	1	2.00
Q57	Healthcare risk waste should be disposed in a specific prescribed manner	Yes	44	85.00
		No	2	4.00
		Not sure	6	12.00
Q60	Burning/ incinerating healthcare risk waste is a safe waste treatment method	Disagree	3	6.82
		Neutral	2	4.55
		Agree	25	56.82
		Not sure	14	31.82

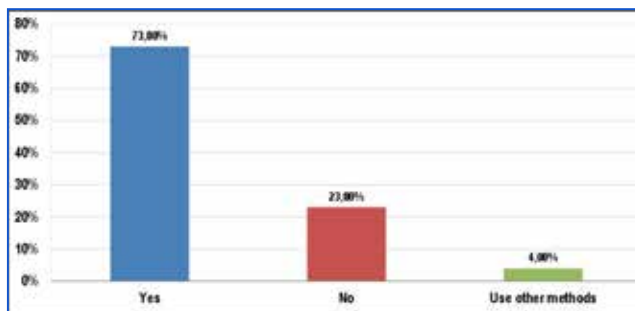


Figure 3: Respondents' attendance at Continuous Professional Development activities

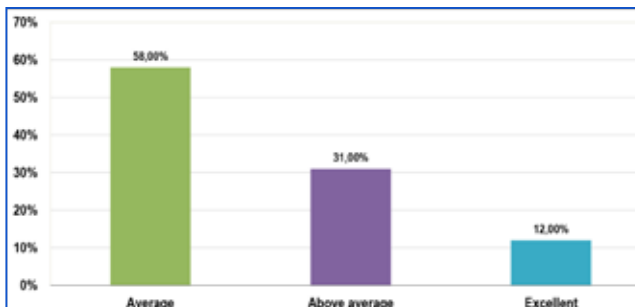


Figure 5: Respondents' personal rating of dental HCWM knowledge

5.3 Continuous Professional Development activities and knowledge refreshment (Q12, 14 and 16)

Most respondents (n=38) indicated that they regularly attend CPD activities, less than a quarter (n=12) of the respondents indicated that they do not attend, while only two respondents indicated that they are not obliged to attend (Fig. 3). One of these two respondents indicated that they assisted a periodontist from time to time and sometimes did online activities, while the other felt no need to attend CPD activities.

On the other hand, one respondent made the remark: "I believe it is important to give dental personnel more training and improve the way of taking care of the dental waste." Respondents further indicated they refreshed their knowledge of dental HCRW management by attending formal training at university (8%) and 22% refreshed their knowledge at their places of employment (Figure. 3). Some respondents (11%) refreshed their knowledge from information shared with colleagues, by reading books and journals while less than a fifth (18%) from searches on the internet. Most (23%) was from attending CPD events with 5% by other methods. Only one respondent did not feel the need to refresh their knowledge (Figure 4).

5.4 Personal rating of dental HCWM knowledge (Q15)

Most of the respondents, almost two-thirds, felt that their

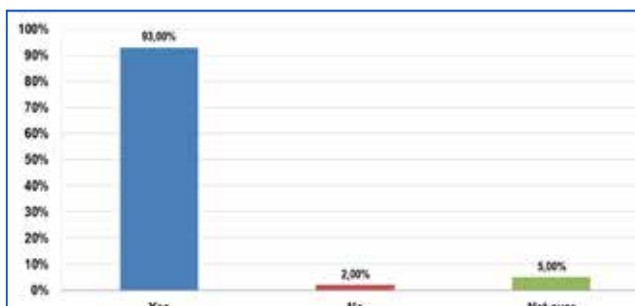


Figure 7: Knowledge of specific colour coding used when disposing different types of dental healthcare risk waste

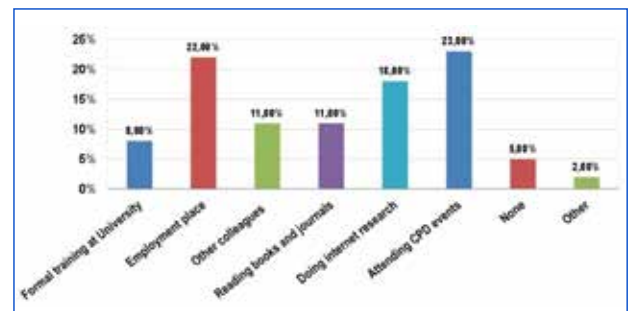


Figure 4: Activities by respondents to refresh their knowledge

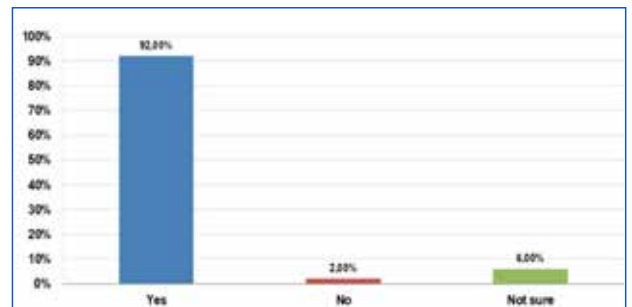


Figure 6: Knowledge of the various categories of dental healthcare risk waste

knowledge of dental HCWM is only average. More than a third of the respondents felt confident with above average knowledge and just above a tenth with excellent knowledge (Figure 5).

5.5 Knowledge of HCRW categories (Q21)

Most of the respondents (n=48) knew that there are various categories of dental HCRW, only one was unaware of this fact, while three respondents indicated that they were not sure about this (Figure 6).

5. KNOWLEDGE OF HCRW DISPOSAL COLOUR CODING (Q23)

Most respondents (n=49) knew that distinct colour coding is used to dispose of HCRW. However, one respondent did not know and two were not sure of the HCRW disposal colour coding system (Figure 7).

5.7 Knowledge of types of HCRW (Q24 – 29)

Most respondents (83.31%) said paper was an example of general waste. However, seven respondents (13.73%) incorrectly identified used gauze as general waste and one respondent named used gloves as general waste (Figure 8).

All respondents were familiar with the example of sharps waste that included used needles (Figure 9).

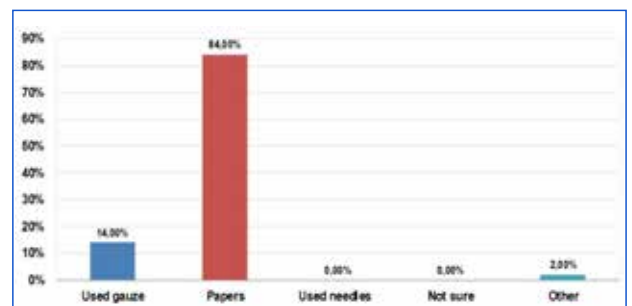


Figure 8: Knowledge of general waste

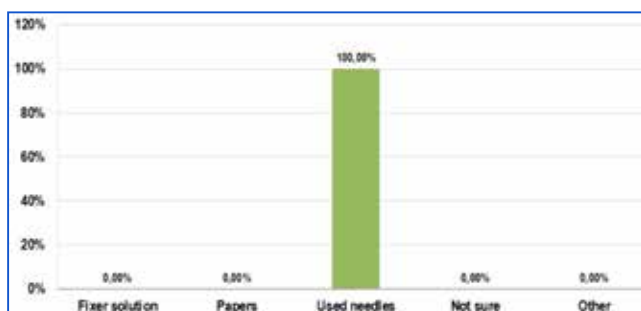


Figure 9: Knowledge of sharps waste

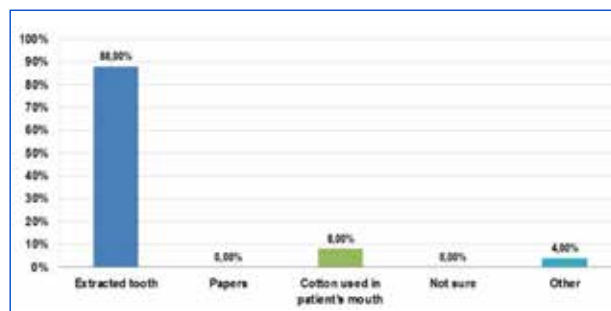


Figure 10: Knowledge of infectious anatomical waste

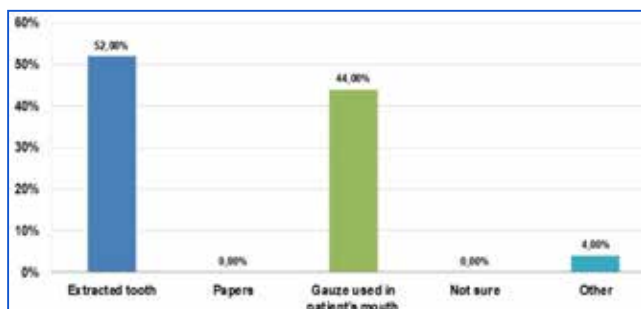


Figure 11: Knowledge of pathological infectious waste

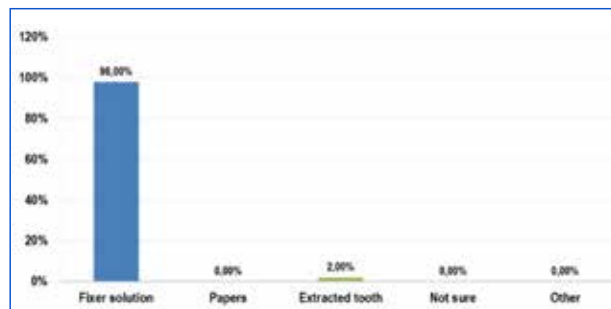


Figure 12: Knowledge of chemical waste

Most respondents (88.46%) identified the example of infectious anatomical waste as an extracted tooth, but four (7.69%) included cotton used for patient care and two (3.85%) included cotton under other (Figure 10). Thus, it is safe to say all respondents correctly identified infectious waste, however, some respondents incorrectly included cotton used for patient care as anatomical waste.

Of the respondents, 27 (51.92%) identified an example of pathological infectious waste as the extracted tooth, 23 (44.23%) included gauze used for patient care and two respondents (3.85%) included the extracted tooth under other (Figure 11).

Most of the respondents (98%) said an example of chemical waste at the dental healthcare facility is fixer solution, while 2% thought it was the extracted tooth (Figure 12).

The same 98% of the respondents said an example of pharmaceutical waste is expired medication and 2% thought it was used needles (Figure 13).

Most of the respondents (81%) felt that the healthcare waste generated at their workplace is hazardous, while the minority (17%) felt the contrary and 2% were not sure (Figure 14).

5.8 Knowledge of HCRW disposal and treatment (Q57 and 60)

Most respondents (85%) said HCRW should be disposed in a specific prescribed manner, 4% said HCRW did not require a specific method of disposal and above 12% were not sure (Figure 15).

More than half (57%) of the respondents agreed that burning/incineration was a safe waste treatment method for

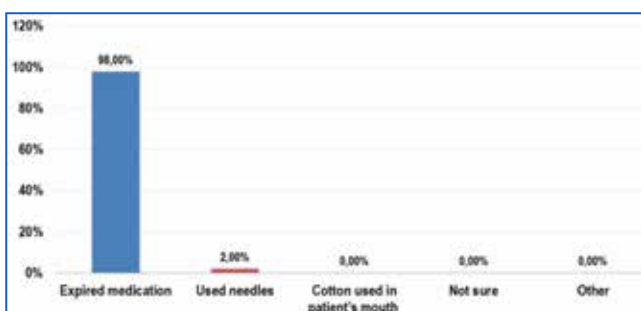


Figure 13: Knowledge of pharmaceutical waste

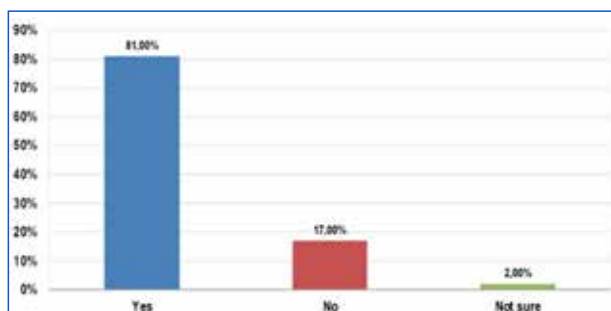


Figure 14: Knowledge that hazardous waste is generated at workplace

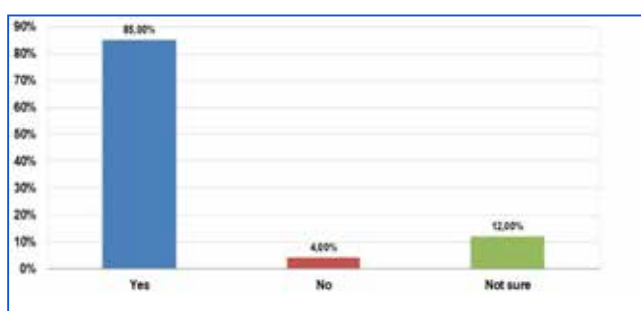


Figure 15: Knowledge of HCRW disposal

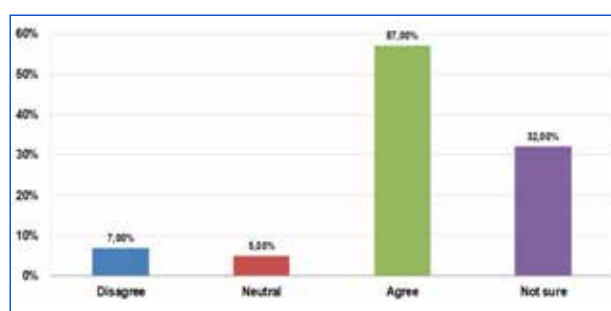


Figure 16: Knowledge of HCRW treatment

HCRW, about a third (32%) of the respondents were not sure about the matter and 7% disagreed. This information is an indication that there is a lack of knowledge (Figure 16).

6. DISCUSSION

More than a quarter of the respondents, who were dental assistants, had in-service training, while most of the respondents had been to university. However, it should be noted that the in-service training might be bias towards the trainer's knowledge or preferences. Research studies show that experience alone is not sufficient to effectively manage healthcare waste.^{36, 41}

This study's results indicated that the majority of the dental healthcare staff felt that they have sufficient knowledge of healthcare waste management and the score on knowledge proved that. The percentage of healthcare workers who had knowledge on dental waste disposal was higher than the one for those who were not knowledgeable, which had the similar results as this research study by Vumase.³⁶ These results also compare with the results of waste management knowledge among dental students and private dental practitioners of Alkharj, Saudi Arabia and results from a study among laboratory workers at a regional hospital in Lesotho.^{40, 41}

More than two third of the respondents were aware of the different healthcare waste categories with the examples and colour coding as well as treatment and disposal of HCW. The only concern is that 12% of the respondents were not sure of their knowledge on healthcare waste disposal. Meanwhile these respondents practice disposal of dental healthcare waste in their day-to-day activities and they also received instruction as part of their education and training.

Gaps can be identified in the HCWM knowledge, and it is necessary to develop plans to close these gaps. It is expected that staff members possess the necessary knowledge for them to dispose of dental healthcare waste according to the national guidelines.³⁵ Proper disposal of dental healthcare waste is of great importance to protect the employees, the environment and the public against health risks. In a comparative analysis of government and private healthcare facilities in Abuja, Nigeria private healthcare workers demonstrated better knowledge of waste segregation, while in contrast, results from government employees indicated more positive attitudes toward waste handling.⁴²

The recommendations include staff training at the start of their new employment and when new infection prevention and control equipment is purchased or taken in for use. The HPCSA accredited training on HCWM is to serve as a reminder. The results of this study provide a baseline for the knowledge of dental healthcare staff regarding HCWM of dental waste. It is suggested that this baseline be used by dental healthcare facilities to develop a plan to improve and address the identified gaps. The need to routinely educate all categories of dental healthcare staff members to ensure that appropriate and standard execution of healthcare waste management practices is affected, is of greater importance than what participants perceived.

7. CONCLUSION

Healthcare workers perform a critical role in the clinical management of patients and in addition, providing adequate infection control and prevention precautions and waste management procedures in healthcare facilities. Aleanzy

and Alqahtani stated staff appreciated the importance of their role in infection control, monitoring of ongoing safety for patients, their facilities and communities. The lack of waste management knowledge related to the policies, standard operating procedures and plans can be addressed with appropriate training to prevent improper waste segregation and non-compliance to legislations and regulations governing HCRW¹⁹. In a recent update on waste disposal in dentistry the focus on waste reduction, reuse, recycling, and responsible disposal to minimise environmental harm while maximising resource recovery and economic benefits was highlighted.⁴⁴ The questions posed during the current study, and data generated were aimed at dental practitioner's dental healthcare waste management knowledge. Data was limited and collected only from a convenience explorative sample from dental healthcare fraternities of one academic hospital, public and private dental healthcare facilities in the Greater Tshwane region.

7.1 SWOT Analysis of dental healthcare waste management knowledge

The SWOT analysis provides an opportunity to improve dental healthcare waste management knowledge. An attempt has been made to identify both the weaknesses and strengths of the internal analysis as well as the opportunities and presumable threats facing those working in healthcare waste management within the dental profession.

Internal Analysis – part of the internal environment that can be influenced and controlled

Strengths

1. Continuous development of technologies and materials used in practice.
2. Possible access to innovations in conventional and non-conventional methods and technologies.
3. Teamwork with dental professionals and professionals from other fields.
4. Job satisfaction of dental professionals.
5. Patient satisfaction with dental services.
8. Job satisfaction as specialist in the waste management focus area of infection prevention and control.
9. Possibilities for private initiative and independent activity.
10. Lifelong learning and professional training.
11. Practical use and application of medical waste management services in the work process with dentists and patients.
12. Demand for dental infection prevention and control specialists in the labour market.

Weaknesses

1. Lack of upgrading training for the specialty "waste management focus area in infection prevention and control."
2. Lack of communication and teamwork training.
3. Absence of regulation for continuing education.
4. Absence of a regulation for carrying out infection prevention and control.
5. Lack of training for successful practice management.
6. Insufficient knowledge of the normative documents of professional organisations.
7. Insufficient activity of the professional organisations regarding the continuing training of working waste management focus area in infection prevention and controls.

8. Need for investments to create, maintain, and guarantee safe and healthy working conditions.
9. Need for large investments to create and maintain modern equipment and/or devices and consumables.
10. Uneven distribution of practical training: they are concentrated mostly in big urban areas.

External Analysis – should be taken into consideration but cannot be directly influenced

Opportunities

1. Introduction of regulation on continuing education in correspondence with South African practices.
2. Continuous training to improve qualifications and acquire new skills and competencies.
3. Professional development in accordance with new technologies and materials in practice through courses or on-the-job training (mentoring).
4. Introduction of regulation for organising training for workers in the “waste management focus area in infection prevention and control” specialty.
5. Expanding the services for the National Health Insurance targeting dental activities by including new medical devices to improve health care for the population across all age groups.
6. Development of project activities for financing the practical training and continuing education of waste management focus area in infection prevention and controls.
7. Involvement of distinguished specialists in continuing education.
8. Introduction of upgrading training in the “waste management focus area of infection prevention and control”.
9. Necessary actions by the professional organisations and training institutions to organise continuing education.
10. Proper distribution of financial resources and purchase of modern equipment and/or devices and consumables.

Threats

1. Unsatisfactory and uneven development of science and practice related to “waste management focus area in infection prevention and control” in different countries and regions.
2. Constantly increasing demands from dentists.
3. Constantly increasing demands from patients.
4. Lack of necessary financial resources for the purchase of new and modern equipment and/or devices and consumables.
5. Necessity of large expenses for continuous theoretical and practical training in “waste management focus area in infection prevention and control.”
6. Lack of sufficient financial resources among users of dental services.
7. Slow return on investment.
8. Shortage of dental infection prevention and control specialists, leading to problems in providing necessary and timely healthcare risk waste management in some regions.
9. Lack of good face-to-face communication within the dental team.
10. Possible exposure to risks to human health and to the environment associated with healthcare waste management when not properly treated, incorrectly disposed or transported over distances.

Further studies on dental healthcare waste management are recommended to include larger geographical populations. The questionnaire can be utilised to survey the knowledge, attitudes and practices towards dental healthcare waste management in the future. Furthermore, the questionnaire can also be applied to future research investigating the knowledge, attitudes and practices towards dental healthcare waste management. Expanded to a broader data base, the questionnaire can enable researchers to also associate findings from similar studies conducted on provincial, national and international levels.

Abbreviations

HCRW	: Healthcare risk waste
HCW	: Healthcare waste
HCWM	: Healthcare waste management

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Conflict of interest statement

The authors declare that they have no competing interests.

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Author Contributions

T Mutibi master's research candidate. T Mutibi conducted research and captured the data HCL Gleimius and J Oosthuysen conceptualised the research design under the guidance of Prof. Annabel Fossey.

T Mutibi, J Oosthuysen and HCL Gleimius conducted data analysis and drafted figures and tables. T Mutibi, HCL Gleimius, & J Oosthuysen drafted the manuscript. All authors critically reviewed and approved the submission of the manuscript.

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Online CPD in 6 Easy Steps



The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.



Dental Students' Perceptions of Sugar Tax and Consumption of Sugar-Sweetened Beverages

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Ntshovela Mabasa,¹ Mpho M Matlakale²

INTRODUCTION

Sugar remains a common risk factor that is associated with an increased risk of type 2 diabetes, obesity, heart disease, and dental caries.¹ One of the strategies for reducing sugar consumption is taxation, which aims to minimise the purchasing behaviour of sugar-containing items by increasing the prices. Sugar is additionally the primary etiological factor for dental caries and its disease progression.³ Many factors influence the relationship between sugar and caries, such as the frequency of sugar consumption and the chemical structure of sugars. Teeth affected by dental caries may often result in irreparable damage and ultimate extraction, subsequently affecting the quality of life, which includes impairment of mastication, phonetics, and sleep disturbance due to unbearable pain.⁴ An increase in the intake of sugary snacks coupled with a poor diet has also been shown to be associated with the progression of non-communicable diseases.⁵ In addition, the high intake of these snacks and sugar-sweetened beverages has been linked with easy access, advertisements, habits, and addiction.⁶

The Sugar Sweetened Beverage (SSB) tax has been implemented in over 40 countries around the world with the aim of reducing purchasing and consumption of sugar sweetened beverages, incentivising product reformulation by industry, and generating revenue that would be directed to health-promoting programs.⁷ SSB are drinks that contain added sugars such as sucrose, high fructose, corn syrup, or fruit-juice concentrates, such as soft drinks, juices, and energy drinks. This excludes beverages that contain intrinsic sugars, such as unsweetened milk and milk products.⁸ The South African government implemented the SSB tax in 2018 following multiple stakeholder consultations. The tax, also termed the Health Promotion Levy was highly contested, and thus the initial proposed tax by the National Treasury was 10%, which was less than the 20% rate recommended by the World

Health Organisation.⁸ A review undertaken to assess the effect of SSB tax on sugar intake and dental caries provided evidence that about 20% of SSB tax, potentially reduced free sugar intake by approximately 4-4.4grams per day. In addition, it led to a reduction of dental caries over time.⁹

A cross-sectional study examining tax awareness and perceived cost of sugar-sweetened beverages in four countries namely Australia, the United States, the United Kingdom and Mexico between 2017 and 2019 assessed three following factors: Perceived cost of SSBs over time, awareness of SSB taxes in years where taxes were present and self-reported changes in beverage purchases in response to SSB taxes in years where taxes were present. This study found that the perceived cost of SSBs relative to non-SSBs was higher in Mexico in all three years. Tax awareness was higher in the U.K., and Mexicans were reported to be buying "less" taxed beverages. Furthermore, respondents with lower socioeconomic status were less likely to be aware of an SSB tax.⁷

Another research paper aimed at evaluating the impact of the sugar tax on sugar-sweetened beverage consumption among school children in Saudi Arabia reported that, after the implementation of the SSB tax, energy drink consumption declined and soft drink consumption increased slightly among school children aged 12-14. (). The proportion of soft drink consumption before tax was 92.5% and increased by 2% after tax to 94.6%. On the other hand, when it came to energy drink consumption before tax, the proportion was 46.1%, and after tax, it reduced to 38.4%, coming down to a reduction of 8%.¹⁰

In South Africa, a qualitative study was conducted in Soweto assessing the attitudes and perceptions that contribute to sugar-sweetened beverage (SSB) intake after the introduction of the sugar tax. Out of 85 participants recruited, only 57 were willing to participate, all of whom were adults over 18.⁶ The participants were divided into focus discussion groups of 8 to 11, and interviews were conducted within these groups. When asked why people consumed sugar-sweetened beverages, many participants reported that the practice was out of habit that had been adopted from childhood, and others admitted that they were addicted. Many participants also mentioned the influence of advertisements on the persuasion of consuming sugar-sweetened beverages and how easily accessible these beverages were.⁶

Oral health professionals generally express support for sugar taxation policies, given their awareness of the detrimental effects of excessive sugar consumption on

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dental health and broader systemic outcomes.¹¹ It is further assumed that such professional endorsement may extend to their personal behaviours, with the expectation that they themselves would reduce their intake of sugarsweetened beverages.¹² However, not much evidence has been shown to link their support or understanding to their personal consumption. A study done in South Africa examining oral health students' knowledge, attitudes and consumption of SSB before the tax reported that although the students supported the implementation tax, they consumed on average 5.8 teaspoons of sugar per day from SSB's alone, not withstanding other types of sugar intake that would exceed the recommended daily intake of 7 or 8 teaspoons of sugar.^{5,13} The tax has since been adopted over 7 years ago in South Africa; However, limited evidence exists regarding the influence of such regulatory interventions on sugarsweetened beverage consumption among oral health professionals and students following their implementation. Therefore, this study aims to investigate perceptions of the SSB tax and patterns of SSB consumption among dental students at the University of the Witwatersrand after the tax was introduced

METHODOLOGY

A quantitative study, using a cross-sectional study design was employed. All 147 undergraduate Wits dental students, across years 1-5, in 2023 were invited to participate on a voluntary basis. The study questionnaire was adopted from a validated questionnaire by Wrottesley et al, 2020.¹⁴ The questionnaires and participant information sheet were printed and handed out to the relevant class representatives, who were asked to distribute them to the students at the end of their clinical session for the day. The self-administered questionnaire took 15 minutes to complete. It had close-ended questions that consisted of four sections with five questions each. Section A addressed the demographic variables such as age, year of study and the average money spent on food and sugar-sweetened beverages. Section B consisted of questions about awareness of sugar taxation and its meaning and rationale. Section C focused on the attitudes towards the sugar tax policy. Section D assessed the daily SSB consumption habits of the students. Ethical principles were adhered to, to ensure that students were not coerced into answering the questionnaires and that anonymity was maintained. Permission was additionally obtained from the Head of School and the University registrar. The ethical clearance number is – M221155.

The data was collected and transferred onto a Microsoft Excel spreadsheet which was imported on to STATA version 14 for data analysis. The data was analysed using descriptive analysis. Chi-squared analysis was then used to assess the association between demographic variables and SSB consumption. All analysis was set to a 95% confidence interval.

Results

Sixty-three out of 147 dental students participated in the study, giving a 42% response rate. Table 1 shows the demographics of the participants, in terms of age, 87.3% of them were between 18-25 years. They were largely in their 1st year of study (31.7%), and most (42.8%) had access to 1000-2000 Rands pocket money a month. The second-year students were not available during the data collection phase.

Table 1: Student demographic profile (N=63)

Variables	Frequency	Proportion (%)
Age		
• 18-25	55	87.30
• 26-32	8	13.70
Year of study		
1	20	31,75
2	0	00.00
3	21	33,33
4	16	25,40
5	6	9,52
Access to money for food		
R0-R1000	21	33,33
R1001-R2000	27	42.86
>R2000	15	23,81

In terms of perceptions, Table 2 shows that 82.5% of the students were aware of the implementation of sugar tax, however 66.6% did not know when it was introduced. They believed (42.8%) that a sugar tax would reduce the consumption of SSBs, and 76.1% of them felt that the money generated should be used to subsidise healthy foods.

Table 2: Students' perceptions of SSB tax

Variable s	Frequency	Proportion (%)
Aware of sugar tax	52	82,54
Year of implementation		
• 2018	12	19,50
• 2019	9	14,29
• Do not know	42	66,67
Sugar tax will reduce obesity	19	30,15
Sugar tax will reduce SSB consumption	27	42,86
Money generated to be used for:		
• Obesity interventions	5	7.94
• Research	9	11.29
• Revenue for government	1	1.59
• Subsidising healthy food	48	76.19

Most (95.2%) of the students continue to consume SSB, see Table 3. The majority of them spend close to R150 rands per month on SSB's. Particularly when they are at restaurants or parties (88,8%; 87,3%). The majority (82,5%) report that the reason they drink SSB's is largely for the enjoyment of the taste.

Table 3: SSB Consumption

Variables	Frequency	Proportion
Drinks SSB	60	95,24%
Money spent on SSB		
• R0-R150	41	65,08%
• R151-R300	16	25,40%
• >R300	6	9,52%
Drinks SSB at these setting		
Home	21	33,33%
Varsity	36	57,14%
Parties	55	87,30%
Restaurant	56	88,89%
Sports/gym	28	44,44%
park/beach	40	63,49%
Reason for drinking SSB		
Drink option	32	50,79%
Enjoy the taste	52	82,54%
To quench thirst	27	42,86%
Family likes to drink it	28	44,44%
Completes a meal	26	41,27%
Mix with alcohol	24	38,19%
Boosts energy level	28	44,44%

No association was found between demographic variables and SSB consumption. However, there was an association between the year of study and money spent on SSB's and SSB consumption. The fourth-year students proportionally spent more than R300 on SSB's ($p=0.048$), Table 4. In addition, only 18.7% of fourth-year students reported not consuming SSBs, compared with the other classes ($p=0.026$). See Table 5.

Table 4: Relationship between Year of Study and money spent on SSB

Year of Study	0-150 (Rands)	151-300 (Rands)	>300 (Rands)
1	70.0%	20.0%	10.0%
3	66.6%	23.8%	9.52%
4	50.0%	37.5%	12.5%
5	83.3%	16.6%	0.0%

Table 5: Relationship between Year of Study and SSB consumption

Year of Study	No	Yes
1	0.0%	100%
3	0.0%	100%
4	18.7%	81.3%
5	0.0%	100%
		$p=0.026^{**}$

DISCUSSION

Our findings indicated that among the $n=63$ students participating in the study, 82.5% of them were aware of the implementation of sugar tax, although more than 50% (66.6%) did not know when it was introduced. They had positive perceptions on the benefits of the tax and believed that it could reduce SSB consumption and that the money generated should be utilised for subsidising healthy foods. Despite these perceptions, most (95.2%) reported consuming SSBs. Although most students spent no more than R150

on SSB, our results showed that 4th-year students spent significantly more ($>R300$) on SSBs ($p=0.048$). In addition, there was an association between the year of study and SSB consumption which revealed that although the fourth year students spent more on SSB's, they were the only group that had 18.7% of participants not consuming SSB's. No association was found between demographic variables and SSB consumption variables.

Our study revealed that as much as the majority of the students were aware of the sugar tax and understood the benefits of such a regulation in reducing obesity, consumption and money being directed to health-promoting initiatives (76.1%), their awareness and positive perceptions were not adequate to influence SSB consumption. This finding aligns with the results of Mosenogi et al. (2024), who examined the influence of multiple regulatory interventions on SSB consumption among South African adults and concluded that taxation alone was insufficient to alter consumer behavior meaningfully.¹⁵ Similarly, Fadupin et al. (2014) reported that despite 86.7% of Nigerian undergraduate students demonstrating good knowledge of SSBs, only a small proportion refrained from consuming fruit juices (17.3%) or carbonated soft drinks (18.3%). Many participants continued to consume SSBs despite awareness of their health implications, largely because these beverages were perceived as socially desirable.¹⁶

Our results interestingly revealed that although the fourth-year students spent more money on SSB's, they were the only group where 18.7% reported not to consume SSB. Concerning access to money and SSB consumption, a systematic review of 21 studies examining association between socio-economic status and SSB consumption, found that those who had a high socio-economic status or more access to money were 48% less likely to consume SSB's.¹⁶ In our findings, this was reflected in the fourth-year students, who presumably had access to more money. This same group was the only one with participants not consuming SSBs. (18,7%; $p=0.026$). Miller et al (2020) further explore other drivers of sugar consumption among young adults. Their qualitative study found that participants drank SSBs to address their low energy levels, as shown by 44.4% of our participants. Miller et al.'s participants also considered frequent consumption acceptable when taken in moderation, even though they could not clearly define "moderation". Finally, many young adults relied on packaging and labeling, which are often unreliable.¹⁵

Regarding determinants of SSB consumption behaviour, the literature suggests that taxation alone is not sufficient to bring about behaviour change. Product formulation and promotion regulations are found as key in influencing positive change.¹⁵ Furthermore, evidence also suggests that 'signalling effects' of an SSB tax may play an important role in changing consumer behaviour. Signaling effects are ways in which the implementation of a tax by government may signal to consumers that consumption of taxed goods should be reduced.¹⁹ This can be implicit or explicit. The implicit signal is tied to the assumption that the price should reduce consumption. The explicit ones are found to be more effective as government directly communicates the potential harms of the taxed product by consistent awareness campaigns.¹⁸ A cross-sectional sample of South African adults found that soda sales dropped as the knowledge of the health harms of SSBs and intention to

reduce consumption increased.²⁰ This suggests that media coverage and pro-tax campaigns in these instances had effects beyond price.

LIMITATIONS

This study had some limitations. The relatively small sample size restricted the depth of the statistical analyses that could be performed, including the inability to conduct regression modelling. Nevertheless, the findings offer valuable preliminary insights into dental students' perceptions of the sugar-sweetened beverage (SSB) tax and their consumption habits after its implementation. Future research could expand the scope of the study by including a broader range of oral health students, such as oral hygiene and dental therapy students. In addition, although the questionnaire provided a practical, low-burden method for estimating habitual dietary intake, participants' reports of their SSB consumption may have been affected by recall bias. However, we had data on perceptions, which provided useful baseline data that can be valuable for building on future research.

CONCLUSION

This study demonstrated that although dental students were generally aware of the sugar-sweetened beverage (SSB) tax and held favorable perceptions of its intended benefits, this awareness alone did not translate into reduced SSB consumption. Given that positive perceptions alone were insufficient to influence consumption behaviour, the existing literature suggests that taxation should be complemented by additional regulatory strategies, such as product formulation and promotion regulations, to bring about a more positive behavioural change.

ACKNOWLEDGEMENT

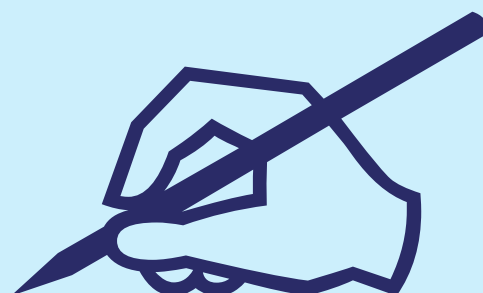
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CPD questionnaire on page 290

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.



Physiotherapeutic approach in Dentistry (Trismus) – A case Study

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ABSTRACT

Trismus, characterized by limited mouth opening, is a condition rather than a standalone disease. It can pose challenges to eating, hinder oral hygiene, limit access for essential dental procedures, and have negative impacts on speech and facial appearance. In a recent case, a 42-year-old male experienced trismus due to submucosal fibrosis, infection, and direct trauma to the temporomandibular joint. Conservative treatment, involving ultrasound therapy, stretching, and mobilization, was administered. Remarkably, the patient experienced significant relief within just two weeks of treatment.

Key Words

Trismus, Mobilization, Electrotherapy, tobacco, oral hygiene.

INTRODUCTION

Trismus (lock jaw) is prolonged tetanic spasm of the jaw muscles. Causes can be trauma, neoplastic, neuromuscular, reactive, congenital, psychogenic and drug induced¹. This condition may impair eating, impede oral hygiene, restrict access for important dental procedures and adversely affect speech and facial appearance². In healthy individuals, mouth opening is around 30-50 mm but when the mouth opening is limited to a maximum of 20 mm, the individual is said to have a reduced mouth opening or trismus². Trismus is a problem commonly encountered by the dental practitioner². Several previous studies have showed that range of motion exercise, soft tissues mobilization, Maitland mobilization, hot pack, self-mobilization were effective and improved function of oral structure^{1,3}.

A case study is presented, illustrating electrotherapy, Stretching and mobilization approaches in treating a patient with trismus caused by oral submucosal fibrosis, infection, tobacco use, and direct trauma to the temporomandibular joint. The treatment aimed to reduce pain, swelling, and restore oral cavity function.

Case Presentation

A 42 years old male patient came in Noida international institute of medical sciences with having pain in Oral

cavity and difficulty in opening mouth due to this difficulty to chewing food. During examination Patient also found oral sub mucosal fibrosis, infection, and direct trauma to temporomandibular joint. He was referred to the Physiotherapy department of NIIMS. During taking history the patient informed that he chewing tobacco from 20yrs. Patient was complaining that right TMJ having severe pain since 8-10days condition is worsening and disrupt in daily activities such as eating, brushing etc. The patient was non-diabetic & non-hypertensive. By profession he was a driver. On examination Pain score was 8 as per Numeric pain rating Scale, pain aggravated during chewing and brushing and relieved at resting position of Mouth. Fibrous band was palpated in right side of his buccal mucosa. Three – knuckle test positive (only one knuckle is getting inserted into patient mouth) and Three finger test positive as ROM restricted.

PRE-TREATMENT ROM: -

Mandibular depression: 17 mm
Lateral excursion: ½ of depression
Protrusion: 4 mm
Retraction: 2 mm



Fig_ 1.1 ROM restricted

Authors Contributions

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Fig_1.2 Three – knuckle test positive (only one knuckle is getting inserted into patient mouth) and Three finger test positive (1 finger getting inserted).

After examination treatment given as Cryotherapy 15 minutes after every session and ultrasound 8 minutes once a day and mobilize as procedure given below. Treatment Duration 15days

Active jaw stretching exercise

- Step 1: Ask patient to hold his head and open mouth as wide as is comfortable for you. Hold it for 10 sec
 Step 2: Move lower jaw to the left and hold it for three sec
 Step 3: Move lower jaw to right and hold for three sec
 Step 4: Move lower jaw in a circle to the left.
 Step 5: Move lower jaw in a circle to right

Step Ask patient to repeat these exercises for five times thrice a day:

Standard treatment evaluation by the Dental Service at Memorial Sloan Kettering Cancer Center.

Passive stretching exercises:

- Step 1: put your (Therapist) thumb on top teeth in the middle of patient's jaw
 Step 2: put index finger on bottom teeth in the middle of jaw
 Step 3: open mouth as wide as possible, using therapist fingers to give extra resistance. Hold this stretches for 10 sec.

Anterior, lateral and inferior glides grade 1 and 2 were performed for 7 sessions and for 7 sessions of grade 3 and 4 were performed in 15 consecutive days for 10 minutes.

Result

Physiotherapy intervention	1st Day	7th Day	10th Day	15th Day
Maitland Mobilization Grade I, II	Yes	Yes	No	No
Maitland Mobilization grade III, IV	Yes	Yes		
Range of motion	Poor	Fair	Good	Excellent
Wong baker face pain rating scale	5	3	2	0
Three finger test	1 finger	2 finger	2 finger	3 finger



POST TREATMENT RANGE OF MOTION

Depression: 45 mm
 Lateral excursion: ¼ of depression
 Protrusion: 6-9 mm
 Retraction: 3mm

After 15 sessions of physiotherapy, the patient reported no pain during chewing food and experienced no difficulty in opening their mouth. The level of pain, measured using the Numeric Pain rating Scale (NPRS) and Wong baker face pain rating Scale was recorded as 0, indicating the absence of pain. Additionally, the range of motion (R.O.M) of the temporomandibular joint (T.M.J) was measured, showing a significant improvement. The positive outcome suggests that the physiotherapy intervention was successful in alleviating pain, improving jaw function, and enhancing the range of motion in the temporomandibular joint. This highlights the effectiveness of the physiotherapeutic approach in managing the patient's condition and restoring normal function to the jaw joint.

DISCUSSION AND CONCLUSION

The study reveals a significant improvement in temporomandibular dysfunction (trismus) following a 15-day physiotherapy treatment. Manual therapy was found to be more beneficial than medical treatment, successfully eliminating pain associated with trismus and demonstrating an overall enhancement in the patient's condition. The combination of ultrasound therapy and Maitland's mobilization was specifically employed to restore normal range of motion (ROM) in the temporomandibular joint (TMJ). The initial assessment on day one using the finger method indicated limited mouth opening, with only one finger insertable. However, by the 15th day of physiotherapy, remarkable progress was observed, as the finger method now allowed the insertion of three fingers into the patient's mouth without causing pain. This tangible improvement highlights the efficacy of the chosen physiotherapeutic interventions, particularly manual therapy and ultrasound therapy with Maitland's mobilization, in addressing trismus

and restoring normal TMJ function. The study emphasizes the crucial role of physiotherapy in managing trismus, underscoring the importance of thorough assessment before intervention due to the diverse causes and varying signs and symptoms associated with the condition. This case study contributes to the discussion on the efficacy of Maitland mobilization, ultrasound therapy, and neck muscle stretching as components of physiotherapy for trismus treatment.

Additional research is warranted to establish the efficacy of physiotherapy in treating trismus, particularly through studies involving a substantial number of patients and diverse physiotherapy procedures. The need for more comprehensive investigations arises from the current gaps in understanding the full scope of physiotherapeutic interventions for trismus. Large-scale studies with varied treatment protocols can provide a more robust evidence base, allowing for a clearer assessment of the effectiveness of physiotherapy in addressing trismus. Such research endeavors would contribute valuable insights, guiding healthcare practitioners in optimizing physiotherapeutic approaches for individuals experiencing jaw-locking issues.

Conflict of interest: No

Funding: Nil

Ethical clearance: No. It is a case study only

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Assessing Waiting Lists and Operational Challenges at Two Oral Health Centres in the Western Cape

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ABSTRACT

Background

Access to timely oral healthcare in South Africa is limited, particularly in the public sector where demand exceeds capacity. Long waiting times, resource constraints, and inequities in service distribution disproportionately affect low-income populations reliant on public oral health facilities.

Aim

To assess the status, management, and operational challenges of oral health service waiting lists at Tygerberg and Mitchell's Plain Oral Health Centres in the Western Cape, and to explore staff perspectives on system effectiveness.

Methods

A descriptive cross-sectional mixed-method study was conducted using structured staff interviews and analysis of 14 official waiting lists. Purposive sampling identified staff directly involved in waiting list management. Quantitative data was analysed using descriptive and comparative statistics.

Results

A total of 10,353 patients were on waiting lists, with an average waiting time of 25.2 months. Orthodontic and prosthetic services had the longest waits. Mitchell's Plain Oral Health Centre showed significantly longer waits compared to Tygerberg (38.4 vs 19.8 months). Most departments used hybrid systems, however, faced challenges such as high demands for services, among others.

Conclusion

Public oral health services face systemic delays and inefficiencies. Addressing digital infrastructure, human resources, and service decentralisation is vital to achieving

equitable, timely care in alignment with national and global health goals.

Keywords

Oral health services, oral health waiting lists, health care equity

INTRODUCTION

Healthcare access is the ability of people to utilise health care services in a timely manner.¹ Access to timely oral health care is essential to maintaining oral health and general well-being.² In South Africa (SA), the private health sector services a small minority of the population, especially for specialised dental services.³ As a result, patients are forced to "desperately" seek oral health care in the public sector, either as the only option or if medical insurance funds are depleted. However, SA's public sector experiences long waiting times and overcrowding. This sector is unable to readily provide the services patients always require.⁴

Moreover, oral health SA remains underfunded and under prioritised, which leaves the population with a high burden of oral disease⁵ as well as unmet dental treatment needs.⁶ This disproportionately affects lower-income populations who rely on the public sector for dental care.⁵ Given the limited number of public-sector dentists, the system struggles to accommodate patient demand, thereby affecting access to timely and quality oral health care, resulting in delayed care⁶ and overcrowding at SAs academic hospitals and dental schools.⁴ In effort to meet the demands of the public health patients at tertiary-level dental schools, patients are often placed on a waiting list (often indefinitely) or wait for extended periods of time before receiving the appropriate dental treatment.⁴

Timely access to dental care is essential for maintaining oral health, as well as for preventing broader health complications and financial strain. Prolonged waiting periods, particularly those exceeding one year or involving over 1000 patients, have been associated with delayed rehabilitative treatments such as dentures and urgent root canal procedures. These delays can significantly impact patients, quality of life, disrupt daily functioning, and place added emotional and financial burdens on families.⁷ Moreover, untreated conditions may worsen over time, resulting in more complex and costly interventions, thereby increasing the overall burden on the health system.⁸

Notably, patients on long WLs experience high levels of anxiety and frustration, lower earning capacity, prolonged suffering as well as poorer health outcomes. Therefore, waiting to receive elective healthcare can be a considerable burden in a health system. In these instances, disease can

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become a chronic burden to patients whilst waiting for healthcare services.⁹

However, unlike the medical school counterparts, dental schools are naturally resource-intensive and require sufficient financing to perform optimally. Unfortunately, dental schools remain severely under-resourced to provide costly dental services. Typically, a dental school employs approximately 100 clinicians to, in turn, treat an average of 3,000 patients monthly. The massive demand for specialised dental services, coupled with academic responsibilities of clinicians, the resource-limited public oral health system as well as highly unaffordable private health care in South Africa, are a few, of the many, challenges facing dental services.⁴

Despite the growing burden of oral disease and increasing pressure on public oral health services, there remains a scarcity of South Africa-specific research examining the status and management of waiting lists within oral health systems. This gap limits understanding of how waiting lists function within the public sector and how they influence service delivery, patient access, and treatment outcomes. In the context of ongoing health system reforms, including the WHO Global Oral Health Strategy and Action Plan,¹⁰ South Africa's proposed National Health Insurance (NHI),¹¹ and the National Oral Health Policy and Strategy (2024–2034).¹² This evidence is essential to inform planning and resource allocation within the oral health sector.

Therefore, this study aims to evaluate the status, management, and perceived operational effectiveness and challenges of patient waiting lists for general and specialist oral health services, as reported by staff involved in these processes at Tygerberg (TBH) and Mitchell's Plain (MP) Oral Health Centres (OHCs) in the Western Cape Province, South Africa.

METHODS

Study Design and Setting

This study employed a descriptive cross-sectional design to assess the status and management of patient waiting lists at two major OHCs in the Western Cape, South Africa, namely, Tygerberg OHC and Mitchell's Plain OHC. The study focused on both general and specialist oral health care services and followed a quantitative methodological approach, allowing for the collection and analysis of numerical data related to patient volumes, waiting times, and system effectiveness.

Study Population and Sampling

The study population comprised two components, (1) all official patient waiting lists for general and specialist oral health services at the two centres during the data collection period, and (2) staff members directly involved in the scheduling, booking, or management of those lists. Services included in the analysis were prosthetic dentistry (full and removable partial dentures), fixed orthodontics, surgical extractions (including removal of impacted third molars), endodontic procedures (root canal treatment), crown and bridge work, and paediatric dental care under general anaesthesia.

A purposive sampling strategy was used to identify relevant waiting lists and to select staff who had direct administrative or clinical responsibilities in patient scheduling. These

included booking clerks, dental assistants, department managers, and any other administrative personnel. The inclusion criteria required that all selected staff be actively engaged in patient booking and list management at the time of the study. Staff who declined to participate or were not involved in the relevant administrative functions, including temporary personnel, were excluded from the study.

Recruitment Procedures

Following ethical clearance and formal permission to conduct the study, recruitment involved communicating to department heads and relevant staff, who were provided with full details of the study and given the opportunity to voluntarily participate. To ensure minimal disruption to services, interviews and assessments were conducted at times convenient to each participant. All participants were informed of their right to withdraw at any point without consequence.

Data Collection

Data were collected using two complementary instruments to capture both objective waiting list data and staff-reported operational insights. The first instrument, a waiting list assessment tool, was used to extract quantitative data from official waiting list records. This included information on the number of patients per service, overall waiting list lengths, waiting times, as well as existing booking and scheduling practices.

The second instrument was a structured staff questionnaire, consisting predominantly of closed-ended items with a limited number of open-ended responses. This questionnaire was administered to staff involved in waiting list management and captured data on perceptions of waiting list usability, the operational effectiveness of booking systems, challenges associated with managing waiting lists, and administrative workflows and practices. All interviews were conducted in private offices to ensure participant privacy and comfort.

Both tools underwent face validity assessment, using the Face Validity Index,¹³ by the Manager of Dental Services and heads of departments across seven clinical areas to ensure clarity, relevance, and ease of use. Revision to the instruments were made based on their feedback, and the researchers received training to standardise procedures and reduce bias.

Measurement of Staff Perspectives

The staff interview tool explored the operational effectiveness and challenges of the waiting list systems. Respondents provided feedback on the adequacy of the booking process, administrative workflows, and perceived barriers to timely patient care. The structured components of the instrument enabled quantitative analysis of key trends. Open-ended responses were analysed using a content analysis approach, whereby similar responses were grouped into thematic categories and subsequently quantified to identify recurring patterns across the two sites. This approach allowed qualitative insights to be systematically integrated with quantitative findings.

Data Analysis

All data were captured, coded, cleaned, and analysed using Epi Info™. Descriptive statistics were used to summarise the data, including means and standard deviations (SDs) for continuous variables, and frequencies and percentages for categorical variables.

Given the small sample size ($N = 14$) and the non-normal distribution of variables, as assessed using the Shapiro–Wilk test, non-parametric statistical methods were applied. The Kruskal–Wallis H test was used to explore differences in waiting times and waiting list sizes across clinical service areas, while Spearman’s rank correlation coefficient was used to assess relationships between variables such as waiting list size and perceived usability. Associations between categorical variables were examined using the Chi-square test of independence, with Fisher’s exact test applied where assumptions for Chi-square were not met. Odds ratios (ORs) were calculated to estimate the likelihood of reported challenges associated with waiting list characteristics. However, due to the limited number of service units and the aggregated nature of the data, many findings were interpreted descriptively rather than relying solely on inferential statistical significance. A significance level of $p < 0.05$ and a 95% confidence interval were applied throughout.

To enhance the validity and depth of the analysis, data triangulation was used by integrating quantitative findings from waiting list records with staff-reported perceptions and operational insights. Quantitative indicators such as waiting times, patient volumes, and list sizes were examined alongside staff-reported challenges, usability concerns, and management practices. Areas of convergence between these data sources were used to corroborate key findings,

while divergences were explored to identify gaps between recorded system performance and the operational realities experienced within clinics. This approach allowed for a comprehensive understanding of waiting list dynamics across both study sites.

Ethical Considerations

Ethical clearance for the study was obtained from the Biomedical Research Ethics Committee of the University of the Western Cape. Additionally, operational permission to conduct the research was secured from the Manager of Dental Services overseeing both the OHCs. Informed consent was obtained in writing from all participating staff members prior to data collection. On all data capture forms, a unique identifier based on the date and time of the interview was assigned to each record. Data captured electronically were stored on a password-protected, secure digital drive, while all paper-based documents are stored in a locked cabinet accessible only to the research team.

RESULTS

The status of patient waiting lists

Table 1 describes the status of patient waiting lists (per clinical service area). A total of 10,353 patients were recorded across all departments on the official waiting lists of Tygerberg and Mitchell’s Plain Oral Health Centres (OHCs). The overall mean waiting time for services at both facilities was 25.2 months, indicating a significant backlog in service delivery (Table 1).

Service Type	Department	Site	Clinical Service	Waiting Time	No. of Patients		
				Mean waiting time (months)	Per waiting list	Total per department n	Mean (SD)
General Dental Services	Prosthetics	TBH	Full Dentures	42	1088	5014	1253.5 (459.5)
			Removable Partial Dentures	42	1677		
		MP	Full Dentures	42	1568		
			Removable Partial Dentures	42	681		
	Paediatric Dentistry	TBH	Dental treatment -general anaesthesia	2.5	108	129	64.5 (61.5)
			Dental treatment -sedation	1	21		
		TBH	Root Canal Treatment	30	1241	1763	440.8 (544.1)
			Crowns and bridges	3	135		
	Restorative Dentistry	MP	Root Canal Treatment	12	320		
			Crowns and bridges	12	67		
Specialist Dental Services	Orthodontics	TBH	Fixed Orthodontics	54	1913	3387	1693.5 (310.4)
		MP	Fixed Orthodontics	84	1474		
	Maxillofacial & Oral surgery	TBH	Surgical removal of wisdom teeth – chairside	1	26	60	30 (5.7)
			Surgical removal of wisdom teeth – general anaesthesia	2	34		
Total number of patients on waiting lists across both sites and all departments						10353	

As described in the above table (Table I), Prosthetics and Orthodontics were the most overburdened departments, both of which recorded the highest patient volumes and the longest waiting times.

Orthodontics demonstrated the longest mean waiting time across both sites at 69 months, with site-specific figures reaching up to 84 months at the MP OHC and 48–60 months at TBH OHC. Prosthetics followed with a consistent 42-month average (ranging from 36–48 months), while restorative dentistry services recorded a mean waiting time of 14.25 months, exceeding one year. In contrast, Paediatric Dentistry and Maxillofacial & Oral Surgery (MFOS) demonstrated significantly shorter average waiting times of 1.75 months and 1.5 months, respectively.

These shorter durations are aligned with the lower number of patients on their respective waiting lists. However, it is important to note that MFOS services, specifically the surgical removal of wisdom teeth, employed a distinct booking system. Patients were required to initiate contact with the department, which differs from the formal waiting list approach used in other services.

Comparative analysis of waiting lists between both OHCs

A comparative analysis of the two Oral Health Centres (OHCs), presented in Table II, revealed differences in both patient volumes and average waiting times. The mean number of patients on the waiting list at Mitchell's Plain (MP) OHC was higher (822; SD = 603.91) than at Tygerberg (TBH) OHC (693.7; SD = 782.41). Similarly, the average waiting time at MP (38.4 months; SD = 29.58) exceeded that of TBH (19.8 months; SD = 21.93).

Table II: Waiting list analysis - site comparison

	TBHOHC (N=9)	MPOHC (N=5)
Waiting Time (months)	19.8 (21.93)	38.4 (29.58)
No. of Patients on WL	693.7 (782.41)	822 (603.91)
WL > 1000 patients	44% (n=4)	40% (n=2)
WL > 1-year	44% (n=4)	60% (n=3)

When analysed at the level of clinical service units (departments), these differences were not statistically significant (Mann–Whitney U = 12, $p = 0.190$). The substantial variability observed within both sites further supports cautious interpretation of these findings. Additionally, a higher proportion of departments at MP reported waiting times exceeding one year (60% vs 44%), while the proportion of departments with waiting lists exceeding 1,000 patients was similar between the two sites (40% vs 44%). However, these differences were also not statistically significant (Fisher's Exact Test, $p > 0.05$). Therefore, while Mitchell's Plain OHC consistently demonstrated longer waiting times and higher patient volumes, these findings should be interpreted as descriptive trends rather than statistically significant differences.

Further analysis identified that six waiting lists across the two centres each contained more than 1,000 patients, all with waiting periods exceeding 12 months.

Waiting list management, strategies, operational practices

Table III describes a summary of waiting list management systems, strategies, and operational practices at the OHCs.

Table III: Waiting List Status, Management Systems, Strategies, and Operational Practices at the OHCs (N=14)

Category	Description	Frequency (%)
WL status	WL ≥ 1 year waiting period	71% (10)
	WL >1000 patients	50% (7)
WL management systems	Department-specific waiting lists	100% (14)
	Paper-based waiting lists only	21% (3)
	Hybrid waiting lists (electronic with paper back-up)	79% (11)
WL management strategies	Triage: severity and then first-come-first served basis	79% (11)
	Triage: treatment time needed and then first-come-first served basis	21% (3)
	Standby lists	57% (8)
WL operational practices	Inform patients of average waiting time to treatment	100% (14)
	Routine revision of waiting lists (6-monthly)	86% (12)

• Waiting list status

Substantial delays in patient access were observed, with 71% ($n = 10$) of departments reporting waiting lists exceeding one year. These prolonged delays were particularly notable in services such as orthodontics, root canal treatments, and prosthetic dentistry (both full and removable partial dentures) at both sites. Additionally, crown and bridge services at Mitchell's Plain OHC were affected. Half of the departments (50%; $n = 7$) reported waiting lists with more than 1,000 patients, concentrated in departments managing fixed orthodontics at both sites, full dentures at Mitchell's Plain, and prosthetics and endodontic services at Tygerberg.

• Waiting List Management Systems

All departments (100%; $n = 14$) operated department-specific waiting lists, which were not updated in real time. This siloed approach likely limited the ability to streamline referrals or redistribute caseloads between services. In terms of format, a hybrid model, which combines electronic systems with paper-based backups, was the most common and used by 79% ($n = 11$) of departments. However, 21% ($n = 3$), all located at Tygerberg, relied solely on paper-based systems. All departments at Mitchell's Plain used hybrid systems, indicating a higher level of digital integration at this site compared to Tygerberg.

• Waiting List Management Strategies

Both OHCs applied structured triage protocols for patient prioritisation. The most widely used method (79%; $n = 11$) involved assessing clinical severity, followed by a first-come-first-served principle. An alternative approach based on estimated treatment duration was applied in 21% ($n = 3$) of departments. Furthermore, standby lists which were used to manage no-shows and last-minute appointment availability, were present in 57% ($n = 8$) of departments and provided flexibility in handling patient flow. Notably, no

departments reported using after-hours services or telehealth consultations, which could have enhanced capacity or reduced waiting times.

• Operational Practices

Across all departments, staff consistently reported informing patients about the estimated waiting time for treatment. Staff also offered guidance on alternative care pathways, including services at other public sector facilities or private practices. This practice reflected a commitment to transparency and patient autonomy despite long delays.

Routine revision of waiting lists occurred every six months in 86% ($n = 12$) of departments. However, site-level discrepancies were noted. At Tygerberg, all departments maintained regular revision schedules. In contrast, only two out of the five departments at Mitchell's Plain conducted six-monthly reviews, with three departments reporting no capacity for such updates. This variation suggests resource and administrative capacity constraints at the Mitchell's Plain OHC.

Staff perceptions on WL effectiveness and challenges

Staff perceptions revealed widespread concerns about the effectiveness and operational efficiency of the existing waiting list systems at both OHCs. As illustrated in Figure 1, a total of 79% ($n = 11$) of service areas reported experiencing significant challenges related to waiting list management, which included issues of structure, usability, and resource limitations.

• Impact of Waiting Time and List Size on Usability

An inverse relationship was observed between waiting time and perceived usability. Waiting lists with durations under one year were more likely to be perceived as manageable compared to those exceeding one year ($OR = 0.20$; $p = 0.057$). Similarly, larger waiting lists ($>1,000$ patients) were associated with increased reports of patient attrition, although this association was not statistically significant ($OR = 0.56$; $p = 0.706$).

• Structural and Operational Constraints

Multiple systemic challenges were cited by staff as limiting their ability to efficiently manage waiting lists. The most prevalent issues included, a high service demand, which was reported by 100% ($n = 14$) of departments, frequent level-of-care changes which required adjustments to scheduling across service tiers as well as incorrect patient information, noted by 71% ($n = 10$), complicating follow-up and continuity of care. Additionally, resource constraints (i.e., staff shortages and limited materials), were challenges expressed by 64% ($n = 9$) of staff participants, as well as insufficient time for list review, which affected 50% ($n = 7$) of departments.

Challenges, in terms of the user-friendliness (usability), were compounded by the fact that 43% ($n = 6$) of departments observed that patients lost interest in remaining on the list, further destabilising service planning. Moreover, 43% ($n = 6$) of staff also indicated that navigating the current waiting list systems were moderately difficult to use, particularly in paper-based environments or where hybrid systems lacked real-time updating capabilities. A smaller proportion (29%, $n = 4$) reported structural problems with the design of the waiting list system itself, while only 7% ($n = 1$) noted cases of lost patient records, suggesting that while data loss was rare, the accuracy and utility of the data collected still posed significant concerns.

Integration of Quantitative and Staff-Reported Findings

Findings from staff-reported data were consistent with patterns observed in the quantitative analysis, particularly within high-burden departments such as orthodontics, prosthetic dentistry, and endodontic services. These departments demonstrated the longest waiting times (e.g., orthodontics up to 84 months and prosthetics approximately 42 months) and the largest patient volumes, often exceeding 1,000 patients per waiting list. Correspondingly, staff within these service areas reported greater operational challenges, including difficulties in managing large waiting lists, reduced system usability, and increased patient attrition.

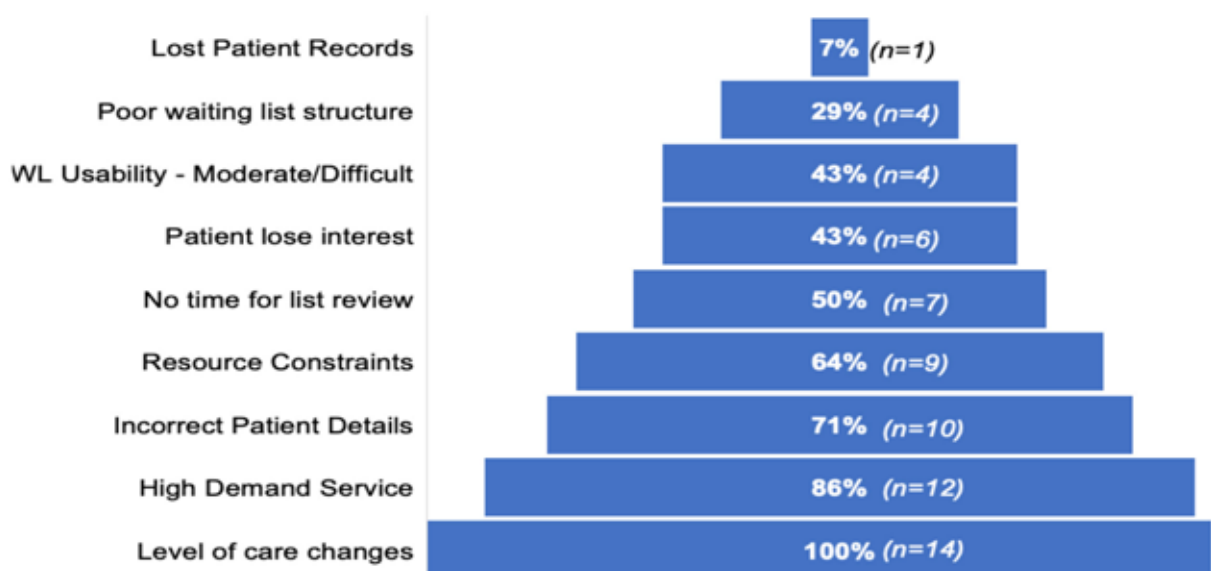


Figure 1: WL Challenges as per Staff Perceptions (N=14)

In contrast, departments with shorter waiting times and lower patient volumes, such as paediatric dentistry and maxillofacial and oral surgery (MFOS), reported fewer operational challenges and improved manageability of waiting lists. However, the distinct booking system used in MFOS, where patients initiate contact rather than being placed on a formal waiting list, may contribute to these differences.

This alignment between quantitative indicators (waiting time and list size) and staff-reported experiences (usability, workload, and patient engagement) demonstrates a consistent pattern across both sites. Specifically, departments with higher waiting list burdens were more likely to experience inefficiencies in waiting list management, supporting the observed relationship between service demand, system capacity, and operational challenges within the studied oral health centres.

DISCUSSION

A well-functioning health system is able to provide access to good quality health services that is equitable, timely, people-centred and responsive to the needs of a population. It aims to improve population health through protecting the population against threats to health and well-being, as well as against the financial burdens which comes with ill-health.¹⁴ However, in resource strained countries with weak policies and leadership, health systems are unable to respond to the populations challenges.¹⁴

Access to healthcare services is a fundamental aspect of South Africa's primary healthcare approach, emphasising availability, affordability, and acceptability.¹⁴ However, waiting for healthcare remains a significant challenge universally, hindering access to services within the healthcare system.^{15,16} The findings of the present study reflect widespread systemic limitations which have the potential to hinder service efficiency, contribute to prolonged wait times, and negatively affect both staff morale as well as patient retention and outcomes.

The status of oral health care waiting lists

The analysis of waiting lists at Tygerberg and Mitchell's Plain OHCs have provided critical insights into the service pressures and patient access constraints within public oral health systems. Notably, the findings revealed that services such as orthodontics and prosthetics were under particularly high demand, with waiting times for routine procedures, such as restorations and root canal treatments, often exceeding one year. This trend is indicative of the persistent burden of untreated dental caries and malocclusion in South Africa, as documented in the National Children's Oral Health Survey (1999–2002)¹⁷ and supported by subsequent literature.^{18,19} These lengthy delays raise concerns about delayed access to essential dental care and may result in disease progression and shifting treatment needs, which could potentially compromise clinical outcomes and increase the complexity of care needed. Moreover, findings reinforce the need for tailored strategies addressing department-specific pressures in order to optimise service delivery and reduce disparities in patient access.

As suggested by McIntyre and Chow,²⁰ health system strain directly correlates with challenges in delivering timely, high-quality care. When service pressures intensify, waiting times lengthen, and the capacity to respond to patient needs reduces. Oudhoff *et al.*,²¹ emphasised that prolonged treatment delays pose a significant risk to the quality of

healthcare delivery, as they may lead to deterioration in patient health and increased burden on services. This was consistent with the findings of this study, where high patient volumes and insufficient capacity created substantial bottlenecks, particularly in departments managing prosthetic, orthodontic and endodontic workloads.

The consequences of extended waiting times are multifaceted. McIntyre and Chow,²⁰ reported that patients frequently reported experiencing anxiety, frustration, discomfort, and a sense of hopelessness while awaiting treatment. Delays in elective procedures often result in worsening (oral) health, reduced earning capacity, and broader social inequality, especially for patients navigating multiple points within an overburdened healthcare system.^{16,21} These opportunity costs are substantial and may lead to declines in quality of life, which further emphasises the importance of responsive and well-coordinated service delivery.

Oral diseases, when untreated, can lead to serious complications. These include difficulties in communication, impaired nutritional intake, and even reduced cognitive development, particularly among children.¹⁸ Functional limitations, persistent pain, and social discomfort are well-documented consequences of delayed oral health interventions. Extended waiting times exacerbate these challenges, compounding the negative impact on individuals' daily lives and well-being. The South African context adds further complexity. With a high burden of dental caries among children, there is a substantial need for dental treatment under general anaesthesia. This demand places additional strain on public healthcare resources due to the high operational costs and limited theatre availability.^{6,19} While GA is effective in improving oral health-related quality of life (OHQoL), the delays in accessing care through this route may compromise its potential benefits.^{6,18}

Research further suggested that patients with conditions such as impacted third molars experience a measurable decline in OHQoL, which worsens the longer the patients waited for surgery.²² Similarly, satisfaction with dental prosthetics, including dentures, is closely tied to their timely provision.²³ Therefore, delays in access may reduce patient satisfaction as well as potentially perpetuate physical, emotional, and economic hardship, particularly among socioeconomically disadvantaged populations dependent on public health services.¹⁸

Inequities in access between OHCs

The significantly longer waiting times observed at Mitchell's Plain OHC, when compared to Tygerberg OHC, highlight a disparity in access to oral healthcare. This imbalance is particularly alarming given that the Mitchell's Plain OHC serves a predominantly low socioeconomic population, many of whom lack access to private oral healthcare and are entirely reliant on the public health system. Therefore, the extended delays in treatment at Mitchell's Plain OHC reflect systemic inequities in service distribution as well as risk worsening oral health outcomes in already vulnerable communities. According to Author(s) in press,⁶ the Western Cape continues to experience structural disparities in the delivery of even basic oral health care services, such as examinations, radiographs, extractions, restorations, and antibiotic prescriptions. A provincial study found that less than one-third of public clinics offered the full basic oral healthcare package, and only 15% of satellite clinics, on

which marginalised populations disproportionately depend, were able to provide these essential services.⁶ Furthermore, a low dentist-to-population ratio of 1:71,875 further impairs access, especially in satellite clinics, where dental services were available for just 3.2 days per month, compared to 7.3 days at better-resourced public clinics.⁶ These geographic and socioeconomic disparities compound the burden on communities, such as those served by MPOHC, where residents face limited service availability, prolonged waiting times, and barriers to continuity of care, all of which contribute to the entrenchment of oral health inequalities. These findings are particularly important to assist in guiding resource allocation and service improvement efforts.

Staff perspectives: waiting lists management, operational effectiveness and challenges

The perspectives of frontline staff are essential in healthcare for identifying operational barriers and driving quality improvement.²⁴ Therefore, integrating staff input into decision-making processes is critical for effectively managing the complexities of patient waiting lists in oral health services.

Similar to the findings of this study, Kavalieratos *et al.*,⁹ highlighted that waiting lists are often poorly managed, and are characterised by inconsistent record-keeping, a lack of standardised triage protocols, and significant variation in management systems. These deficiencies can obstruct equitable access to care by delaying service delivery and undermining system efficiency. A particularly persistent challenge cited in literature was the difficulty in reaching patients due to outdated or inaccurate contact details, which hampers communication and contributes to further delays or missed appointments.^{9,25}

Moreover, the challenges identified in this study, such as insufficient clinical staff, inadequate time, and limited materials, mirror broader systemic issues seen in medical and surgical service delivery. Naidu and Chu,²⁵ reported that surgical care at district hospitals is hindered by both human and non-human resource constraints, and along with deficits in equipment and financial resources, limits service capacity, delays care and results in excessively lengthy waiting lists at regional and tertiary hospitals in the Western Cape. These parallels highlight that the difficulties experienced in oral health are not isolated, but rather indicative of system-wide structural weaknesses affecting the broader public health sector.

From an ethical perspective, lengthy waiting lists compromise the delivery of quality health care. Apart from the ethical consequences related to rationing care through long waiting lists, it is well-established that waiting lists are generally poorly managed, and consequently, fairness to healthcare access is often compromised by difficulties in contacting patients.⁹ Ideally, waiting times for patients on waiting lists need to be clearly outlined and should not exceed a certain threshold of time and therefore be linked to an average waiting time.²⁶ However, literature recognised that in public healthcare systems, the maximum waiting time for patients on waiting lists may span into years.^{26,27} As a result, patients that are deserving and eligible for care, might not receive the appropriate care at the appropriate time. This is concerning and unjustifiable, which pose numerous ethical threats to sound clinical practices, and symbolise larger issues with policy implementation.⁴

Study Limitations

This study has several limitations which should be considered when interpreting the findings. At the outset, the reported waiting times for maxillofacial and oral surgery may not accurately reflect actual service delays, as they are dependent on the accuracy and completeness of existing waiting list records. In addition, the absence of rotating postgraduate registrars at MP OHC meant that these surgical services were unavailable at that site, further restricting access and potentially influencing the overall assessment of service delivery.

The use of purposive sampling for staff interviews, while valuable for obtaining in-depth insights, may have introduced selection bias by limiting the inclusion of a broader range of perspectives. Furthermore, interview data are inherently subject to individual interpretation, which may affect objectivity.

Although variations in waiting times and patient volumes were observed across clinical service areas, the small number of service units and the aggregated nature of the data limited the ability to perform robust inferential statistical analyses. As a result, these differences were interpreted descriptively rather than statistically. Furthermore, the context-specific nature of the study limits the generalisability of the findings to other settings. Variations in resource availability, staffing models, and healthcare infrastructure may result in different waiting list dynamics elsewhere. Future research should therefore consider more inclusive sampling approaches and multi-centre study designs to better capture variability and enhance the external validity of findings.

RECOMMENDATIONS AND CONCLUSIONS

Despite the demand for oral health care services, this study has also highlighted that public oral health services continue to face challenges in scaling up their capacity to meet these needs. A high burden of oral disease, persistent resource constraints, limited clinical time, and high staff workloads have been suggested to contribute to the prolonged waiting times for oral health care services at the OHCs, however, have far-reaching implications for equity, health outcomes, and patient trust in the healthcare system.

Addressing these challenges requires a multifaceted approach. Strengthening waiting list management through the implementation of integrated electronic booking systems could improve the accuracy, transparency, and efficiency of waiting lists⁹, while regular audits are essential to maintain data integrity.²² In addition, investing in capacity-building initiatives and workforce support is critical to improving service delivery.²³ Aligned with the WHO Global Oral Health Strategy and Action Plan,⁷ these efforts should be complemented by targeted oral disease prevention strategies and improved availability of general dental services at district and primary levels of care.^{7,28} Furthermore, longer-term strategies such as decentralising specialist services to district-level facilities may help address systemic inefficiencies and reduce pressure on tertiary institutions.^{23,25}

Importantly, future research should adopt broader sampling methods, and could employ multi-centre designs to capture broader trends in waiting list management practices. By addressing identified deficiencies, Tygerberg and Mitchell's Plain OHCs, as well as similar oral health settings, can advance towards delivering more accessible, equitable, and efficient

oral health services, without imposing a financial burden to patients. This approach aligns with the goals of SA's NHI Act, which endeavours toward provision of equitable, timely and quality healthcare access for all¹¹, South Africa's revised National Oral Health Policy and Strategy 2024-2034,¹² as well as the WHO's Global Oral Health Strategy and Action Plan.¹⁰

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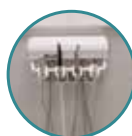
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Factors associated with delayed presentation among patients with oral cancer in Malawi

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INTRODUCTION

Worldwide oral cancer is the sixth most common cancer, affecting important structures for respiration, feeding and vision and is the leading cause of illness and death.^{1,2} In developing countries such as India and Tanzania, many cancer patients visit healthcare facilities in the late stage of the disease. This results in delayed diagnosis, poor prognosis, and palliative care treatment. Comparatively in developed countries such as the United Kingdom (UK) where oral cancers are usually diagnosed early,^{1,3} there is less disfigurement, and a reduction in management costs of oral cancer patients.⁴

Several factors associated with treatment delays have been identified, including gender, patient age, tumor site, lack of awareness, differences between rural and urban areas, fear of disfiguring surgery, and psycho-social factors.³

Among oral cancer patients in developing countries, one of the significant factors contributing to the severity of the disease is a lack of positive health-seeking behavior.⁵ Health-seeking behavior is any action taken by a person who believes that they have a health problem or they are ill with the intention of finding a suitable treatment.⁶ This is influenced by a lack of knowledge of oral cancers, culture, religion², challenges in accessing a health facility and high treatment costs.¹

The delay can be stratified into three phases; first phase is patient delay, the time taken for the patient experiencing symptoms of a disease to visit the health care facility.⁷ The second phase is healthcare worker delay, the time from when the healthcare worker has seen the patient with oral cancer symptoms to the time diagnosis is made.¹ The third phase is total delay, between the time from when the patient became aware of the symptoms to the time diagnosis is made.⁴

In developing countries, an estimate of 20%-50% of patients will visit the health care worker in the range of 1-3 months after noticing the symptoms of oral cancer.^{1, 8} and about 5 out of every 10 oral cancer patients have advanced-stage disease when they are first diagnosed.^{1, 8} the patient's delay accounts for most of the delay rather than health care worker delay.⁹ It was also found that, 55.6% of the patients visited health facilities that did not offer oral health services and another reason for the delay was the absence of pain.⁸ A study in India¹⁰ reported that patients delay in seeking treatment was associated with low knowledge ($p = 0.014$) and 52%- 60% of patients presented to the hospital late after noticing symptoms and having to travel 10km on average to the nearest health facility.^{10,11}

According to studies in Sri Lanka¹¹ and India,¹⁰ most patients (59- 61%) were diagnosed with advanced stage of cancer, which was attributed to delayed presentation ($p = 0.001$). A study in India¹⁰ reported a significant association of patients delaying for treatment at a health facility and fear ($p = 0.01$).^{7,10,11} Agarwal *et al*¹¹ reported that approximately 70% and 77% of patients were aware of oral cancer but not its symptoms. According to Rath *et al*,⁵ ninety percent of patients were of the view that symptoms of oral cancer will disappear on their own and eighty percent of the patients went to the hospital because the lesion was increasing in size.^{5, 12}

Malawi's population was approximately 17.4 million in 2017 with 64% under 15 years and life expectancy of 58 years was estimated for both genders¹². The Malawi health system comprises private for-profit, non-profit, and public sector¹². Moreover, the Ministry of Health offers public services and works with private sector such as the Christian Health Association of Malawi (CHAM) to provide essential health services. Although the public health services are free, but CHAM charges a user fee¹², the public health system is organised into a primary, secondary, and tertiary level.¹² The tertiary level provides advanced specialised care, secondary services are offered by district 4 hospitals which serve as a referral point for patients from the primary level¹². The primary level of healthcare in Malawi consists of village clinics, dispensaries, and health centers. However, the distance to the nearest health center or dispensary exceeds 10 kilometers¹². Despite that, a referral process is followed to ensure appropriate healthcare delivery. Patients are directed from dispensaries to health centers, and then further referred from district hospitals to central hospitals¹². These factors are indicative of the challenges individuals face in accessing these services in Malawi.

The health-seeking delay adversely affects the management planning and the treatment outcome of the patient.⁸ Since most of the patients in poor nations depend on public health services, this delay has a huge impact on human capital and material resources.^{8, 14} The delay in seeking care

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Contribution ratios.

- | | |
|----------------------|-----|
| 1. Mervyn Turton | 30% |
| 2. Nathan Lungu | 30% |
| 3. Mmathambo Sekhoto | 20% |
| 4. Russell Turton | 20% |

can eventually result in treatment that requires extensive ablative surgeries, a need for more expertise, a longer stay in the hospital, and possible significant morbidity because of structural and aesthetic defects in the patient.^{8, 14}

In Malawi contributing factors to delay in seeking care among cancer patient are limited knowledge of the initial symptoms of cancer and financial constraint.^{15, 16} Because of this, women with cervical and breast cancer delay for screening, diagnosis and treatment.^{15, 16} Other factors include long distance and unavailability of cancer screening facilities in the health centers.^{15, 16} Another factor was the prolonged use of antibiotics before referral of the patients and also consultation of traditional healers oherbalist¹⁶. Patients took 42 weeks to visit the main referral hospital after noticing initial symptoms of cervical cancer in a study done in Malawi.¹⁶ On average, 8 out of every 10 patients seeking medical care at the hospital are in a critical condition that cannot be treated in Malawi.^{16, 17}

METHODOLOGY

This was a descriptive study conducted in all major referral hospitals in Malawi namely: Mzuzu, Kamuzu, Queen Elizabeth and Zomba Central Hospital from April to June 2023. This study population consisted of 68 patients, histologically diagnosed with oral cancer attending dental clinics during the study period. The inclusion criteria were all oral cancer patients who were willing to give consent. Excluding criteria was all the patients who did not consent, patients not able to provide any of the necessary details, patients with onset symptoms and patients less than 18 years. The sampling technique employed for this study was non-probability systematic sampling.

The independent variables were demographic variables; (age, sex, level of education), social economic status, level of education and organisational factors (long walking distance to the health facility. The dependent variables were oral cancer and the reason for delayed presentation. A closed ended structured questionnaire was used for data collection. The questionnaire translated from English to Chichewa was used to collect relevant information. A pilot study involving five patients in each central hospital was undertaken to adapt it to the local conditions.

The questionnaire was divided into social demographic information where age was categorised into distinct age ranges, using a grouping interval of 20 years. Marital status was divided into two groups: married individuals (including those who were married or cohabiting). While unmarried individuals consisted of singles, widows, widowers, and divorced individuals. The level of education was categorised based on different educational milestones or degrees achieved. The following categories were used: Illiterate (without formal education): Participants who had never attended primary school. Educated (formal education) Participants who had attended primary education, finished primary education, attended secondary school, finished secondary school, or obtained a college/university education.

Additionally, income level was categorised as follows: low income: Participants earning less than or equal to K 50,000 (equivalent to 1000 Rands).

Medium income: Participants earning between K 50,000 and K 100,000 (equivalent to 1000-2000 Rands). High income: Participants earning more than K 100,000 (equivalent to more than 2000 Rands). When it comes to Health seeking behavior, the distance to the nearest health facility was categorised into two groups: less than 10 kilometers and more than 10

kilometers. The patient was considered to have been delayed for treatment if it took more than two weeks to report to the health care worker upon noticing the initial symptoms. The diagnosis was recorded from the Pathology Laboratories of the Kamuzu Central and Queen Elizabeth Central hospitals.

Permission was obtained from the heads of departments of the dental units for the study to be conducted within their departments. Data was entered into an Excel spreadsheet, cleaned, validated, and analysed using STATA version 17. Data was presented using frequency distributions, pie chart and histogram. The independent variables were examined statistically for associations and a p-value of =0.05 was taken as significant. Logistic regression was used to determine socio-economic factors associated with delayed presentation. Each participant gave their written informed consent after receiving ethical approval from the Wits University Human Research Ethical Committees and Kamuzu University of Health Science (COMREC). The Research committees' of all central hospitals approved this study. The Heads of Department in the dental units gave permission for the study to be conducted in their departments.

RESULTS

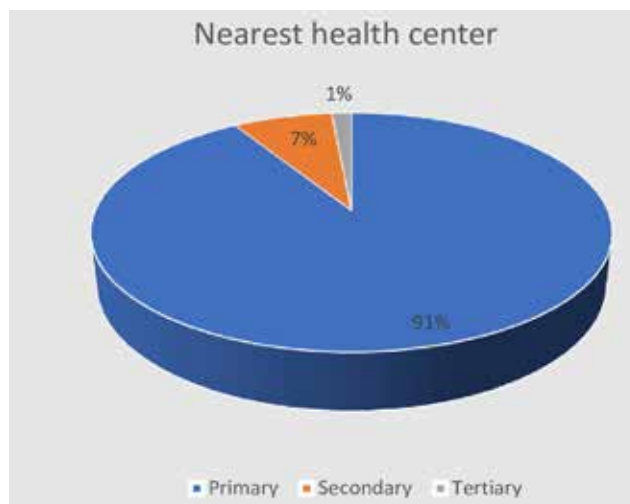
The total number of participants was 68 patients with oral cancer of which 36(52.4%) were females (and thirty two (n=47.06%) were males Twenty-six percent were between 21-40 years while five (7.35%) of the patients were above 60 years see (Table I).

Table 1: Social- demographic characteristics

Social demographic characteristics	Frequency (68)	Percentage
Sex		
Male	32	47.06
Female	36	52.4
Age group		
0-20	12	17.65
21-40	26	38.24
41-60	25	36.76
>60	5	7.35
Education		
Illiterate	51	75
Educated	17	25
Marital status		
Married	39	57.35
Unmarried	29	42.65
Primary		
Secondary	23	33.82
Tertiary	13	7.35
Occupation		
Employed	21	30.88
Farmer	39	57.35
Student	8	11.76
Income		
Less than K50,000 (1000R)	51	75
Between K50,000 and K100,000 (1000-2000R)	11	16.8
More than K100,000 (>2000)	5	7.3 5

Most of the patients were farmers ($n=39$, 57.35%) and twenty-one (30.88%) of the patients were employed, while ($n=51$, 75.88%) were illiterate with a level of income of less than K50, 000 (1000R) a month ($n=51$, 75%). Fifty patients (73.53%) reported that the distance to the nearest health facility was more than 10 km. The nearest health facility for most of the patients ($n=62$, 91.18%) was a primary health care facility and only one (1.47%) of the patients was close to the central hospital [Figure 1].

Figure 1: Distribution of patients according to the health facility they attended.



Most of the patients ($n=45$, 66.18%) reported unavailability of dental services at the nearest health facility. More than that, thirty-two patients (47.06%) were referred from primary healthcare facilities, followed by those who were referred from district hospitals ($n=23$, 33.82%). While a smaller proportion ($n=13$, 19.12%) directly arrived at the tertiary health centers without prior referral. Thirty-eight patients (55.88%) were able to inform their relatives when they are sick, and of which ($n=22$, 32.35%) informed their spouses. Thirty-six patients (52.94%) and ($n=31$, 45.59%) reported that the main reason for visiting the hospital was pain and increasing symptoms respectively.

Most participants ($n=55$, 82.35%) experienced a delay in seeking healthcare after recognising the initial symptoms. Twelve patients (17.65%) sought care within one to two weeks, forty (58.82%) waited for more than three weeks to six months, and, sixteen (23.53%) reported waiting for over 12 months. There was no statistically significant between delayed visit to healthcare facilities after symptom recognition and various social demographic characteristics, including marital status ($p = 0.064$), age group ($p = 0.411$), occupation ($p = 0.170$) and educational level ($p = 0.463$). However, there was a statistically significant correlation ($p = 0.042$) was found between the delay in reporting to the nearest healthcare facility and the distance to that facility. There was significance ($p = 0.000$) between the delayed presentation and the nearest health care facility as well as disclosure of symptoms to a relative or a spouse [Table II].

Factors	Delayed	Not Delayed	Chi-Square	P-Value
Age				
0-20	9	3	2.9	0.411
21-40	23	3		
41-60	21	4		
>60	3	2		
Education				
Educated	13	4	0.5	0.463
Illiterate	43	8		
Marital status				
Married	35	4	3.43	0.064
Unmarried	21	8		
Employment				
Employed	16	5	5.02	0.17
Farmer	33	6		
Student	7	1		
Gender				
Male	29	7	0.2	0.68
Female	27	5		
Distance				
Less than 10km	12	6	4.4	0.042
More than 10km	44	12		
Nearest Health facility				
Primary H/C	55	7	19.76	0.000
Secondary H/C	1	4		
Tertiary H/C	0	1		
Disclosure of cancer				
Yes	51	5	12.29	0.000
No	5	6		

Table II: Different factors associated with delay.

The histology results were available to 47 patients, (69.12%) at one to two weeks and to 21 patients (30.88%) at more than three weeks. Seventeen patients (25%) reported to the health facility when oral cancer was at stage I and 41 patients (60.29%) reported to the health facility when oral cancer was at stage II.

Fifty (73.53%) of patients reported that they have never heard of oral cancer and all the patients were not afraid to see the doctor. Most participants (n=45, 66.18%) had already started taking medication prior to their visit to the health facility, with 45 (66.67%) of them self-prescribing the medication. Fifty nine of the participants (86.76%) stated that they had sufficient time to make a visit to a health facility.

The logistic regression analysis results for factors predicting delayed hospital reporting are presented in Table 4. An odds ratio of 3.6 suggests that individuals who are more educated are 3.6 times more likely to have heard about oral cancer in relation to those with a lower level of education, with p value of 0.584 which is not statistically significant. Furthermore, individuals who are located more than 10km are 3.7 times more likely to have a delayed presentation for treatment compared to individuals who are located less than 10km; the association is statistically significant (p-value 0.05). More than that the odds ratio of 3.4 suggests that individuals close to primary healthcare (HCF) are 3.4 times more likely to have delayed presentation in seeking treatment unlike individuals located close to secondary and tertiary healthcare, this difference with a p=0.004 was statistically significant.

Table III: Logistic regression analysis for predictors of late reporting to the hospital

Factor	p-Value (logistic regression test)	OR (95% CI)
Level of education vs hearing about oral cancer	0.584	3.6 (.1672752 2.739744)
Less than 10km vs more than 10km	0.05	3.7(1.000086 13.44329)
Primary H/C vs Secondary and Tertiary H/C	0.004	3.4 (1.119468 5.775417)

DISCUSSION

This study was done in all central hospitals of Malawi which serve as the main referral centers in the country. In the Malawi healthcare system, patients with oral cancer are referred and treated through a similar process. Thus, patients initially seek care at primary healthcare facilities such as dispensaries or health centers, where a clinical diagnosis is made.⁸ Subsequently, they are referred to a district hospital and then to central hospitals, where specimens are collected for histological diagnosis and later treatment.^{3, 8} These findings enhance the understanding of the delay in diagnosis and treatment-seeking among oral cancer patients, and the similarities have been noted in prior studies.^{5, 8}

Moreover, in this study women were more affected compared to men, the same findings were reported in Tanzania, which has a similar healthcare system as Malawi.⁸ However, this contrasts with numerous studies in India where men were more affected than females.^{13, 18} According to the findings of this study, men tend to exhibit a higher tendency to delay seeking medical attention when experiencing oral cancer

symptoms compared to women.¹⁹ This could be attributed to the fact that women generally visit healthcare facilities more often to seek help than men.^{20, 21} But also, women rely on larger social networks for emotional support and advice which potentially reduces the delay.^{19, 21}

The delayed presentation of oral cancer patients especially men can be attributed to cultural factors.¹⁹ despite being more susceptible to risk factors, such as tobacco smoking and outdoor work.¹⁹ Bassey et al,¹⁸ found that oral cancer predominantly affects the most disadvantaged population group, particularly men, with a prevalence of 25%.¹⁸ This is, not different to the present study where most of affected patients were men from rural areas, especially farmers. Additionally, having a low-income status of less than or equal to 1,000R (K50,000) per month which is consistent with research findings in Tanzania and India.^{5, 8, 14}

The results of the current study also align with those of research done in Malaysia, which found that patients' knowledge and education levels have an impact on how they interpret symptoms, use coping mechanisms, and engage in health-seeking behaviors.² Similarly, Scott et al⁴ reported a strong positive correlation between a delayed presentation and inadequate knowledge of head and neck cancer, considering it as one of the three independent predictors of patient delay.^{1, 2, 7} Several studies, concluded there is a significant association between patient delay and education level, with a p-value of 0.001¹⁰ although this was not the case in the current study (p = 0.463).^{6, 7, 9, 10}

Most patients in this study reported farming as their occupation, which coincides with low-income levels. This higher occurrence of SCC especially among farmers might be attributed to continuous exposure to the sun and carcinogens present in the chemical composition of fertilisers, however the malignant lesions that are diagnosed at Stage I have a cure rate of more than 90%.^{22, 23} Early detection and timely interventions are crucial in enabling individuals to accurately evaluate oral symptoms, thereby reducing the risk of misinterpretation, and associated harmful behaviors like prolonged self-medication.¹ This will enhance the chances of successful treatment, the preservation of function, esthetics, survival rate and psychological outcome.^{3, 23}

This study, found that in the early stages of oral cancer, patients frequently disregard painless lesions similar to the conclusion reached by Azhar et al,² but tend to visit the health care facility when in pain or upon worsening of symptoms.^{2, 9} and, the persistence of symptoms was perceived as a signal that something was wrong, prompting individuals to seek medical attention. The intensity of symptoms affects the time for an individual to seek medical care.¹ Hence, the cognitive and emotional reactions to symptom detection, personal beliefs about seeking assistance, and the contextual factors surrounding symptom manifestation all contribute to the decision-making process regarding seeking help.¹

Ravi et al,²⁰ in their study reported that fear was a significant factor contributing to the delay in seeking treatment.²⁰ Several studies^{2, 15, 20} have indicated that an increase in fear is related to a higher likelihood of delayed seeking help, although the underlying reasons remain unclear.^{2, 19} But fear did not have any impact on delayed presentation in this study, similar to a study in Pakistani.²³ However, delay was associated with disclosing symptoms (p=0.000) and was statistically significant however, in other studies disclosing symptoms to

others and patient delay was not statistically significant.^{19,20,23} Literature^{2,18,21} has shown that, as oral cancer progresses in TNM staging there is persistent of symptoms, increasing concern and worry among patients. As there is deterioration of oral function affecting emotional well-being of individuals and overall quality of life, motivating patients to seek medical care.² This has been explained through the utilisation of the Self-Regulatory Model (SRM) which is utilised to understand the cognitive processes and mechanisms involved in individuals' perception and response to health threats.^{2,9}

The SRM provides insights into the underlying reasons behind the delay.^{2,9} The model proposes that participants have four types of coping mechanisms; self-remedy based on previous experience, self-medication such as pills and mouthwashes, and consulting traditional healers', which are cheap means and readily accessible and little time cost than consulting GPs.² Psychologically, these coping mechanisms result in delayed presentation of patients to the HCF⁹ this was observed in this study whereby patients took self-medication before seeing a clinician and hoping that the lesion will heal on its own. Thus, the application of the SRM can widen our knowledge of the processes behind patients' delay.^{2,9}

Many researchers^{4,9,21,23} have discussed the factors that affect patients with malignant melanoma, oral cancer, and breast cancer to delay for treatment. Factors like the severity of symptoms, anxiety, and humiliation, can contribute to the delay for medical attention in patients with breast cancer.²¹ Likewise, individuals with ovarian cancer may also associate significant symptoms with an existing benign condition or coexisting illness.²¹ But quick identification of specific symptoms, such as a breast lump, reduces the delay in seeking medical attention compared to patients with nonspecific symptoms.²¹

There have been studies on the delayed presentation of patients with oral cancer in Tanzania, India, and London, though the length of the delay which was considered the time the first signs of oral cancer are noticed until the patient sees a health personnel varied.^{8,14,23} and it ranged from 31 days to 2 years.^{8,14,23} similarly, a 2–6-month delay was found in this study. But also, professional delay can also impact the treatment modalities for patients, even if they arrive at the hospital in time.⁵ This study provided evidence that aligned with this where it was found that histology reports took one to two weeks to become available to the patients, although this aspect was not the focus of this present study.

The limitation of this study, the sample size was small, and the duration of data collection was short, diseases like oral cancer need a longer duration hence, it's difficult to generalize the findings must be generalized with caution. Another challenge encountered was measurements of patients' delay. The patients had to recall when they first noticed the symptom and presented it to the physician, this is prone to errors due to recall bias.

CONCLUSION AND RECOMMENDATIONS

Oral cancer was diagnosed among the young age group at central hospitals, and patients with stage I and II cancer reported delays in seeking treatment. Factors contributing to delay were living far from healthcare facilities, lack of

dental staff at primary healthcare facilities, lack of knowledge about oral cancer, and the delay in receiving the previously investigated pathological results. Therefore, education and awareness campaigns should be used as a tool for guidance towards intervention programs to reduce patient delayed presentation at the primary health care level and to ensure proper diagnosis also continuing education must be offered to dental health personnel as well as health care workers at primary health care facilities. An additional measure can be the provision of Standard Operating Procedures for monitoring pre-cancerous lesions at any health Care facility. Hence conducting another study specifically targeting health care profession delays would provide valuable insights into this aspect of oral cancer management.

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Evaluation of association between self-reported harmful Oral Habits and the Temporomandibular joint Disorders (TMD) amongst oral hygiene students

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ABSTRACT

Introduction

Engagement in harmful oral habits is one of the biggest initiating factors of Temporomandibular disorder (TMD) related signs and symptoms among individuals. University students are particularly at risk for developing TMD often due to a higher degree of engagement in harmful oral habits due to writing of examinations. The purpose of the study was to determine the association between self-reported harmful oral habits and the TMD related signs and symptoms amongst oral hygiene students at a training institution.

Methods

A cross-sectional analytic survey was carried out. A pretested-validated modified self-administered questionnaire about the engagement in oral habits that may be harmful to the Temporomandibular joint (TMJ) and the experience of TMD related symptoms was distributed to all oral hygiene students and additionally a clinical examination of the TMJ was performed to assess for signs and symptoms of TMD.

Data analysis was done with SPSS version 30. Quantitative variables were summarised as proportions, frequencies, mean with standard deviations, ranges and percentages. Chi square test was used to evaluate the association between variables with the level of significance set at $p \leq 0.05$.

Results

The study had a response rate of 95.6% with ages ranging from 18 to 28 with the mean age of 20.6 (SD=1.97) Majority (84%) of the participants were female. Most 37 (84%) students had bad habits such as nail biting, chewing gum, resting chin on hands, cheek chewing, lip biting, clenching their teeth. Significantly more participants participated in these bad habits after exams than before exams, $p=0.001$. More than half (52.3%) reported to have a stiff/tired jaw, 31% had myofascial pain and 27.3% suffered headaches attributed to the TMJ before exams. The prevalence of TMD was found to be 59%.

Conclusions

Most students had bad habits and the occurrence of this were done daily in many cases, as well as weekly and they were observed after and before exams suggesting that the habits could be seen to be increased during stressful times. The prevalence of TMD was higher than in many studies

Key words

Temporomandibular disorder, Temporomandibular joint, harmful oral habits

INTRODUCTION

Temporomandibular joint (TMJ) is an important joint that allows people to eat, yawn, kiss and suck. This joint is described as ginglymoarthrodial joint as it allows both hinge and gliding movement.¹ The articulating surfaces of the joint are covered by fibrocartilage. The TMJ is divided by biconcave fibrocartilaginous structure located between the mandibular condyle and the temporal bone component of the joint known as the articular disc². This articular disc divides the joint into two cavities, the upper and lower joint, together, with the teeth they are collectively referred to as the "trijoint complex".¹ The joint is surrounded by fibrous capsule which helps in stabilising the joint. This fibrous capsule extends from cranial articular surface to the neck of the condyle. The lateral ligament as well as the sphenomandibular and stylomandibular ligaments play an important role in the kinematics of the jaw.³

In normal circumstances the articular disc remains between the articulating surfaces. Derangement between the position of the articular disc in relation to the articulating surfaces may result in clicking sound² and / or restricted mouth opening. This is regarded as one of the early signs of TMJ disease. An abnormal motion between the disc and mandible causes a clicking sound.² A developing disjunction is present during

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the early stages whereas it can become a chronic problem later. Clicking results when the disc is in a slightly more forward position and the condyle moves over the disc and clicks into its place.²

Temporomandibular disorder (TMD) can be defined as a condition in which the tempo-mandibular joint (TMJ) functions abnormally, resulting in clinical signs and symptoms experienced by the individual.⁴ Symptoms may include clicking or popping noises when mobilising the jaw, difficulty opening the mouth, during which jaw locking may also occur as well as pain in the ear, temporal and jaw regions.⁴

Some literature define TMD as a heterogeneous group of psychophysiological disorders characterised by either orofacial pain or a dysfunction in chewing or even both simultaneously, which is caused by injury or inflammation of the temporomandibular joint and associated muscles, ligaments and nerves.⁵ The cardinal features are namely, orofacial pain, restricted jaw motion and joint noise.² Although psychosocial factors are known to be a predisposing factor, the aetiology is multifactorial.⁶ The factors that are reported as the cause of TMD include stress, muscular dysfunction, changes in dental occlusion⁶, chronic and repetitive tooth grinding and clenching⁷ and parafunctional habits such as chewing gum.⁸ This disorder leads to severe discomfort and pain during mastication, limitation/deviation in jaw opening, protrusion or lateral movements as well as clicking and dislocation of the joint and crackling or popping of the jaw.⁹ It also leads to nerve irritation and inflammation in the infratemporal and temporal regions of the face leading to swellings on the side of the face.⁸ Some patients may present with pre-auricular, popping sound in ears, and bruxism or grinding of teeth are prevalent.⁸

It has been reported that bad oral habits are the biggest etiological factor in the development of the TMD,¹⁰ possibly leading to traumatic dental occlusion affecting masticatory muscles, teeth and the temporomandibular joint. An anamnestic study (focusing on current and previous medical history of patients) found that bad oral habits such as onychophagy (excessive biting of nails and or toe nails), bruxism, biting or clenching objects between teeth, smoking pipe, biting lips or cheeks continuously as well as resting their jaw on their hand were reported by most patients with TMD upon questioning.¹⁰

The debate on the signs and symptoms for TMD have been going on since the 1900s. A review article on bruxism and TMD conducted by Kalamir et al., in 2006 illustrated that 172 relevant papers were found, where 101 found an association between bruxism and TMD but 71 did not.¹¹ The authors concluded that although there seems to be a very strong relationship between TMD and bruxism, it is very difficult to conduct a study of such sort because of the lack of universally accepted definition for bruxism and TMD (and what it entails) which leads to inconsistent variable measurements in different research papers such as duration and frequency, therefore bruxism's exact role is still seen as unresolved.¹¹

Another oral habit that has been reported to be harmful to the masticatory muscle and the TMJ is chewing gum sticks.¹² Wicour et al. in 2001 reported TMD in 62,4% of girls aged 15-16 years who were chewing gum sticks. This high prevalence was followed by hand resting on head.¹² The

authors concluded that gum stick chewing was the primary cause of TMD.¹²

A study conducted in 2016 by de Oliveira et al., among high school students of the ages 16-19 refer to the bad oral habits as parafunctional. After conducting a cross-sectional study, they reported a high prevalence of individuals with parafunctional habits (91.5%), being chewing gum the most common habit in the sample (65.9%), followed by chewing ice/ lollipops (57.4%) and lip sucking (53.5%).¹³ Studies conducted regarding the risk assessment on oral parafunctions in relation to TMD discovered that the most prevalent reported oral parafunctional habits included: teeth clenching and grinding, nail biting and chewing gum sticks.⁵ However, a study conducted by Michelotti et al in 2010¹⁴ found that nail biting was not a risk factor for any of the TMD subgroups (men and women) analysed, despite the fact that incisal clenching has been reported to reduce anterior joint space and to determine disc compression. On the other hand, the authors found a significant association between daytime teeth clenching/ grinding and myofascial pain, one of the subgroups of TMD which agreed with previous studies.¹⁴

A study conducted by Conti et al., investigated the association between TMD signs and symptoms and engagement in harmful oral habits among high school and university students.² The study found a strong association between engagement in harmful oral habits and TMD related signs and symptoms.² The study also found an association between increased stress levels (caused by exams and tests) and TMD related signs and symptoms among the students. The reviewed literature shows that there is a strong association between participation in harmful oral habits and TMD related signs and symptoms among university students.^{2, 14}

Although TMD has been highly researched, the approach in conducting this study emphasises on oral health habits' contribution towards TMD.

The present study intends targeting all registered students in oral hygiene who are at different levels of their studies and therefore have different study responsibilities with increased workload as the level of the study goes up. The study compared this groups to assess which level had more of the TMD symptoms and will hopefully recommend or develop interventions should the results point out to an increased level of symptoms with increased workload. The aim of the study therefore was to investigate if there was an association between self-reported harmful Oral Habits and the temporomandibular joint disorders among oral hygiene students at a training institution in Pretoria. The objectives were to determine the prevalence and severity of TMD signs and symptoms, the prevalence and frequency of harmful oral habits, determine factors that are associated with TMD in this cohort and lastly the severity of TMD was compared before and after exams.

Methodology

Ethical approval was obtained from the University of Pretoria, Faculty of Health Sciences Ethics committee (732/2022). No personal details of the students were disclosed, and all information was strictly confidential and anonymous.

Study Design

A cross-sectional analytic survey was carried out on undergraduate oral hygiene students at University of Pretoria.

Patient/ Research Object Selection

The self- completed questionnaires about the engagement in oral habits that may be harmful to the TMJ and the experience of TMD related symptoms was distributed to all oral hygiene the School of Dentistry, University of Pretoria. The number of Oral hygiene students registered for 2023 was 46 which made the population of the study.

Measurements/ Data Collection

A pretested-validated modified self-administered questionnaire¹⁵ was used to collect information on the socio- demographic characteristics, knowledge and practice patterns of the students with regard to their engagement in harmful oral habits and their experience of signs and symptoms related to TMD. The students were asked to list their engagement in harmful oral hygiene habits such as nail biting, pen chewing, cheek chewing, resting their chin in their hands etc. The students were asked about any signs and symptoms they experienced which may be related to TMD and lastly, if they had had trauma to their head in recent times. All the questions were closed ended.

Students were assessed by an experienced specialist maxillofacial and oral surgeon a month before the midyear examination and a first month after the midyear recess/break for signs and symptoms of TMD. A stethoscope was used to assess the TMJ sounds.

The clinical signs and symptoms were compared. All participants were given a unique identifier used for both the questionnaire and the clinical examination. Diagnostic criteria

for TMD (DCR/TMD) was used to assess the severity of the TMD.

Data Analysis

Data was collected using a data collection sheet. Data was then transferred into an excel spread sheet. Data analysis was done with SPSS version 30. Quantitative variables were summarised as proportions, frequencies, mean with their standard deviations, range and percentages. Chi square test was used to evaluate the association between variables: Level of significance was set at $p \leq 0.05$.

Results

The study had a response rate of 95,6% as 44 out of 46 students participated in the study. The ages ranged from 18 to 28 with the mean age of 20.6 (SD=1.97) and 37 (84%) participants were female with 7(16) being male. As far as year of study was concerned 20(46%) were in the first year, 12(27%) were in the second year and 12(27%) were in the third year.

To check the intra-examiner reliability the specialist re-examined every fifth patient and the kappa was found to be 80%

Intervention: Participants who presented with clicking TMJ sounds were referred for an x-ray and further management was implemented.

The majority of students had bad (harmful oral habits) habits such as nail biting, chewing gum, resting chin on hands,

Table 1: The frequency of the occurrence of bad habits in participants (n=44)

Variable (Before the examination)	Daily n%	Monthly n%	Weekly n%	N/A n%	Variable (After the examination)	Daily n%	Monthly n%	Weekly n%	N/A n%
Nail-biting before exams	13 (29.5)	2(4.5)	8(18.2)	21(47.7)	Nail biting after exams	13(29.5)	2(4.5)	7(15.9)	22 (50)
Clenching before exams	11(25)	0(0)	13(29.5)	20(45.5)	Clenching after exams	12(27.3)	0(0)	13(29.5)	20(43.2)
Grinding before exams	6(13.6)	1(2.3)	8(18.2)	29(65.9)	Grinding after exams	6(13.6)	1(2.3)	5(11.4)	32(72.8)
Unilateral chewing before exams	13(29.5)	3(6.8)	6(13.6)	22(50)	Unilateral chewing after exams	16(36.4)	1(2.3)	7(15.9)	20(45.5)
Biting objects before	8(18.2)	0(0)	11(25)	25(56.8)	Biting object after exams	8(18.2)	4(9.1)	8(18.2)	24(54.4)
Lip biting before	7(15.9)	4(9.1)	8(18.2)	25(56.8)	Lip biting after exams	10(22.7)	2(4.5)	7(15.9)	25(56.8)
Cheek chewing before exams	4(9.1)	4(9.1)	7(15.9)	29(65.9)	Cheek chewing after exams	6(13.6)	3(6.8)	6(13.6)	29(65.9)
Chewing ice before	0(0)	14(31.8)	14(31.8)	16(36.4)	Chewing ice After exams	0(0)	12(27.3)	9(20.5)	23(52.2)
Chewing gum Before exams	11(25.0)	12(27.3)	10(22.7)	11(25.0)	Chewing gum after exams	6(13.6)	10(22.7)	15(34.1)	13(29.6)
Resting chin On hands before exams	21(47.7)	2(4.5)	14(31.8)	7(15.9)	Resting chin after exams	23(52.3)	1(2.3)	13(29.6)	7(15.9)
Yawn wide Before exams	20(45.5)	2(4.5)	8(18.2)	14(31.8)	Yawn wide after exams	14(31.8)	5(11.4)	5(11.4)	20(45.4)

Table 2: Self-reported occurrence of bad habits and symptoms of TMD by participants (n=44)

Variable	Yes n%	No n%	Variable	Yes n%	No n%	Variable	Yes n%	No n%
Do you engage in these habits more frequently during stress times	37(84.1)	7(15.9)	Do you experience pain when opening or closing your mouth	8(18.2)	36(81.8)	Do you experience pain in your muscles of mastication when chewing food	5(11.4)	39(88.6)
Do you experience clicking sounds when chewing or opening mouth	15(34.1)	29(65.9)	Does your jaw get locked out of place	6(13.6)	38(86.4)	Do your jaw get stiff or tired at times	23(52.3)	21(47.7)
Do you have pain in or around your ears, temples or cheek	14(31.8)	30(68.2)	Have you suffered recent trauma to your head, neck or jaw	3(6.8)	41(93.2)	Did you suffer from myalgia before exams	1(2.3)	43(97.7)
Did you suffer from myalgia during exams	2(4.5)	42(95.5)	Did you suffer from myofascial pain before exams	14(31.8)	30(68.2)	Did you suffer from myofascial pain during exams	6(13.6)	38(86.4)
Did you suffer from Antralgia before exams	3(6.8)	41(93.2)	Did you suffer from Arthralgia during exams	5(11.4)	39(88.6)	Have you suffered headaches attributed to TMJ before exams	12(27.3)	32(72.7)
Did you suffer from headaches attributed to TMJ during the exams	7(15.9)	37(84.1)						

cheek chewing, lip biting, clenching their teeth and the occurrence of this were done daily in many cases and weekly and they were observed more after the examinations than before examination suggesting that the habits could be seen to be increased during stressful times.

Self-reported occurrence of bad habits and symptoms of TMD are reported in Table 2 above.

In Table 2 above 84% of the participants reported that they practiced the bad habits more during stressful times. More than half (52.3%) reported to have a stiff/tired jaw, 31% had myofascial pain and 27,3% suffered headaches attributed to the Temporomandibular joint before exams

The table below depicts the prevalence of TMD before and after exams.

Table 3: Prevalence of TMD before and after exams (n= 44)

Variable	Yes (n%)	No (n%)
TMD before exams	26(59)	18(41)
TMD after exams	26(59)	18(41)

The prevalence of TMD was found to be 59% after the exams and before exams.

Table 4 below depicts the association of bad habits before and after exams

Table 4: Associations between bad habits before and after exams (n=44)

Nail biting after exams								
Variable	frequency		daily	monthly	weekly	n/a	Total	p=
Nail biting before exams	daily	1	10	0	0	2	13	0.001
	monthly	0	0	2	0	0	2	
	weekly	0	0	0	20	1	21	
	N/A	0	3	0	1	4	8	
Total		1	13	2	21	7	44	
Clenching after exams								
Variable	frequency		daily	N/A	weekly		Total	p=
Clenching before exams		0	0	1	0		1	0.003
	Daily	0	7	1	3		11	
	N/A	1	1	13	3		19	
	Weekly	0	4	2	7		13	
Total		1	12	18	13		44	
Grinding after exams								
Variable	frequency		daily	monthly	weekly	n/a	Total	p=
Grinding before exams	daily	0	2	1	0	3	6	0.001
	Monthly	0	0	0	0	1	1	
	N/A	1	1	0	1	26	29	
	weekly	0	3	0	4	1	8	
Total		1	6	1	5	31	44	

Unilateral chewing after the examination							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Unilateral chewing before		0	1	0	0	1	0.01
	daily	1	9	0	3	0	
	monthly	0	1	0	1	1	
	n/a	0	5	1	13	1	
	weekly	0	0	0	2	4	
Total		1	16	1	19	7	44
Biting objects after the examination							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Biting objects before		1	0	0	0	0	0.001
	daily	0	5	0	1	2	
	n/a	1	1	2	18	2	
	weekly	0	2	2	3	4	
Total		2	8	4	22	8	44
Lip biting/sucking after							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Lip biting/sucking before	daily	0	4	0	2	1	0.001
	monthly	0	3	1	0	0	
	n/a	1	2	1	20	1	
	weekly	0	1	0	2	5	
Total		1	10	2	24	7	44
Cheek chewing after							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Cheek chewing before		0	1	0	0	0	0.001
	daily	0	4	0	0	0	
	monthly	1	0	2	1	0	
	n/a	2	1	1	24	0	
	weekly	0	0	0	1	6	
Total		3	14	5	17	6	44
Yawn very wide after exams							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Yawn very wide before exams		0	0	0	1	0	0.02
	daily	0	3	1	0	0	
	monthly	2	0	0	0	2	
	n/a	1	9	3	12	3	
	weekly	0	2	1	4	0	
Total		3	14	5	17	5	44
Chewing gum after exams							
Variable	frequency	daily	monthly	n/a	weekly	Total	p=
Chewing gum before exams		0	0	0	0	1	0.001
	daily	1	5	1	0	4	
	monthly	0	0	7	4	1	
	n/a	0	1	0	8	1	
	weekly	0	0	2	0	8	
Total		1	6	10	12	15	44

The majority of participants do not participate in bad habits but the associations have revealed the following for those who engage in the bad habits: Significantly more participants bit on their nails weekly after exams as opposed to before exams, ($p=0.001$). Significantly more participants clenched daily and weekly after the exams as opposed to before exams, $p=0.003$. Significantly more participants grinded their teeth daily and weekly after the exams as opposed to before exams, $p=0.001$. Significantly more participants chewed unilaterally after the exams daily as opposed to

before the exams and so did those who bit on objects and the same was observed for lip sucking, $p<0.05$. As for cheek chewing more participants practised the behaviour monthly, weekly and daily as opposed to before the exams, $p<0.05$. As for gum chewing significantly more chewed gum weekly followed by monthly and daily, $p=0.001$. This is also the only variable where in general those who chewed the gum exceeded those who didn't chew the gum. Significantly more participants yawned widely daily after exams than before exams, $p=0.02$.

Table 5: Association between yawning and TMD (n=44)

		Yawn widely before exams					P value
		daily	monthly	n/a	weekly	Total	
TMD diagnosis	No	4	2	8	4	18	0.04
	Yes	16	0	6	4	26	
Total		20	2	14	8	44	
		Yawn widely after exams					P value
		daily	monthly	n/a	weekly	Total	
TMD diagnosis	No	2	4	9	3	18	0.02
	Yes	12	1	8	2	26	
Total		14	5	17	5	44	

There was found to be no association between year of study and gender in the engagement in bad habits as well the frequency before and after exams, $p > 0.05$.

Association between TMD and yawning very wide is depicted in the table above.

Statistically more participants that yawn widely daily before and after exams are more likely to have a TMD diagnosis as opposed to those that yawns monthly or weekly, $p = 0.04$ and 0.02 respectively. When the association between TMD diagnosis and other bad habits (grinding, chewing on objects, lip biting and sucking, etc.) was done there was found to be no association between TMD and bad habits, $p > 0.05$

Association between symptoms of TMD (clicks, myalgia, arthralgia, and myofascial pain) and examination (n=44) in the table below.

The presence of clicking, myalgia, myofascial pain and arthralgia are significantly associated with TMD, $p = 0.00$, 0.01 , 0.01 and 0.04 respectively. There was also found to be no association between gender and year of study with TMD diagnosis, $p > 0.05$.

Discussion

TMD are a complex set of disorders that can often lead to chronic pain. The major clinical presentation of these disorders is pain in the orofacial region of non-odontogenic origin. Since TMDs considerably affects daily functions and follow a biopsychosocial pattern of a disease, its prevention, early diagnosis, and therapeutic management are deemed necessary. In the modern era, studies are being carried out in varied population using Diagnostic Criteria for Temporomandibular Disorders (DC/TMD).¹⁶⁻¹⁷ In this study DC/TMD was used to diagnose TMD and determine its prevalence. Preparing and writing of the examination was the common psychosocial factor (Axis II) affecting the students.

A common observation made in the past studies was the majority of TMD among females and in the younger age groups. Previous studies have also pointed out the higher prevalence of TMD in university students, especially medical and dental undergraduates.¹⁸⁻¹⁹ A high prevalence of 59 % was noted in this study. Interestingly, this prevalence remained the same even after the examinations. This suggests that either examinations were not the predisposing factor or examination and other factors such as clinical demands and complex curriculum also played a significant role in students

		Do you experience clicking sounds when chewing, opening, closing your mouth or yawning			p=value
		No	Yes	Total	
TMD diagnosis	No	18	0	18	0.00
	Yes	11	15	26	
Total		29	15	44	
		Experience of Myalgia			p=value
		No	Yes	total	
TMD diagnosis	No	16	2	18	0.01
	Yes	11	15	26	
Total		27	17	44	
		Experience of myofascial pain			p=value
		No	Yes	Total	
TMD diagnosis	No	16	2	18	0.01
	Yes	14	12	26	
Total		30	14	44	
		Experience of Arthralgia			p=value
		No	Yes	Total	
TMD diagnosis	No	18	0	18	0.04
	Yes	21	5	26	
Total		39	5	44	

with TMD. The complex nature of dental curriculum and its presentation also pose increased amount of stress, anxiety, and distress for students.

The purpose of the study was to determine the association between self-reported harmful oral habits and the TMD related signs and symptoms amongst oral hygiene students at a training institution in Gauteng and the frequency of the students' engagement in harmful oral habits.

Previous studies employed only the TMD pain screener questionnaire with university students while other researchers used RDC/TMD for assessing the prevalence of TMD or used Fonseca anamnestic index (FAI) in combination with various other questionnaires for classifying the TMD.^{18,17,20} The present study has an edge over other studies in Saudi Arabia, as it is first of its kind which has evaluated the male and female oral hygiene undergraduates for TMD using Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), although males were few.

The DC/TMD is a diagnostic framework that provide a systematic approach to the diagnosis of TMD, allowing clinicians to make more informed decisions about treatment.²¹ The DC/TMD includes assessing the patient's symptoms and performing a clinical examination. During the clinical examination, the clinician looks for signs and symptoms that are consistent with TMD, such as tenderness in the jaw muscles, pain with jaw movement, clicking of the jaw, and altered range of motion.

The study by Srivastava conducted among undergraduates' dental students found the overall cross-sectional prevalence of TMD to be 36.99%.²⁰ Pain arising from the jaw, temple, and the peri-auricular area were the most commonly reported symptoms and elicited signs during examination.²⁰ Among the pain-related TMD, myalgia was the commonest diagnosed condition. Female and students in clinical academic levels were found to have significantly increased risk of TMD. Among the psychosocial parameters, anxiety and parafunctional behaviour were shown to increase the risk of developing TMD. Students with any TMD reported to have significantly higher pain intensity levels and jaw functional limitations.

Similar observation was reported by Zafar et al., wherein variation in the prevalence among the university students of different disciplines was found.²² The dental students had experienced more TMD compared to the pharmacy and medical students. The prevalence was slightly higher in the female group compared to the male group. In a study by Larkin et al., the most reported symptoms were temporal headache neck pain and TMJ clicking among dental students.²³ Those reporting a higher number of parafunctional and jaw-strain-related habits were 1.6 times (95% CI 1.05, 2.42) more likely to exhibit at least one TMD sign or symptom. The most common parafunctional activities were teeth clenching (56.5%), grinding (36.1%), and chewing gum (35.4%). This study showed that the association between harmful oral habits and TMD was statistically significant.

Studies conducted regarding the risk assessment on oral parafunctions in relation to TMD discovered that the most prevalent reported oral parafunctional habits included: teeth clenching and grinding, nail biting and chewing gum sticks.^{5,10}

However, a study conducted by Michelotti et al found that nail biting was not a risk factor for any of the TMD subgroups (men and women) analysed, despite the fact that incisal clenching has been reported to reduce anterior joint space and to determine disc compression.¹⁴

There is a growing body of evidence that suggest that there are gender differences in the prevalence and presentation of TMD in adult.^{17,18,23} For example, women are more likely than men to seek treatment for TMD, and they are also more likely to report higher levels of pain and disability. There are a number of possible explanations for these gender differences. It might be related to social factors, hormonal factors, differences in pain sensitivity, as well as health-seeking behaviours. However, our study showed there was no association between gender and prevalence of TMD in our participants before and after exams.

CONCLUSIONS

The present study showed a high prevalence of TMD which was associated some of the harmful oral habits. The study also showed that examinations is not the only psychosocial factor predisposing factor students to TMD as the prevalence was the same before and after the exams.

LIMITATIONS

This study was limited by the cross-sectional study design and causality cannot be inferred. Response acquiescence is common in questionnaires that tend to determine habits that are considered taboo or have negative connotations. The study is also limited by the small sample size of the oral hygienists with a skewed distribution between males and females.

RECOMMENDATIONS

Dental students including oral hygienists in previous studies and in our study were shown to pose a higher risk of developing TMD, hence strategies such as early diagnosis and management of TMD need to be implemented so that they could improve prognosis and quality of student life. Additionally, academic counselling should be planned to assist students to cope with academic activities especially during exam time.

CONFLICT OF INTEREST

The authors declare there are no conflicts of interest

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Knowledge and Attitude of Dentists towards Caries Detection and Excavation

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ABSTRACT

Aim

To evaluate caries detection and excavation methods used by dental students and practitioners in Hyderabad, and also to investigate differences in the attitude towards leaving residual caries and assess sufficient removal of caries.

Materials and Methods: A structured questionnaire-based survey consisting of multiple-choice questions was compiled and responded by distributed among 420 dentists. These included 212 students (131 undergraduates and 81 postgraduates), and 208 dental practitioners (BDS and MDS). The survey compared the various techniques used for caries detection and caries removal. Data was collected and compared using the chi-square test with a level of significance at $p < 0.05$.

Results

Demographic data presented 47% male and 53% female. The majority of the dentists preferred conventional methods for caries detection and excavation. For assessment of sufficient caries removal, hardness ($p = 0.001$) and slight discoloration ($p = 0.05$) were most common criteria. While

assessing residual caries under restoration, results were significant for postgraduates ($p = 0.001$).

Conclusion

The majority of the respondents prefer conventional methods of caries diagnosis and excavation among dental students and practitioners in Hyderabad. Dentists have a minimally invasive approach towards caries removal and reported various criteria for the assessment of caries such as hardness, color, and moisture.

Keywords

caries detection, caries removal, dental practitioners, dental students, visual-tactile examination

INTRODUCTION

Dental caries remains an infectious microbial disease of the teeth, and in the absence of treatment, may progress to the loss of tooth structure.¹ An imbalance in the demineralisation-remineralisation cycle of the tooth surface and biofilm (plaque), over time, leads to net mineral loss, cavitation, and carious lesion.²

Dental caries diagnosis is about identifying caries based on signs and symptoms. It is not merely detection of caries but also a conceptual triad of identification of the carious lesion, its progression, and assessment of whether more lesions will occur or not.³

In Modern dentistry, the dental practice has shifted from restorative era to preventive era, with emphasis on minimal intervention approach. It is recognised that demineralised but non-cavitated enamel and dentine can heal, the treatment being noninvasive measures to arrest the disease.⁴ Due to recent advancements and better diagnostic aids and treatment strategies, more evidence-based guidelines for appropriate dental practice are available.

Caries detection was limited to clinical visual examination and radiographic means. However, advancements in technology have provided us with methods such as electrical conductance, which includes electronic caries monitor (ECM), Enhanced visual techniques like Fiber-optic transillumination (FOTI and DIFOTI), Fluorescent techniques Visible light fluorescence – QLF, Laser fluorescence – DIAGNODent, and other techniques like optical coherence tomography (OCT) and ultrasound.^{5, 6}

Similarly, popular methods for caries excavation are visual-tactile, and dye staining along with usage of smart burs or polymer burs, especially for deep dentinal caries. Advanced methods for caries excavation include fluorescence-aided caries excavation (FACE).⁷

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1. Dr. Mamta Kaushik - 35%
2. Neha Verma - 25%
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4. Dr. Alvin George - 10%
5. Dr. Ajita Rath - 10%

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Based on advances in understanding the caries process and surge in diagnostic aids, there has been a concept change in the diagnosis and management of dental caries. Thus, the management of dental caries requires accurate diagnosis, which culminates in the management of carious tooth structure with minimal invasion of healthy tissue.

A lot of these changes are getting incorporated into the dental curriculum, but the traditional concept of Black's Cavities is still dominating. Hence, this study aims to analyse the methods for caries detection and caries excavation used by dental students and practitioners in Hyderabad, Telangana, India. The auxiliary aim was to investigate the difference in the attitude towards leaving residual caries and assessment of sufficient caries removal.

MATERIALS AND METHODS

A survey to evaluate the Knowledge and Attitude of Dentists towards the latest methods of caries detection and excavation was planned. A structured questionnaire was designed and validated by 10 members of the Department of Conservative Dentistry and Endodontics, Army College of Dental Sciences, Secunderabad, Telangana. The survey was presented to the Institutional Review Board (Ethics Committee) and certificate with number ACDS/IRB/03/JUN/2021 was obtained.

Study population

A cross-sectional, descriptive questionnaire-based study was conducted from June 2018 to July 2018. A convenient

sample of 500 dental professionals (250 dental students and 250 dental practitioners) from Hyderabad city was selected for the present study. The questionnaire was distributed randomly to 250 dental students and 250 practitioners in dental colleges and clinics in Hyderabad. Students filled the Questionnaires on their own, without discussing with their contemporaries and others. About 30-minutes time was allotted to the participants to fill the questionnaire.

Data collection

The survey prepared consisted of multiple-choice questions regarding methods of caries detection and caries removal. It also recorded attitude towards caries removal and assessment of caries. Questions consisted of multiple selections, with a closed response and partially closed response, and it comprised two sections (Figures 1 and 2).

A pilot survey conducted amongst the staff in the Department of Conservative Dentistry and Endodontics validated the survey. These pre-respondents were excluded from the final tabulation.

The first section assessed the demographic and personal details of the participants, along with questions related to caries detection, excavation, and caries assessment criteria for sufficient removal. The second section that assessed their attitude towards leaving residual caries was recorded on a 5-point Likert scale.

QUESTIONNAIRE				
A. General Information				
1) Education- i) UG-				
a) Final year BDS ☐		b) Intern ☐		
ii) PG- year of study first year ☐ second year ☐ third year ☐				
Speciality- Prosthodontist ☐ Oral surgery ☐ Endodontist ☐				
Orthodontist ☐ Periodontist ☐ Public Health Dentist ☐				
Pedodontist ☐ Oral Pathologist ☐ Oral Medicine and Radiologist ☐				
2) Years of Experience- after BDS ☐ after MDS ☐				
B. Questionnaire				
1. Which method of Caries Detection do you use?				
a) Occlusal Caries		b) Smooth Surface Caries		c) Root Caries
i) Direct vision ☐		i) Visual-tactile methods ☐		i) Visual-tactile methods ☐
ii) Visual-tactile methods ☐		ii) Floss ☐		ii) Radiographs ☐
iii) Radiographic diagnosis ☐		iii) Tooth Separation-Rapid (wedges) ☐		iii) Caries disclosing dyes ☐
iv) Caries disclosing dye ☐		Slow (elastics) ☐		iv) Surgical exploration ☐
v) Electronic caries monitor ☐		iv) Electronic caries monitor ☐		v) Electronic caries monitor ☐
		v) Radiograph-IDPA ☐		
		Bitewing ☐		
Any other (please specify) _____				
2. Which method of Caries Removal do you use?				
	Enamel caries	Dental caries	Root caries	
i) Arotor with carbide bur	☐	☐	☐	
ii) Micro motor with Carbide bur	☐	☐	☐	
iii) Arotor with Diamond points	☐	☐	☐	
iv) Micro motor with steel burs	☐	☐	☐	
v) Spoon excavator	☐	☐	☐	
vi) Polymer burs	☐	☐	☐	
vii) Chemo mechanical methods	☐	☐	☐	
viii) Ultrasonic	☐	☐	☐	
ix) Air Abrasion	☐	☐	☐	
x) Lasers	☐	☐	☐	
Any other (please specify) _____				
3. Which criteria do you use to assess sufficient removal of caries?				
1. Hardness	a) soft ☐	b) leathery ☐	c) hard ☐	d) not relevant ☐
2. Color	a) very discolored ☐	b) slightly discolored ☐	c) not discolored ☐	d) not relevant ☐
3. Moisture	a) wet ☐	b) slightly moist ☐	c) dry ☐	d) not relevant ☐
4. Further criteria	a) dye staining ☐	b) shiny surface ☐	c) diagenodent ☐	d) pain/sensitivity ☐
	e) Others ☐			
4. Leaving caries under the restoration-				
	strongly disagree	disagree	agree	strongly agree
a) Soft Caries should completely be removed.	☐	☐	☐	☐
As may progress otherwise	☐	☐	☐	☐
b) All Caries should always be removed completely.	☐	☐	☐	☐
As residual caries is a risk for pulp	☐	☐	☐	☐
c) Certain amount Caries can be left, as intact restoration	☐	☐	☐	☐
Can seal and thus arrest caries	☐	☐	☐	☐
d) Caries close to pulp should be left to avoid	☐	☐	☐	☐
Pulp exposure	☐	☐	☐	☐
5. Primary concern-				
b) Invasive methods for restoration survival preferred	☐	☐	☐	☐
Over conservation of tooth structure	☐	☐	☐	☐
c) Minimally invasive methods should be used.	☐	☐	☐	☐
Followed by re-treatment if required	☐	☐	☐	☐

Figure 1: Questionnaire for Dental Students

QUESTIONNAIRE

A. General Information

1) Education- i) BDS ☐ MDS ☐

ii) MDS: Prosthodontist ☐ Oral surgery ☐ Endodontist ☐
 Orthodontist ☐ Periodontist ☐ Public Health Dentist ☐
 Pedodontist ☐ Oral Pathologist ☐ Oral Medicine and Radiologist ☐

b) Years of Experience- after BDS ☐ after MDS ☐

c) Type of Experience- Private Practice ☐ Academia ☐ Public Practice ☐

B. Questionnaire

1. Which method of Caries Detection do you use?

a) Occlusal Caries i) Direct vision ☐ ii) Visual-tactile methods ☐ iii) Radiographic diagnosis ☐ iv) Caries disclosing dye ☐ v) Electronic caries monitor ☐

b) Smooth Surface Caries i) Visual-tactile methods ☐ ii) Floss ☐ iii) Tooth Separation -Rapid (wedges) ☐ Slow (elastics) ☐ iv) Electronic caries monitor ☐ v) Radiograph- IOPA ☐ Bitewing ☐

c) Root Caries i) Visual-tactile methods ☐ ii) Radiographs ☐ iii) Caries disclosing dyes ☐ iv) Surgical exploration ☐ v) Electronic caries monitor ☐

Any other (please specify) _____

2. Which method of Caries Removal do you use?

	Enamel caries	Dentinal caries	Root caries
i) Airtor with carbide bur	☐	☐	☐
ii) Micro motor with Carbide bur	☐	☐	☐
iii) Airtor with Diamond points	☐	☐	☐
iv) Micro motor with steel burs	☐	☐	☐
v) Spoon excavator	☐	☐	☐
vi) Polymer burs	☐	☐	☐
vii) Chemo mechanical methods	☐	☐	☐
viii) Ultrasonic	☐	☐	☐
ix) Air Abrasion	☐	☐	☐
x) Lasers	☐	☐	☐

Any other (please specify) _____

3. Which criteria do you use to assess sufficient removal of caries?

1. Hardness a) soft ☐ b) leathery ☐ c) hard ☐ d) not relevant ☐

2. Color a) very discolored ☐ b) slightly discolored ☐ c) not discolored ☐ d) not relevant ☐

3. Moisture a) wet ☐ b) slightly moist ☐ c) dry ☐ d) not relevant ☐

4. Further criteria a) dye staining ☐ b) shiny surface ☐ c) diagenodent ☐ d) pain/sensitivity ☐

e) Others ☐

4. Leaving caries under the restoration-

	strongly disagree	disagree	agree	strongly agree	not specified
a) Soft Caries should completely be removed, As may progress otherwise	☐	☐	☐	☐	☐
b) All Caries should always be removed completely, As residual caries is a risk for pulp	☐	☐	☐	☐	☐
c) Certain amount Caries can be left, as intact restoration Can seal and thus arrest caries	☐	☐	☐	☐	☐
d) Caries close to pulp should be left to avoid Pulp exposure	☐	☐	☐	☐	☐

5. Primary concern-

b) Invasive methods for restoration survival preferred Over conservation of tooth structure ☐

c) Minimally invasive methods should be used, Followed by re-treatment if required ☐

Figure 1: Questionnaire for Dental Students

STATISTICAL ANALYSIS

Questionnaire data were organised using a databank Excel 10 (Microsoft, USA) and subject to statistical analysis using SPSS 20(IBM, Armonk, NY:IBM Corp). Statistical analysis was performed using SPSS version 20. Descriptive statistics was done to understand the mean, std deviation and other parameters to describe the study population. Chi square test was done to check the association of different demographic details with other relevant study variables and the ones which were statistically significant were reported as mentioned in the tables. A level of significance at $p < 0.05$ was accepted.

RESULTS

Among the 500 participants dentists surveyed, 420 responded participated, resulting in a response rate of 84%. The respondents comprised 208 practitioners and 212 students (undergraduate students- 131, Postgraduate students- 81). The demographic data presented that 47% were males, and 53% were females.

The various methods employed for the detection of occlusal, smooth surface and root caries are listed in Table I. All the respondents stated that they prefer direct vision, visual examination and tactile sensation, and radiographic methods for the detection of occlusal caries. For smooth surface caries, 100% of the participants prefer visual-tactile method. The intraoral periapical radiograph (IOPA) is the most commonly employed radiographic technique followed by bitewing ($p = 0.043$) for the detection of smooth caries. 100% of dental practitioners, 96.3% of postgraduates, and 94.7% of undergraduates were using IOPA. Whereas, for root caries, all of the participants (100%) preferred radiographic methods followed by visual-tactile method ($p = 0.001$)

(98.6% practitioners, 96.3% postgraduate students, 89.3% undergraduate students) and surgical exploration (46.6% practitioners, 22.3% postgraduate students and none of the undergraduate students). None of the participants use caries disclosing dye and electronic caries monitor for caries detection.

Out of 500 dentists approached, 420 responded (response rate: 84%). The sample included 208 practitioners and 212 students (131 undergraduates and 81 postgraduates), with a slight female predominance.

All participants reported the use of visual-tactile and radiographic methods for the detection of occlusal and smooth surface caries (Table I). For smooth surface caries, intraoral periapical radiographs were preferred over bitewing radiographs, with a statistically significant difference ($p = 0.043$). In the detection of root caries, radiographic methods were universally employed, while the use of visual-tactile methods showed a statistically significant difference among groups ($p = 0.001$). Surgical exploration was reported variably, with minimal use among undergraduates. No participants reported the use of caries disclosing dyes or electronic caries monitoring devices.

For caries removal (Table II), airtor handpieces with diamond burs were the most commonly used method across all lesion types, with no statistically significant intergroup differences. The use of carbide burs for enamel caries showed a statistically significant difference ($p = 0.001$), as did the use of polymer burs for dentinal caries ($p = 0.001$). Spoon excavators were used consistently across groups without statistically significant variation. None of the respondents

reported the use of chemo-mechanical, ultrasonic, air abrasion, or laser-assisted techniques.

Regarding criteria for sufficient caries removal (Graph I), hardness of dentine was the most significant parameter ($p = 0.001$), followed by slight discolouration ($p = 0.05$). Other criteria showed variability but were not statistically significant. Dentists' perspectives on leaving caries beneath restorations (Table III) demonstrated a statistically significant difference among postgraduates ($p = 0.001$), particularly in the assessment of residual caries. Differences in attitudes towards complete caries removal, pulpal risk, and minimally invasive approaches were observed but did not consistently reach statistical significance.

Graph I presents the criteria for the assessment of sufficient caries removal among dentists. The majority of dentists stated that they check for hardness (78.4% practitioners, 59.3% postgraduate and 51.9% undergraduates) and slight discoloration (55.8% practitioners, 63% postgraduates and 45.8% undergraduates) 46.6% undergraduates check for dry surface, whereas 39% of practitioners and 30.9% postgraduates assess by slightly moist surface. The majority of undergraduates (70.2 %) assess through pain and sensitivity, postgraduates (40.4 %) by dye staining, and practitioners (38.6 %) shiny surface. For assessment of sufficient caries removal, hardness ($p = 0.001$) and slight discoloration ($p = 0.05$) were most common criteria.

Table III depicts the perspective of dentists towards leaving caries under the restoration. 70.4% postgraduates, 57.4% practitioners, and 51.6% undergraduates, strongly agree that 'soft caries should be completely excavated as it may progress otherwise.'

65.1% undergraduates, 51.9% postgraduates, and 46.4% practitioners agreed that 'all caries should always be removed completely, as residual caries is a risk for pulp.'

On the concept of leaving caries under an intact restoration 58.7% of undergraduates disagreed, whereas 70.3% of practitioners and 45.7% of postgraduates agreed.

34.9% undergraduates strongly disagreed, 59.3% postgraduates agreed, and 54.5% practitioners disagreed that caries close to the pulp should be left to avoid pulp exposure.

Assessing residual caries under restoration results were significant for postgraduates ($p = 0.001$). The participants were also asked about their primary concern whether 'invasive methods for restoration survival preferred over conservation or minimally invasive methods should be used, followed by retreatment if required'. 44.4% undergraduates disagreed, 67.9% postgraduates, and 48.8% practitioners strongly agreed that invasive methods for restoration survival preferred over conservation. Whereas, 56.9% practitioners, 55.6% undergraduates, agreed and 44.4% postgraduates strongly agreed that minimally invasive methods should be used, followed by retreatment if required.'

DISCUSSION

An ideal diagnostic tool should have accuracy, reliability, precision, objectivity, sensitivity, specificity, reproducibility, validity quantitative analysis, ease of application, and should be able to identify caries adjacent to restorations.⁵

Conventional or traditional methods are qualitative in nature, inferior in validity, with low sensitivity, and less specificity. The need for identification of carious lesions in the early stages is of utmost importance in deciding the treatment plan. Advanced diagnostic methods are quantitative, detect lesions at an earlier stage, and are more reliable than the conventional methods. They have better sensitivity and specificity and help in a preventive approach towards the management of caries.⁸

Studies by Khaleis et al.(2010) and Diniz et al.(2013) have compared conventional diagnostic methods with advancements in the diagnosis of caries.^{6,9}

The present study found that the majority (100%) of the respondents prefer direct vision, visual-tactile and radiographic methods for caries detection (occlusal, smooth surface caries and root caries) (Table I). These findings are similar to the results obtained by Ntovas et al. (2018) among Greek dentists^[10]. The preference of radiographs is IOPA and bitewings in 94.7% and 71.8% undergraduates, 96.3% and 79% postgraduate students, and 100% and 83.2% practitioners' respectively. Visual-tactile and conventional radiographic diagnostic modalities are the most common methods used to diagnose caries even though the use of the traditional probe has been discouraged because of the risk of mechanically damaging the enamel.⁶ This may be because the visual-tactile method is easy to perform routinely in clinical practice has high specificity but low sensitivity.^[11]

Radiographic methods act as an adjunct to the clinical examination and allow more sensitive detection of carious lesions (proximal and occlusal) in dentin, which are not detected just by visual –tactile examination. It also provides better lesion depth than the visual inspection performed alone.¹¹

For root caries, postgraduate students (22.3%) and practitioners (46.6%) preferred to explore caries surgically. None of the dentists reported the use of caries disclosing dye and electronic caries monitor for caries detection. This could be due to technique sensitivity and high cost.¹²

For caries removal of enamel caries, dentinal caries, and root caries, airtor with diamond points, was found to be the most popular for the removal of enamel caries, dentinal caries, and root caries, followed by airtor with carbide burs and spoon excavators. The difference is statistically significant among the three categories. None of the dentists reported the use of ultrasonic, air abrasion, or lasers. However, the use of polymer burs (Table II) was reported which is in contrast with the study performed by Ntovas, *et al.*¹⁰ The reason behind this is probably the necessity of additional equipment for the application of new technology and ease of application of polymer burs.

The most commonly used criteria for assessing sufficient caries removal among dentists were dentin hardness (51–78%) and slight discoloration (45–63%). Among undergraduates, 46.6% evaluated dryness of the surface, while 30.9% of postgraduates and 39% of practitioners assessed a slightly moist surface. Additionally, 70.2% of undergraduates relied on pain and sensitivity, 38.3% of practitioners considered a shiny surface, and 40.4% of postgraduates used dye staining as their assessment method (Graph I). These findings are consistent with a previous study conducted in Northern Germany (2013).¹³

Assessment to analyse the perspective of the dentists regarding leaving caries under the restoration was done. The majority of the respondents (51-70%) strongly agreed that soft caries should completely be removed, as may progress otherwise (Table III). 46-65% of the respondents agreed that all caries should always be removed completely, as residual caries is a risk for pulp. Among undergraduate respondents, 58.7% opposed the concept of leaving residual carious tissue, indicating a preference for complete caries removal. Conversely, 45.7% of postgraduate students and 70.3% of dental practitioners supported the selective removal of caries, acknowledging that a properly sealed restoration can isolate the lesion from the oral environment and thereby arrest its progression.

These results are concurring with the study performed by F. Schwendicke et al.(2013)^[13] and Terek Rabi (2016)^[14] in northern Germany and Palestine respectively. 34.9% of undergraduates strongly disagreed and 54.5% of practitioners disagreed, whereas 59.3% of postgraduates agreed (Table III) that caries close to the pulp should be left to avoid pulp exposure, which may be due to their knowledge of minimally invasive dentistry. These results are in contrast with the study performed by F. Schwendicke et al.(2013)^[13] and Terek Rabi (2016).¹⁴

Dentists were also asked about their primary concern—whether they prioritised invasive methods to ensure

restoration longevity over conserving tooth structure through minimally invasive techniques, with the option of re-treatment if necessary (Table III).

44.4% of undergraduates disagreed, 67.9% of postgraduates and 48.8 % of practitioners strongly agreed that invasive methods for restoration survival were preferred over conservation. 44-60% respondents agreed that minimally invasive methods should be used, followed by retreatment if required the results are in disagreement to previous studies conducted by F. Schwendicke et al.(2013)¹³ and Terek Rabi (2016)^[14] in Northern German dentist and Palestine dentists respectively, where the majority of dentists attempt complete removal of caries since they fear residual caries may progress or harm if not excavated.

The limitations of the present study include its confinement to a single city and its reliance on a questionnaire-based survey; as such, the self-reported responses may not accurately reflect actual clinical practices. Further studies are recommended to gain a more comprehensive understanding of dentists' awareness and approaches.

CONCLUSION

The findings of this study highlight a continued reliance on conventional methods such as visual-tactile examination and traditional radiography for caries diagnosis and removal among dental students and practitioners in Hyderabad. While

Table I: Caries detection methods

Caries detection	Undergraduates % (n=131)	Post graduates % (n=81)	Practitioners % (n=208)	Chi-square value	p value
Occlusal caries					
Direct vision	100	100	100	--	--
Visual-tactile	100	100	100	--	--
Radiographic diagnosis	100	100	100	--	--
Caries disclosing dye	0	0	0	--	--
Electronic caries monitor	0	0	0	--	--
Smooth surface caries					
Visual-tactile	100	100	100	--	--
Floss	61.1	46.9	53.8	4.188	0.123
Tooth separation rapid (wedges)	83.2	61.7	83.2	18.175	0.001*
Tooth separation slow(elastics)	3.8	27.2	10.6	26.941	0.001*
Electronic caries monitor	0	0	0	--	--
Radiographic IOPA	94.7	96.3	100	10.630	0.005*
Radiographic bitewing	71.8	79	83.2	6.276	0.043*
Root caries					
Visual-tactile	89.3	96.3	98.6	17.673	0.001*
Radiographic	100	100	100	--	--
Caries disclosing dye	0	0	0	--	--
Surgical exploration	0	22.3	46.6	99.689	0.001*
Electronic caries monitor	0	0	0	--	--

Chi-square test; * indicates significant at $p \leq 0.05$

a minimally invasive approach is generally adopted, the criteria for assessing sufficient caries removal vary, with hardness and color being the most commonly used indicators. These results emphasise the need for increased awareness and integration of evidence-based, modern diagnostic tools and techniques to enhance clinical decision-making and improve patient outcomes in caries management.

Table II: Caries removal methods

Caries removal	Undergraduates %	Post graduates %	Practitioners %	Chi-square value	p value
Enamel caries					
Airotor with carbide bur	64.9	75.3	61.5	8.782	0.067
Micro motor with carbide bur	2.3	3.7	1.0	1.127	0.569
Airotor with diamond points	90.1	90.1	99	16.226	0.001*
Micro motor with steel burs	0.8	2.5	0	3.645	0.162
Spoon excavator	35.1	54.3	77.4	60.687	0.001*
Polymer burs	0	0	0	--	--
Chemo mechanical methods	0	0	0	--	--
Ultrasonic	0	0	0	--	--
Air abrasion	0	0	0	--	--
Lasers	0	0	0	--	--
Dentinal caries					
Airotor with carbide bur	61.8	53.1	79.3	21.890	0.001*
Micro motor with carbide bur	0	0	18.8	43.819	0.001*
Airotor with diamond points	89.3	91.3	92.8	1.239	0.538
Micro motor with steel burs	0	16	12	20.089	0.001*
Spoon excavator	74	80.2	79.3	1.633	0.442
Polymer burs	14.8	17.6	37.0	38.953	0.001*
Chemo mechanical methods	8.4	1.2	9.1	5.610	0.061
Ultrasonic	0	0	0	--	--
Air abrasion	0	0	0	--	--
Lasers	0	0	0	--	--
Root caries					
Airotor with carbide bur	3.8	1.2	50.5	122.775	0.001*
Micro motor with carbide bur	6.1	6.2	1.9	4.790	0.091
Airotor with diamond points	77.9	98.8	86.5	18.415	0.001*
Micro motor with steel burs	0	0	0	--	--
Spoon excavator	45.8	71.6	59.2	27.812	0.001*
Polymer burs	0	0	0	--	--
Chemo mechanical methods	0	0	0	--	--
Ultrasonic	0	0	0	--	--
Air abrasion	0	0	0	--	--
Lasers	0	0	0	--	--

Chi-square test; * indicates significant at $p \leq 0.05$

Graph I: Assessment of sufficient caries removal

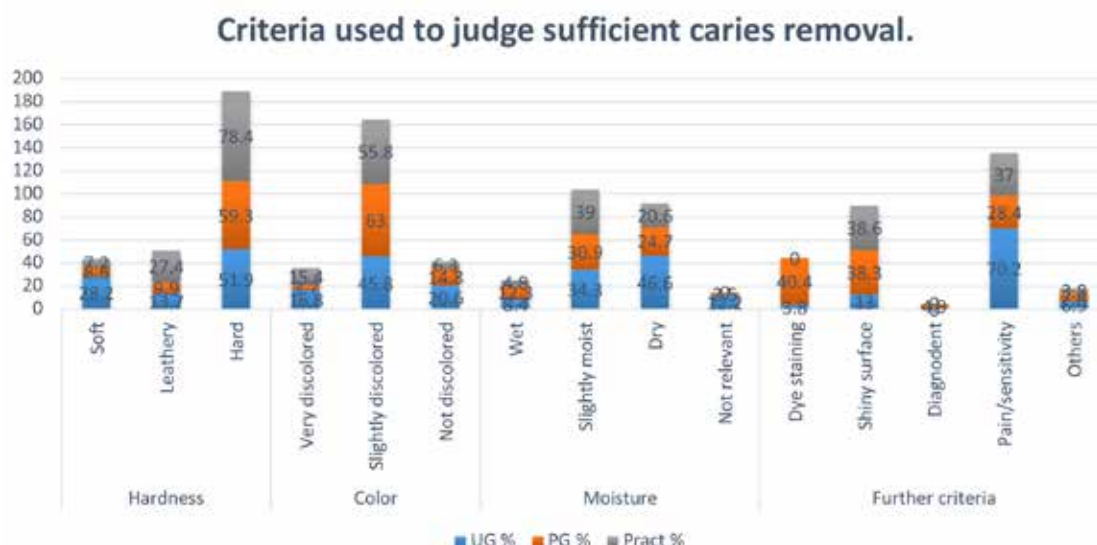


Table III: Leaving caries under the restoration

	Strongly disagree %	Disagree %	Agree %	Strongly agree %	Not relevant %	Chi-square value	p value
Soft Caries should completely be removed, As may progress otherwise							
Undergraduates	3.2	15.1	11.1	51.6	19	64.897	0.001*
Post graduates	0	0	29.6	70.4	0		
Practitioners	0	8.6	29.2	57.4	4.8		
All Caries should always be removed completely, As residual caries is a risk for pulp							
Undergraduates	1.6	10.3	65.1	16.7	6.3	31.025	0.001*
Post graduates	0.	21	51.9	22.2	4.9		
Practitioners	0	34	46.4	13.9	5.7		
Certain amount Caries can be left, as intact restoration Can seal and thus arrest caries							
Undergraduates	11.9	58.7	10.3	9.5	9.5	151.019	0.001*
Post graduates	0	35.8	45.7	13.6	4.9		
Practitioners	0	18.7	70.3	11	0		
Caries close to pulp should be left to avoid pulp exposure							
Undergraduates	34.9	18.3	12.7	10.3	23.8	216.773	0.001*
Post graduates	0	12.3	59.3	28.4	0		
Practitioners	11.5	54.5	27.3	6.7	0		
Primary concern -							
Invasive methods for restoration survival preferred over conservation							
Undergraduates	21.4	44.4	9.5	0	24.6	323.766	0.001*
Post graduates	0	0	32.1	67.9	0		
Practitioners	0	0	43.1	48.8	8.1		
Minimally invasive methods should be used, followed by re-treatment if required							
Undergraduates	17.5	7.9	55.6	11.9	7.1	193.545	0.001*
Post graduates	0	0	30.9	44.4	24.7		
Practitioners	0	32.1	56.9	11	0		

Chi-square test; * indicates significant at $p \leq 0.05$

The association between ethical feedback delivery and student self-regulation

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ABSTRACT

Purpose

This paper examined the association between the ethical basis of feedback delivery and the student's ability to self-regulate learning.

Methods

A Prisma 2020 scoping review was conducted by entering "Ethics" and "Feedback" as the only two key words in the Medline (Web of Science), Pubmed and PsycINFO databases. No limitations were placed on the search to maximise the identification of ethical considerations that influence feedback. Duplicates, non-sensical publications and non-English articles were systematically removed. The remaining publication titles were screened for appropriateness and relevance. The search strategy required there to be some form of connotation to 1) feedback delivery 2) ethical considerations and 3) the impact on students' self-regulation in any teaching context. Articles were qualitatively analysed. Apposite quotations were recorded, and emerging themes were grouped under teacher and student-related factors.

Results

"Ethical" feedback delivery was linked to academic success and promoted the development of self-regulation amongst learners. Conversely an "unethical" mode of feedback delivery was linked to poor performance and a lack of growth. Respect, being autonomy supportive and the maintenance of confidentiality during feedback delivery could be linked to psychological safety, which encourages learning. The opposite behaviour created fear which is not conducive to learning, particularly amongst students with low self-esteem and self-regulating capabilities.

Conclusion

The associations drawn in this study may serve as a conceptual model for staff development to provide constructive feedback with an ethical basis to induce self-regulation amongst students.

KEYWORDS

Ethics, feedback, self-regulation, psychological safety

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INTRODUCTION

The provision of feedback is critical to close learning gaps in dental education. Feedback is effective when given correctly.¹ Empirical evidence exists that good feedback improves self-regulation.² Unfortunately feedback is not always constructive. Feedback on the self is, in particular, discouraged as it negatively affects self-efficacy belief, motivation and learning.^{1,3} It can hence be argued that feedback on the self is unethical as it harms the student's self-esteem and may be counterproductive in the learning process.

Undergraduate dental education can be a challenging endeavour for learners, with one of their main stressors being their interaction with teachers.⁴ A sense of psychological safety is necessary to enhance personal and professional development.¹ Psychological safety is important for learning.⁵ Thus, disparaging behaviour by the teachers that denigrates this could be considered academically and ethically unacceptable, especially in terms of their commitment towards beneficence and doing good.³

Feedback is often that interface between the teacher and the student and can either enrich or be detrimental to learning, depending on the mode of delivery.¹ The efficacy of feedback however does not only depend on the teacher's ability to appropriately convey their message, but also on the student's ability to self-reflect and then adapt accordingly.³ Zimmermann believes that students regulate their learning through self-efficacy belief and motivation which elicits a goal orientation along with a distinct outcome expectation. Self-regulated learners exercise self-control and metacognitive monitoring to successfully complete a task. Thereafter, they are able to reflect on their performance, take responsibility for their own failures, and implement constructive changes.⁶ It can be argued that because of the default power relationship that exists between a teacher and a student, the incorrect delivery of feedback maybe intentionally or unintentionally unethical as it works against the notion of contributing to the greater good.⁷

A need therefore exists to explore the relationship of ethics and feedback in education. This paper aimed to investigate the factors that inform on the ethical basis of clinical teaching. Understanding their relationship and how feedback delivery impacts on learning, may allow for improvements in the approach to feedback delivery in the clinical training environment. The establishment of a model may also systematically inform staff training through the conception of a standard against which staff can be evaluated.

MATERIALS AND METHODS

A PRISMA 2020 scoping review⁸ was conducted to identify the ethical considerations that interface with feedback delivery, and then to synthesise these into a proposed model

for staff development. “Ethics” and “Feedback” were entered as the only two key words in the Medline (Web of Science (WoS)), Pubmed and PsycINFO databases. No limitations were placed on the search to maximise the identification of ethical considerations that influence feedback. Identified citations were downloaded and organised in a Microsoft Excel dataset. The citation titles were alphabetically sorted, duplicates, non-sensical publications and non-English articles were systematically filtered out through a manual process.

The remaining publication titles were screened for appropriateness by the primary researcher (TCP) and later verified by the co-author (LMS). The only inclusion criterion at this stage was a clear connection to feedback delivery. The elimination process continued after reading the abstracts of the initially included titles. At this point the search strategy required a connotation to 1) feedback delivery 2) ethical considerations and 3) the impact on students’ self-regulation in any teaching context.

The remaining articles were qualitatively analysed and focal ethical principles and considerations were identified and thematically grouped.⁹ Ethical observations related

to teacher behaviour were deductively analysed using the basic ethical principles (beneficence, non-maleficence, respect, integrity, tolerance, veracity, and confidentiality) as a point of reference, and at the same time allowing for the open-ended addition of related themes. Reference to students’ self-regulation were deductively organised against the components of Zimmermann’s model of self-regulated learning (e.g., self-esteem, self-efficacy belief, motivation, goal setting, outcome expectation, self-observation, self-control, self-monitoring, self-evaluation, self-reflection, attribution and adaptation),⁶ similarly allowing for the open-ended (inductive) addition of related concepts and themes.

Emerging themes were used to synthesise a proposed model that demonstrates how the ethical basis of clinical teaching, combined with student characteristics could affect learning outcomes.

RESULTS

A total of 5351 documents were identified of which 1236 were from Medline (WoS), 3278 from Pubmed and 837 from PsycINFO (dated 3 June 2023). This was followed by the removal of one non-sensical document, 1256 duplicates and the remaining 56 non-English articles (Figure 1).

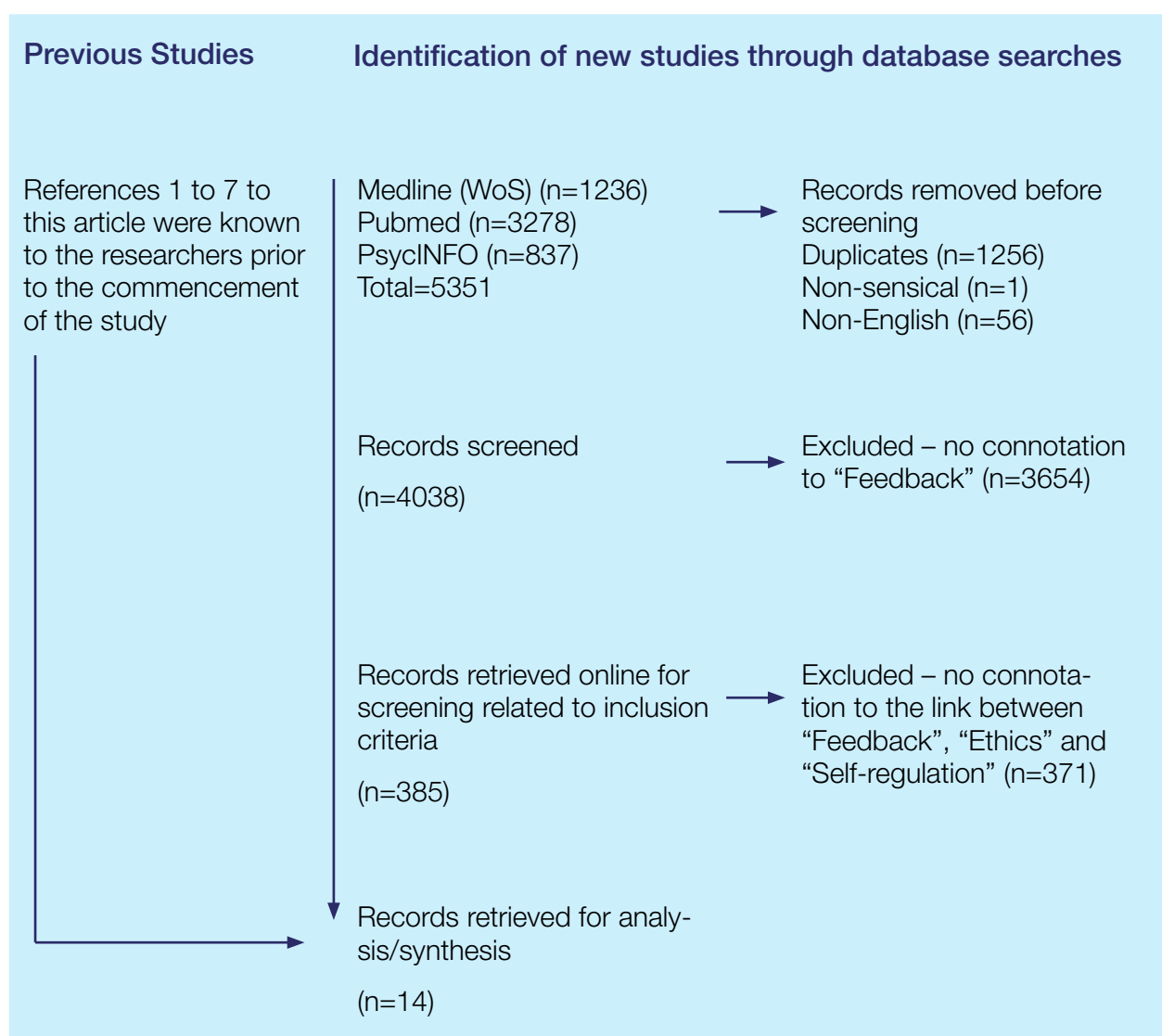


FIGURE 1: PRISMA 2020 flow diagram⁸

The number of remaining titles with a connotation to feedback delivery and self-regulation totalled 385 of which 14 were kept (Table 1) for analysis after reading the abstracts and the articles.

TABLE 1. Articles included in the analysis and synthesis

1.	Braun V, Clarke V. Culture and understanding the role of feedback for health professions students: realist synthesis protocol. ⁹
2.	Irlenbusch B, Rilke RM, Walkowitz G. Designing feedback in voluntary contribution games: the role of transparency. ¹¹
3.	Emke AR, Cheng S, Dufault C, Cianciolo AT, Musick D, Richards B. Developing professionalism via multisource feedback in team-based learning. ¹²
4.	Johnson CE, Keating JL, Farlie MK, Kent F, Leech M, Molloy EK. Educators' behaviours during feedback in authentic clinical practice settings: an observational study and systematic analysis. ¹³
5.	Eva KW, Regehr G. Effective feedback for maintenance of competence: from data delivery to trusting dialogues. ¹⁴
6.	Herrmann-Werner A, Loda T, Erschens R, Schneider P, Junne F, Gilligan C, Teufel M, Zipfel S, Keifenheim KE. Face yourself! -learning progress and shame in different approaches of video feedback: a comparative study. ¹⁵
7.	Fourie MM, Thomas KG, Armodio DM, Warton CM, Meintjes EM. Neural correlates of experienced moral emotion: an fMRI investigation of emotion in response to prejudice feedback. ¹⁶
8.	Rösler IK, van Nunspeet F, Ellemers N. Falling on deaf ears: The effects of sender identity and feedback dimension on how people process and respond to negative feedback— An ERP study. ¹⁷
9.	Larson EL, Patel SJ, Evans D, Saiman L. Feedback as a strategy to change behaviour: the devil is in the details. Journal of evaluation in clinical practice. 2013;19(2):230-4. ¹⁸
10.	Henry D, Vesel T, Boscardin C, van Schaik S. Motivation for feedback-seeking among pediatric residents: a mixed methods study. ¹⁹
11.	Gong Z, Van Swol L, Xu Z, Yin K, Zhang N, Gul Gilal F, Li X. High-power distance is not always bad: ethical leadership results in feedback Seeking. ²⁰
12.	Moss SE, Song M, Hannah ST, Wang Z, Sumanth JJ. The duty to improve oneself: How duty orientation mediates the relationship between ethical leadership and followers' feedback-seeking and feedback-avoiding behavior. ²¹
13.	Mouratidis A, Lens W, Vansteenkiste M. How you provide corrective feedback makes a difference: The motivating role of communicating in an autonomy-supporting way. Journal of sport and exercise psychology. ²²
14.	Harrison CJ, Könings KD, Dannefer EF, Schuwirth LW, Wass V, van der Vleuten CP. Factors influencing students' receptivity to formative feedback emerging from different assessment cultures. ²³

Table 2 displays the main emerging quotations, and Table 3 the teacher- and student-related themes. The emerging quotations highlights potential connections between ethical behaviour of the feedback provider as well as the self-regulation impacts the feedback has on the receiver.

TABLE 2: Emerging quotations (including philosophical interpretations of the authors)

Emerging quotations
Includes the original authors' philosophical interpretation of the cited literature, literature review, results or discussion sections
Article 1: ¹⁰ "Confucius saw learning as a means of social change and to overcome social differences, but also placed much emphasis on personal effort. The Chinese philosophy of education also highlighted a mutually respectful relationship between teacher and learner, with the teacher guiding the learner, rather than pulling the learner along. This parallels the role of <i>guru</i> (teacher) seen in the Indian culture of education—with the <i>guru</i> nurturing the learner."
Article 2: ¹¹ "Feedback shapes subjects' beliefs"
Article 3: ¹² "A few individuals in the group consistently rated themselves highly while their peers rated them poorly"
Article 4: ¹³ Educators commonly provided performance analysis, described how the task should be performed, and were respectful and supportive. Many of the recommended feedback behaviours were rarely seen, such as clarifying the session purpose and expectations, promoting learner involvement, creating an action plan or arranging a subsequent review session
Article 5: ¹⁴ "Dialogue between peers or with a coach in a trusting relationship that aims at building on a physician's strengths more likely to be an effective mechanism for practice change and maintenance of competence." "Cognitive dissonance is the discomfort created by trying to maintain conflicting beliefs at the same time. We are motivated to lessen such discomfort and, in response, tend to alter one of the beliefs. Accepting and incorporating corrective feedback, even in the form of "objective" practice data, requires the acknowledgement that one is performing sub optimally. Such an understanding is, by definition, in conflict with the belief that one is serving one's patients well. Because it is easier to question the data than to question oneself, this pair of conflicting beliefs will often be resolved by discounting the feedback rather than altering one's sense of self as a competent clinician." "Literature on self-efficacy suggests that this discounting may have value. Having a belief that one can accomplish a goal increases the likelihood of accomplishing it. Thus, the drive to sustain a positive self-concept might be important to good performance, and threats to positive self-concept should be defended against."
Article 6: ¹⁵ "Feedback associated with different levels of shame in students with a simple checklist is likely to be perceived as the least embarrassing. Receiving feedback in front of a group of fellow students being perceived as most embarrassing."
Article 7: ¹⁶ "The paradigm induced intense moral-negative emotion (primarily guilt) in 22 low-prejudice individuals through preprogrammed feedback indicating implicit prejudice against Black and disabled people. fMRI data indicated that this experience of moral-negative emotion was associated with increased activity in anterior paralimbic structures. Of significance was prominent conflict-related activity in the supragenual ACC, which is consistent with theories proposing an association between acute guilt and behavioural inhibition. A significant negative association between self-reported guilt and neural activity in the pregenual ACC suggested a role of self-regulatory processes in response to moral-negative affect. These findings are consistent with the multifaceted self-regulatory functions of moral-negative emotions in social behaviour."

Emerging quotations

Includes the original authors' philosophical interpretation of the cited literature, literature review, results or discussion sections

Article 8:¹⁷ "Subtle cues such as the social group-membership of a sender or the dimension addressed in a feedback message can modulate the cognitive processing of that message. This may explain why people are inclined to disregard negative feedback from outgroup senders."

Article 9:¹⁸ "Authors developed the 'feedback intervention theory' (FIT), which is based on five assumptions:

1. behaviour is regulated by comparing practice with a goal or standard;
2. the goals or standards are rank ordered by importance;
3. only those gaps between feedback and goals that receive explicit attention will have an impact on behaviour;
4. attention by the learner is normally directed to a moderate level of control hierarchy (from task learning, task motivation and meta-tasks);
5. feedback affects behaviour by changing the locus of control so that the learner feels more 'in charge'.

The central explanatory theme to FIT is not how feedback affects one's learning or motivation to perform a task but rather how the feedback focuses one's attention."

Article 10:¹⁹ "For effective self-directed life-long learning physicians need to engage in feedback-seeking, which means fostering such behaviour during training. Self-determination theory (SDT) posits that intrinsic motivation is fostered when the environment optimizes the individual's experience of autonomy, relatedness, and competence. Educational settings meeting these psychological needs may foster intrinsic motivation in trainees, enhance their desire for feedback, and promote feedback-seeking. Findings suggest that the relationship between motivation and feedback-seeking is complex and cannot be predicted by IMI scores. Career plans and relationships with feedback providers impact feedback-seeking, which can inform educational interventions."

Article 11:²⁰ "The results indicate that ethical leadership positively affected nurses' feedback-seeking. Ethical leadership influences feedback seeking through psychological safety. With high power distance, ethical leadership significantly positively influenced psychological safety and then positively affected feedback-seeking behaviour. In sum, in the context of high-power distance, ethical leadership is especially important for psychological safety and feedback-seeking behaviour."

Article 12:²¹ "We tested our hypotheses using a sample of 249 followers across two waves of data collection. Results suggest that ethical leadership and leader competence interact to drive followers' duty orientation, thereby reducing followers' feedback-avoiding behaviours. Further, ethical leadership had a direct positive relationship with followers' feedback-seeking behaviours."

Article 13:²² "Autonomy-supporting feedback can still be motivating even when it conveys messages of low competence."

Article 14:²³ "Students should be enabled to have greater control over assessment and feedback processes, which should be as authentic as possible. Effective long-term mentoring facilitates this process. The trend of curriculum change towards constructivism should be mirrored in the assessment processes in order to enhance receptivity to feedback."

TABLE 3: Emerging themes

Source	Teacher-related themes	Student-related themes
Article 1: ¹⁰	Respect	Self-regulated learning as an expectation;
Article 2: ¹¹	The provision of feedback	Self-regulated learning; Belief
Article 3: ¹²	Encouragement of self-evaluation/reflection	Self-regulated learning; self-reflection; self-assessment
Article 4: ¹³	Basic ethical behaviour: Respect; Beneficence (supportive / lacked procedure); Autonomy (not autonomy supportive and lack of explanatory rationale) Basic ethical behaviour: Trust Threats targeting the self-esteem is unacceptable	Learner involvement (autonomous function) Self-regulated learning; Self-efficacy; Outcome belief; Self-concept; self-reflection; self-assessment; internal attribution (acknowledgment of suboptimal performance)
Article 6: ¹⁵	Basic ethical behaviour: Confidentiality	Self-regulated learning; Self-esteem (shame/ embarrassment)
Article 7: ¹⁶	Basic ethical behaviour: Tolerance (prejudice)	Self-regulated learning: Self-motivation); Guilt feelings (lack of psychological safety)
Article 8: ¹⁷	Cognitive bias	Self-regulated learning: External attribution; Prejudiced (culturally); Lack of psychological safety
Article 9: ¹⁸	Basic ethical behaviour: Autonomy (allowing autonomy for behaviour change)	Self-regulated learning: Self-efficacy; Outcome belief; Self-motivation; Self-concept; Self-reflection; Self-assessment; Internal attribution (acknowledgment of suboptimal performance)
Article 10: ¹⁹	Autonomy (self-determination theory)	Self-regulated learning: Self-motivation); Self-adaptation/ reflection (Feedback seeking)
Article 11: ²⁰	Ethical leadership (during power relationship)	Self-regulated learning: Self-esteem (psychological safety); Self-adaptation/ reflection (Feedback seeking)
Article 12: ²¹	Ethical leadership	Feedback seeking and avoiding behaviours
Article 13: ²²	Autonomy (autonomy supportive in pointing out gaps)	Self-regulated learning: Self-motivation (even with negative feedback)
Article 14: ²³	Autonomy (student should have greater control); Build knowledge through a constructivist philosophy	Receptivity to feedback (feedback seeking)

This study examined the relationship between the ethical behaviour of teachers and the self-regulation ability of students using qualitative data obtained from the scoping review.

Learners have a moral obligation regulate their own learning (Article 1, Table 1).¹⁰

Building trust and respect: Teachers in turn should guide and nurture the student through a respectful relationship (Article 1).¹⁰ Constructive feedback has the potential to instill self-belief in learners (Article 2).¹¹ The encouragement of self-evaluation and reflection is also likely to develop self-regulation (Article 3).¹² Feedback with an intention to do good and supports the autonomy of the learner is seen to be desirable and effective (Article 4).¹³ Building trust between the teacher and learner tends to promote desired self-regulation behaviours such as self-efficacy, self-concept and internal attribution whilst negative remarks aimed at the learner's self-esteem is unacceptable (Article 5).¹⁴ Maintaining confidentiality during feedback delivery is crucial to preserve the learner's self-esteem. For example, giving negative feedback in front of any other person about a person's inability causes extreme embarrassment and harms to the self-esteem (Article 6).¹⁵ Feedback perceived to be prejudicial has a high likelihood to impact on learner's self esteem eliciting a strong feeling of guilt, which is counterproductive (Article 7).¹⁶ Receiving

Be autonomy supportive: Allowing students autonomy has a connection with self-regulated learning concepts such as self-efficacy belief, outcome expectation, self-motivation self-concept, self-reflection, self-assessment, internal attribution (acknowledgment of suboptimal performance) (Article 9).¹⁸ Self-determination theory is key to develop feedback-seeking behaviours and to stimulate learners' intrinsic motivation that is needed to drive improvement (Article 10).¹⁹ Feedback given in an ethical way encourages desirable feedback-seeking behaviours because it provides a basis of psychological safety, while the reverse is also true. It provides a basis for self-reflection and positive adaptation (Article 11).²⁰ Ethical guidance is directly linked with feedback seeking behaviours (Article 12).²¹ Feedback that is autonomy supportive can be effective even if the message is that of incompetence (Article 13).²² Gaps in performance should be highlighted discretely to allow the learner the autonomy to build on existing knowledge (constructivist approach) (Article 14).²³

The above-mentioned were used together with the literature known to the authors to synthesize a model to illustrate the potential impact of a teacher's clinical behaviour on a student's self-regulation and academic success.

Figure 2 contains a synthesised model of these relationships.



On the left side is the teachers who have an obligation to teach. At the same time, they have a moral duty to do so in a manner that will create an environment of psychological safety for the students.²⁴ On the right side are the students who have a need and desire to learn, as well as a moral obligation to put in the self-regulation,¹⁰ effort and work required to gain maximum value from the opportunity afforded to them. The results of this review suggest that there may be an association between the manner in which the teachers impart their knowledge and provide feedback (their ethical behaviour) and the effect it has on promoting self-regulation abilities in the students.¹⁰⁻²³

The lines A and B in the middle demonstrates the general relationships described in the literature. In scenario A there is a combination of ethical teachers who behave with professionalism and are student-centred in their approach. They deliver feedback with the aim of doing good by focussing on the gaps in understanding, allowing the students time and opportunity to self-reflect, and respecting their views whilst giving truthful feedback in a respectful way.¹⁰ The teachers understand that the student is still learning and not yet competent, and thus strive to create a psychologically safe environment. If such educators are linked with learners who already have high levels of self-regulation, and feedback seeking behaviours, it will almost inevitably lead to academic success.

In scenario B the teachers mistrust the student and show little compassion for the fact that they are still new to the study material and will have skills and knowledge gaps. They are often judgmental and prejudicial even before the learning contact starts. They may shame the student in front of others people. This type of behaviour is even more morally reprehensible if they do so when interacting with students who they know have low self-regulation abilities or poor self-esteem. Such students will not perform well academically and avoid feedback because it affects their self-esteem negatively. They thus not only deprive themselves of the much-needed tuition, but may even become depressed and anxious, which further hinders their progress.

In scenario C, the upwards arrow indicates the situation where the teacher behaves as described in scenario B, but the student has high self-regulation ability and ignores the comments of the teacher or puts in more effort to prove them wrong. The student now enters the “Bermuda Triangle”. This is risky as it’s a large space (illustrated by the pink triangle) and there is no way of telling where they may end up within this triangle. Some may rise up the C arrow and achieve academic success, while others end up anywhere in between the top and bottom limits, achieving varying levels of clinical and academic success.

In scenario D, the downwards arrow represents the situation where the teacher behaves as described in scenario A but the student has low self-regulation and does not perform academically. Once again, few will directly follow the straight line, while most will fall within the green triangle of unknown outcomes.

CONCLUSION

Staff competence should be developed in the field of ethical feedback delivery to enhance student self-regulation and promote learning. Assessment of their skills in feedback delivery could even be used as a measure of their performance as educators. The above-mentioned model may serve as a framework for such development.

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DISCLOSURE

Nothing to disclose

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What’s new for the clinician – summaries of recently published papers (May 2026)

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Edited and Compiled by Prof V Yengopal, Faculty of Dentistry, University of the Western Cape

1. SCOTCHBOND UNIVERSAL ADHESIVE (SBU) VS SCOTCHBOND UNIVERSAL ADHESIVE PLUS (SBU+) FOR CLINICAL APPLICATION IN POSTERIOR COMPOSITE RESTORATIONS: A RANDOMIZED CLINICAL TRIAL

Universal dental adhesives, introduced in 2011, represent a significant evolution in adhesive dentistry by offering clinicians the flexibility to function as etch-and-rinse (ER), self-etch (SE), or selective enamel etching (SEE) systems. The central mechanism underlying their performance is ionic adhesion to tooth structure, primarily mediated by acidic functional monomers—most notably 10-methacryloyloxydecyl dihydrogen phosphate (MDP)—which form nano-layered MDP-calcium salts within the adhesive interface.

Scotchbond Universal Adhesive (SBU) has established a robust clinical track record, while Scotchbond Universal Plus (SBU+) offers several technical refinements: dual/self-cure compatibility without a separate activator, a Bis-GMA-free radiopaque crosslinking monomer, and an extended silane chain eliminating the need for a separate ceramic primer. Despite promising laboratory data, peer-reviewed clinical trials of SBU+ in posterior restorations remain scarce. This equivalence trial addresses this evidence gap by comparing SBU+ against SBU (control) in Class I and II restorations using the SE technique. The investigators hypothesized no difference in 2-year clinical outcomes assessed by FDI criteria. The study is particularly relevant given ongoing debate about SE versus ER/SEE strategies, with prior NCCL studies suggesting ER/SEE superiority for retention, while Class I/II data indicate SE technique equivalence.

METHODOLOGY

Study Design

Prospective, double-blind, randomized, paired-comparison clinical trial with 2-year follow-up, conducted at the University of Minnesota Oral Health Clinical Research Center (June 2022–March 2025). The paired design (each subject receiving both adhesives) controls inter-subject variability.

Participants

51 healthy adults (55% female, median age 30 years, range 18–68) from university dental clinics. Four screening failures occurred. Each subject received two posterior restorations (102 total).

Randomization & Blinding:

Teeth randomized 1:1 via centralized electronic system (Zelta) after preparation but before adhesive application. Evaluators and subjects were blinded; operators were not (due to distinguishable adhesive colors).

Interventions: Class I/II preparations restored with Filtek Universal Restorative composite following manufacturer instructions. Both adhesives applied in SE mode. Isolation with Isovac; V3-ring sectional matrices for Class II. Deep

dentin cases received calcium hydroxide liner plus Vitrebond Plus RMGIC base. Adhesives and composite cured with Elipar DeepCure-S LED (1470 mW/cm²).

Outcomes: FDI World Dental Federation criteria assessing esthetic, functional, and biological properties. Primary endpoints: fracture/retention, marginal adaptation, marginal staining, surface luster, postoperative sensitivity, color match, translucency. Secondary endpoints: proximal anatomical form, surface staining, caries recurrence.

Calibration: Two independent evaluators trained using 13 photographs; calibrated with 25 photographs. Inter-rater Cohen's Kappa: 0.63–0.87 (except color match/translucency: 0.55). Recalibration occurred after 6 months when a new evaluator joined.

Statistics: Wilcoxon signed-rank test for continuous/ordinal data; McNemar/Cochran-Mantel-Haenszel for categorical data. Two-tailed $\alpha = 0.05$. SAS v9.4. Analysis with and without imputation for primary endpoints; per-protocol for secondary endpoints.

Sample Size Justification: 50 subjects (100 restorations) with 20% anticipated attrition to yield 40 completers. Based on 1.0–3.5% annual failure rates, expected 3.3% annual failure with upper 95% CI limit of 7.7% using Wilson score method.

RESULTS

Follow-up: 13 subjects withdrew by 2 years (25.4% attrition vs. predicted 20%), yielding 38 subjects with primary 2-year data. One additional tooth withdrawn for non-compliance.

Primary Endpoints:

Table: Summary of Primary Endpoints

Criterion	Key Finding at 2 Years
Retention	100% for both SBU+ (37/37) and SBU (38/38)
Fracture/Retention	SBU+: 97% "Excellent/Very Good," 3% "Satisfactory"; SBU: 100% "Excellent/Very Good" ($p > 0.05$)
Marginal Adaptation	All clinically acceptable; no significant difference
Marginal Staining	All acceptable; no significant difference
Surface Luster	All acceptable; no significant difference
Postoperative Sensitivity	100% absence in both groups
Color Match/Translucency	Significant difference at 6 months (SBU lower, $p = 0.016$); no difference at 1 or 2 years

Secondary Endpoints:

- **Proximal Anatomical Form (Class II only):** SBU slightly better but not statistically significant
- **Surface Staining:** 95% SBU+ vs. 97% SBU “Excellent/Very Good” ($p > 0.05$)
- **Recurrent Caries:** None observed at 2 years in either group

Notable Observations:

- At 6 months, both groups showed some reduction in marginal adaptation, marginal staining, and surface luster compared to baseline, though all remained clinically acceptable
- No restorations scored “Clinically Insufficient/Unsatisfactory” or “Clinically Poor” for any criterion at any timepoint
- The transient color match/translucency difference at 6 months resolved by 1 year

Key Conclusions at 2 year follow-up:

- No restoration failures or recurrent caries in either group
- All FDI criteria clinically acceptable for both adhesives
- The SE technique with MDP-containing universal adhesives produces durable outcomes in Class I/II restorations
- Ionic bonding mechanisms (MDP-Ca salts and polyalkenoic acid copolymer-calcium interactions) likely explain the clinical resilience despite mild self-etching on enamel

Implications for Practice

- **Clinical Equivalence:** SBU+ can be substituted for SBU in posterior composite restorations without compromising 2-year clinical outcomes. The additional features of SBU+ (dual/self-cure compatibility, Bis-GMA-free formulation, integrated silane) offer practical advantages without performance penalty.
- **Self-Etch Viability:** This trial adds to accumulating evidence that the SE technique with MDP-containing

universal adhesives is clinically viable for posterior restorations, challenging the dogma that ER or SEE is mandatory for enamel bonding. The ionic bonding mechanism appears to compensate for limited enamel demineralization.

- **Material Selection:** The importance of MDP and polyalkenoic acid copolymers in adhesive composition is reinforced. Clinicians should prioritize adhesives with demonstrated ionic bonding capability, particularly when using SE protocols.
- **Patient-Centered Outcomes:** The complete absence of postoperative sensitivity and recurrent caries supports patient comfort and safety. The transient color match difference at 6 months (favoring SBU+) is of limited clinical significance given resolution by 1 year.
- **Limitations in Translation:** The 25% attrition rate and academic center setting suggest cautious generalization to private practice. The paired design, while statistically efficient, may not capture population-level variability as effectively as parallel-group designs.
- **Long-term Monitoring:** While 2-year data are encouraging, longer follow-up (3–5 years) remains necessary to confirm durability, particularly for marginal adaptation and color stability where subtle degradation may progress over time.

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2. TIMING AND EXTENT OF PERI-IMPLANT BONE LOSS FOR DENTAL IMPLANT REMOVAL

Dental implant therapy has revolutionized oral rehabilitation, with survival rates exceeding 90% over two decades – a testament to advances in osseointegration science and peri-implant tissue management. However, as implant utilization has expanded globally, implant failure has emerged as a significant clinical concern requiring systematic investigation. Implant loss is broadly categorized into early failure (during osseointegration, prior to prosthetic loading) and late failure (following functional loading), with distinct etiological profiles. Early failure, affecting approximately 1.5% of placed implants, is attributed to infection, inflammatory processes, and potentially foreign body reactions characterized by soft tissue encapsulation. Late failure is predominantly driven by biological and biomechanical factors, with peri-implantitis – an inflammatory disease characterized by progressive crestal bone loss – serving as the leading cause.

Despite extensive research on peri-implant disease prevalence and risk factors, a critical knowledge gap persists regarding the temporal dynamics and morphological characteristics of bone loss at the point of implant removal. Existing literature has focused primarily on disease prevalence and therapeutic interventions, while the terminal

stage of implant failure – specifically when and how clinicians decide to remove implants – has not been systematically characterized. Understanding these patterns is essential for refining diagnostic thresholds, optimizing intervention timing, and developing evidence-based guidelines to prevent progression to irreversible failure.

This retrospective cross-sectional study by Halstenbach and colleagues (2026)¹ addresses this gap by analyzing 738 removed dental implants across a 10-year period (2014–2024) at the University of Freiburg. The investigation is particularly timely given the increasing recognition that peri-implantitis progresses in a non-linear fashion, with accelerated bone loss in advanced stages. The study aims to correlate implant loss timing with radiographic bone loss levels and defect morphology, offering clinicians practical benchmarks for decision-making.

METHODOLOGY

This retrospective, cross-sectional, monocentric study was conducted at the Department of Oral and Maxillofacial Surgery, University Medical Center Freiburg, Germany and included all available patients referred for implant removal between 2014 and 2024.

- **Inclusion and Exclusion Criteria:** Participants were adults (≥ 18 years) with at least one dental implant scheduled for removal and radiographs of adequate quality (panoramic or intraoral) taken within six months prior to removal. Cases were excluded if radiographs were of inferior quality (mispositioning, low resolution, motion artifacts) or if the implant was incompletely depicted.
- **Study Design Considerations:** The investigators appropriately acknowledge a fundamental limitation: the cohort comprises only implants referred for removal, characterizing terminal conditions without comparison to surviving implants. The selective nature of the sample – reflecting referral patterns to a tertiary academic center – introduces inherent bias that the authors transparently discuss.
- **Data Acquisition:** Comprehensive demographic and clinical data were collected, including patient gender, age at placement and removal, implant position, reason for removal, anamnestic factors (head/neck radiation, antiresorptive medication), implant manufacturer, and timing variables. Notably, insufficient clinical data on probing depth and bleeding on probing necessitated use of “peri-implant inflammation” as an umbrella term encompassing peri-implantitis, suppuration, abscess formation, pain, and implant loosening.
- **Radiological Assessment:** Bone loss was quantified as relative radiological bone loss (%BL), calculated as the ratio between bone defect (BD) and implant length (IL), measured from the most coronal point of the intraosseous implant portion. This approach mitigates distortion effects inherent in panoramic radiography. Measurements were performed using DeepUnity Diagnost software.
- **Defect Classification:** Peri-implant bone defects were classified according to Monje et al.’s system: Class I (intraosseous), Class II (supracrestal/horizontal), and Class III (combined), with severity graded as Slight ($<25\%$), Moderate ($25\text{--}50\%$), and Advanced ($>50\%$) bone loss. The authors appropriately note that two-dimensional radiography cannot reliably distinguish subtypes within Classes I and III (buccal dehiscence, 2–3 wall defects, circumferential defects), limiting three-dimensional morphological assessment.
- **Methodological Strengths:** The large sample size (738 implants from 462 patients) represents one of the most extensive retrospective cohorts of removed implants in the literature. The use of relative bone loss (rather than absolute measurements) standardizes comparisons across implant lengths and radiographic modalities. The explicit acknowledgment of limitations demonstrates methodological rigor.
- **Methodological Limitations:** The absence of Cone Beam Computed Tomography (CBCT) is a significant constraint, as buccal and lingual defect components cannot be assessed with two-dimensional imaging, potentially leading to misclassification of combined defects. The retrospective design precludes standardized clinical data collection, resulting in missing information on critical confounders including smoking history, periodontal status, and detailed clinical inflammatory parameters. The monocentric design limits generalizability to other clinical settings with different referral patterns and maintenance protocols.

RESULTS

- **Cohort Characteristics:** The study included 738 implants from 462 patients (56% male, mean age at removal 66 ± 13 years). Maxillary implants accounted for 55% of cases, with mandibular implants representing 45%. The first molar was the most frequently removed position in the mandible, while premolars and first molars predominated in the maxilla.
- **Timing of Implant Loss:** Early implant loss (prior to prosthetic loading) occurred in 107 cases (14.5%). Late implant loss accounted for 85.5%, with peri-implant inflammation as the dominant cause (71% of late losses). Other reasons—mechanical failure, osteonecrosis, aesthetic/prosthetic concerns, and displacement – were comparatively rare. The reason for removal was unclear in 8% of cases.

For the 183 late-loss implants with known placement dates, the mean functional duration was 7.4 ± 4.9 years (median 6 years). A notable peak in removals occurred at three years post-placement, with subsequent progressive decline. Mann-Kendall trend testing confirmed significant temporal association ($\tau = -0.645$, $p < 0.001$), while Pearson correlation indicated moderate strength ($r = 0.54$).

Radiological Bone Loss: Among inflammatory cases ($n = 524$, excluding osteoradionecrosis and MRONJ), mean bone loss at removal was $51\% \pm 28\%$ (median 49%, IQR 32.43–67.05%). Mandibular implants demonstrated significantly greater bone loss ($59\% \pm 31\%$) than maxillary implants ($45\% \pm 23\%$) ($p < 0.001$). No significant differences in bone loss were observed across implant positions within either jaw. Temporal analysis revealed that implants removed within 1–3 years exhibited mean bone loss of $36\% \pm 21\%$, while those removed at 8–10 years showed $60\% \pm 30\%$ ($p = 0.002$). Complete loss of osseointegration (100% bone loss) increased from 18% in years 1–3 to 28% in years 8–10.

Defect Morphology: Class I (intraosseous) defects predominated (45.1%), followed by Class III (combined, 25%) and Class II (horizontal, 21.6%). No radiological bone loss was observed in 8.3% of cases. Class I and III defects were predominantly graded Advanced ($>50\%$ bone loss; 55% of these classes), while Class II defects were mainly Moderate (25–50%; 51% of Class II). Class II defects demonstrated significantly lower bone loss ($47\% \pm 22\%$) compared to Class I ($57\% \pm 28\%$, $p = 0.0007$) and Class III ($55\% \pm 22\%$, $p = 0.0044$). The proportion of defect classes remained stable over time ($p = 0.7342$).

CONCLUSIONS

The authors present several key conclusions supported by their data. First, peri-implant inflammation is the dominant cause of late implant failure, accounting for 83% of cases. Second, implant removal most commonly occurs at approximately 50% radiological bone loss, with a peak in the early post-loading period (three years). Third, bone loss severity increases with implant functional duration, with advanced osseous destruction more prevalent in older implants. Fourth, intraosseous defects (Class I) are the most common morphology, though horizontal defects (Class II) appear more frequently in terminal cases than previously reported. Fifth, mandibular implants are removed at more advanced bone loss stages than maxillary implants, likely

reflecting anatomical and physiological differences in bone density and symptom presentation.

The authors appropriately acknowledge that implant removal decisions are multifactorial, incorporating patient factors, anatomical conditions, clinician experience, and socioeconomic considerations beyond radiographic thresholds alone.

IMPLICATIONS FOR PRACTICE

Diagnostic Thresholds: The finding that implants are typically removed at ~50% bone loss provides a practical benchmark for clinicians. Current reviews have identified this as an appropriate cutoff for considering explantation, beyond which regenerative prognosis becomes increasingly unfavorable. However, this should not be applied rigidly—individual patient factors and defect morphology must inform decisions.

Maintenance Protocol Intensification: The peak in implant removals at three years post-placement aligns with the established timeline for peri-implantitis onset. This underscores the critical importance of intensive maintenance during the first three years, with frequent professional cleaning and monitoring. Declining adherence to maintenance over time likely contributes to delayed diagnosis and more severe defects.

Defect-Morphology-Guided Treatment Planning: The high prevalence of Class I defects supports regenerative approaches in appropriately selected cases, while the

significant proportion of Class II defects (21%) highlights the need for resective treatment expertise. Class II defects, associated with lower bone loss at removal, may represent cases where earlier intervention could have preserved the implant.

Jaw-Specific Considerations: The greater bone loss at mandibular implant removal suggests that clinicians may tolerate more advanced disease in the mandible before intervention, possibly due to delayed symptom presentation in denser bone. This warrants heightened vigilance for mandibular implants, where clinical signs may underestimate disease severity.

Imaging Limitations: The reliance on two-dimensional radiography in routine practice may underestimate defect complexity. While CBCT is not universally indicated, clinicians should consider three-dimensional imaging when defect morphology influences treatment planning, particularly for regenerative procedures.

Early Intervention: The progressive increase in bone loss with implant age, coupled with the poor prognosis of advanced defects, supports early, aggressive intervention when peri-implantitis is diagnosed. The temporal data suggest that implants surviving beyond the initial high-risk period may still develop severe disease if maintenance is neglected.

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Online CPD in 6 Easy Steps



The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.



Green Dentistry as an Ethical Imperative in Sustainable Oral Healthcare

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R Ahmed,¹ S Ahmed,² R Adam³

Environmental sustainability has emerged as an important ethical concern in modern healthcare systems, including dentistry. The healthcare sector contributes significantly to environmental degradation through energy consumption, waste generation, and the use of resource-intensive technologies. Although dentistry represents a smaller component of healthcare services, dental practices generate considerable environmental impact through the use of disposable materials, hazardous waste, and energy-intensive equipment.¹

Carbon emissions, often described as the carbon footprint, represent the total amount of greenhouse gases released into the atmosphere as a result of human activities, including healthcare delivery. Healthcare systems worldwide are estimated to contribute approximately 4–5% of global greenhouse gas emissions, largely through energy consumption, transportation, procurement of medical products, and waste management. Dental services contribute to this footprint through energy-intensive equipment, manufacturing of dental materials, laboratory processes, and repeated patient travel for clinical appointments. Understanding and reducing the carbon footprint of dental practice is therefore an essential component of environmentally sustainable oral healthcare.^{1,2}

As a result, the concept of green dentistry, also referred to as sustainable or eco-friendly dentistry, has gained increasing attention as a framework for reducing the environmental footprint of oral healthcare while maintaining high standards of patient safety and clinical effectiveness.² Green dentistry promotes environmentally responsible clinical practices aimed at reducing waste, conserving resources, and minimising the release of harmful substances into the environment.³

Integrating sustainability into dental practice reflects the broader ethical responsibility of healthcare professionals to safeguard public health and environmental well-being for present and future generations.

Environmental Impact of Dental Practice

Dental clinics rely heavily on single-use materials and technologically intensive procedures, both of which contribute to environmental waste and pollution. Disposable items such as gloves, masks, plastic barriers, suction tips,

and sterilisation packaging are widely used to maintain infection control standards, yet many of these materials are non-biodegradable and contribute significantly to clinical waste streams.⁴

In addition to general waste, dentistry generates hazardous materials including mercury-containing dental amalgam, heavy metals, and chemical residues from radiographic processing.⁵ If improperly managed, these materials may contaminate water systems and ecosystems. Furthermore, dental equipment such as sterilisation units, suction systems, and radiographic devices requires substantial energy and water resources. Collectively, these factors highlight the need for more sustainable approaches to dental practice that reduce environmental impact without compromising patient care.

Ethical Foundations of Green Dentistry

The ethical justification for sustainable dental practice can be understood through the four principles of biomedical ethics – non-maleficence, beneficence, justice, and autonomy.⁶

The principle of non-maleficence, which requires healthcare professionals to avoid causing harm, can extend beyond individual patients to encompass environmental harm that indirectly affects population health. Environmental pollution and improper waste management associated with healthcare activities may contribute to broader public health risk.⁷

In this context, greenhouse gas emissions generated by healthcare activities may also be considered a form of indirect harm, as they contribute to climate change, which is increasingly recognised as a major global health threat. From an ethical perspective, reducing the carbon footprint of healthcare systems aligns with the principle of non-maleficence by limiting environmental harm that may ultimately affect population health.

Beneficence emphasises promoting well-being and acting in the best interests of patients and society. Sustainable dental practices, including preventive care and minimally invasive treatments, can improve oral health outcomes while simultaneously reducing the environmental burden associated with complex restorative procedures.⁸

The principle of justice highlights the importance of fairness in the distribution of health resources and environmental burdens. Environmental degradation often disproportionately affects vulnerable populations; therefore, sustainable healthcare practices contribute to environmental justice by reducing the ecological footprint of healthcare systems.⁹

Finally, autonomy supports transparent communication and informed decision-making in healthcare. Increasingly, patients are aware of environmental issues and may prefer healthcare providers who adopt environmentally responsible practices.

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Informing patients about preventive and sustainable treatment options can therefore support shared decision-making and strengthen trust in the dental profession.¹⁰
 Principles and Practices of Green Dentistry

Green dentistry is often guided by the principles of rethink, reduce, reuse, and recycle, which encourage environmentally responsible clinical practice. Several strategies have been proposed to support the transition to sustainable dental care.¹¹ First, improved waste management practices, including waste segregation, recycling programs, and the safe disposal of hazardous materials such as amalgam waste, can significantly reduce environmental contamination. The use of amalgam separators has also been recommended to prevent mercury from entering wastewater systems.¹²

Second, the adoption of digital technologies may reduce environmental impact. Digital radiography eliminates the need for chemical processing associated with conventional film radiographs, while electronic patient records reduce paper consumption. Similarly, digital impressions and CAD/CAM technologies may decrease the material waste associated with traditional impression techniques.¹³

Third, energy and water conservation measures – such as energy-efficient equipment, LED lighting, and water-efficient dental units – can help reduce the environmental footprint of dental clinics. Finally, preventive and minimally invasive dentistry represents one of the most sustainable approaches to oral healthcare. Preventing oral disease reduces the need for resource-intensive treatments and therefore lowers the overall environmental impact of dental care.¹⁵

Challenges to Implementing Green Dentistry

Despite growing awareness of sustainability, the implementation of green dentistry remains limited in many settings. Studies indicate that while dental professionals often express positive attitudes toward environmentally responsible practice, sustainable strategies are not consistently integrated into routine clinical workflows.^{13,15} Several barriers have been identified, including financial constraints, limited awareness of sustainable practices, and the difficulty of modifying existing clinical protocols. Additionally, strict infection control requirements – particularly the widespread use of disposable materials – may present challenges when attempting to reduce waste while maintaining patient safety.

Role of Education and Policy

Education and policy development are essential for promoting sustainable dental practice. Integrating sustainability principles into dental curricula can increase awareness among future dental professionals regarding the environmental impact of healthcare practices and encourage environmentally responsible behaviour.

At the international level, the World Health Organisation has emphasised sustainability within oral healthcare through the Global Oral Health Action Plan 2023–2030, which encourages countries to adopt environmentally responsible oral health systems, improve waste management practices, and promote the use of mercury-free restorative materials. These initiatives align with the objectives of the Minamata Convention on Mercury, which calls for the gradual phase-down of dental amalgam and the adoption of safer alternatives.¹⁴

At the national level, regulatory bodies and professional organisations also play a crucial role. In South Africa, institutions such as the Health Professions Council of South Africa and the South African Department of Health contribute to the development of professional standards and healthcare policies that promote responsible waste management and ethical healthcare practice.¹⁵

CONCLUSION

Green dentistry represents an important ethical and professional responsibility within contemporary oral healthcare. As awareness of environmental challenges continues to grow, dental professionals must consider the ecological implications of their clinical practices. Applying ethical principles such as non-maleficence, beneficence, justice, and autonomy supports the integration of sustainability into dental care.

Through strategies including waste reduction, digital technologies, energy conservation, and preventive approaches, dentistry can reduce its environmental footprint while maintaining high standards of patient care. Continued research, education, and supportive policy frameworks will be essential to ensure that sustainability becomes a fundamental component of ethical dental practice.

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CPD questionnaire



Evaluation of association between self-reported harmful Oral Habits and the Temporomandibular joint Disorders (TMD) amongst oral hygiene students

1. Select the CORRECT answer. What was the response rate of the study?
 - * A. 95,6%
 - B. 75,5%
 - C. 66.7%
 - D. 70,6%
2. Consider the statements regarding TMD. Which answer is CORRECT?
 - A. TMD are a complex set of disorders that can often lead to chronic pain. The major clinical presentation of these disorders is pain in the shoulder.
 - B. TMD are a complex set of disorders that can often lead to chronic pain. The major clinical presentation of these disorders is pain in the back.
 - C. TMD are a complex set of disorders that can often lead to chronic pain. The major clinical presentation of these disorders is pain in the chest.
 - D. TMD are a complex set of disorders that can often lead to chronic pain. The major clinical presentation of these disorders is pain in the orofacial region of non-odontogenic origin.
3. Choose the CORRECT answer. What type of study design was employed in this study?
 - A. Cohort
 - B. Case Control
 - C. Longitudinal
 - D. Cross-sectional
4. Select the INCORRECT statement. One of the following statements is false.
 - A. After the exams, significantly more participants chewed unilaterally daily as opposed to before the exams and so did those who bit on objects and the same was observed for lip sucking
 - B. As opposed to before the exams, significantly more participants chewed unilaterally after the exams daily and so did those who bit on objects and the same was observed for lip sucking
 - C. Significantly more participants chewed unilaterally before the exams daily as opposed to after the exams and so did those who bit on objects and the same was observed for lip sucking
 - D. Significantly more participants chewed unilaterally after the exams daily as opposed to before the exams and so did those who bit on objects and the same was observed for lip sucking
5. Select the CORRECT option. What statistical software was used to analyze the data in the study?
 - A. SPSS version 30
 - B. STATA
 - C. Microsoft word
 - D. EPIINFO version 50

Knowledge and attitude of dentists towards caries detection and excavation

6. Select the CORRECT answer. Which of the following are methods for occlusal caries detection
 - A. Visual examination
 - B. Tactile examination
 - C. Dyes
 - D. Radiographs
 - E. All the above
7. Which option is CORRECT. Which of the following are methods for root caries detection
 - A. Surgical exploration
 - B. Electronic caries monitor
 - C. Dyes
 - D. Radiographs
 - E. All the above
8. Select the CORRECT option. Which of the following options was the most preferred for sufficient caries removal assessment based on color in the present study
 - A. Slightly discolored
 - B. Very discolored
 - C. No discoloration
 - D. All of the above
 - E. None of the above
9. Select the CORRECT answer. Which among the following is the most preferred method of removing dental caries
 - A. Air rotor with diamond points
 - B. Micromotor with steel burs
 - C. Spoon excavator
 - D. Polymer burs
10. Which option is CORRECT. Which among the following is the most preferred method of removing root caries
 - A. Air rotor with diamond points
 - B. Micromotor with steel burs
 - C. Laser
 - D. Polymer burs

Factors associated with delayed presentation among patients with oral cancer in Malawi

11. Select the CORRECT answer. The following is true regarding the self-regulating model (SRM)
 - A. It teaches us how to regulate diseases
 - B. It is utilized to understand the cognitive process impacting the delay among patients.
 - C. Is part of the locus control of a human
 - D. Is a mechanism used in Artificial intelligence
 - E. All of the above
12. Which answer is CORRECT. Which coping mechanisms are used by patients in the study as per SRM?
 - A. Self medication
 - B. Consulting GPs
 - C. Consulting traditional healers
 - D. Psychologically
 - E. All of the above.

13. Select the CORRECT option. During which stage of cancer was delayed treatment reported?

- A. Stage I
- B. Stage II only
- C. Stage I and II
- D. Stage 1, II and III
- E. None of the above

14. Which option is CORRECT. The significance between delayed presentation and the nearest health care facility is

- A. $p=0.411$
- B. $p=0.463$
- C. $p=0.042$
- D. $p=0.000$
- E. $p=3.14$

15. Select the CORRECT answer: the following factors contribute to the decision-making process regarding seeking help

- A. The cognitive and emotional reactions to symptom detection
- B. Personal beliefs about seeking assistance
- C. The contextual factors surrounding symptom manifestation
- D. a and b only
- E. All of the above

Assessing Waiting Lists and Operational Challenges at Two Oral Health Centres in the Western Cape

16. Select the CORRECT statement. Services included in the analysis were:

- A. prosthetic dentistry, fixed orthodontics, school visits, and paediatric dental care under general anaesthesia
- B. fixed orthodontics, endodontic procedures, crown and bridge work, scale and polish and paediatric dental care under general anaesthesia.
- C. prosthetic dentistry, fixed orthodontics, surgical extractions, jaw fracture repair, crown and bridge work, and incision and drainage of sepsis under general anaesthesia
- D. prosthetic dentistry, fixed orthodontics, surgical extractions, endodontic procedures, crown and bridge work, and paediatric dental care under general anaesthesia.

17. Select the CORRECT answer. Which department showed the longest waiting time for procedures

- A. Orthodontics
- B. Paedodontics
- C. Oral Surgery
- D. Oral Medicine and Periodontology
- E. Community Dentistry

18. Which answer is CORRECT. The number of patients on the waiting list across the two research sites were:

- A. 253 – 355
- B. 694 – 822
- C. 1 200 -1 800
- D. 20 - 80
- E. 2 500 – 3 500

19. Select the CORRECT option. One of the waiting lists management strategies is considered by this research study was:

- A. early starts for oral health centre start
- B. increase commuted overtime for staff
- C. structured triage protocols for patient prioritisation
- D. organize more weekend outreaches
- E. build another oral health centre

20. Which answer is CORRECT. According to the research, what was the biggest challenge as per staff perception related to waiting lists?

- A. No time for the list review
- B. Poor waiting list structure
- C. Incorrect patient details
- D. Level of care changes
- E. Resource constraints

Ethics: Green Dentistry as an Ethical Imperative in Sustainable Oral Healthcare

21. Select the CORRECT statement. What is the main goal of green dentistry?

- A. Increase use of single-use instruments
- B. Reduce environmental impact of dental care
- C. Eliminate preventive dentistry
- D. Increase patient appointment frequency

22. Which answer is CORRECT. Which ethical principle supports avoiding harm to the environment in healthcare?

- A. Autonomy
- B. Justice
- C. Non-maleficence
- D. Veracity

23. Select the CORRECT statement. Which of the following is a key source of environmental waste in dental clinics?

- A. Patient records only
- B. Disposable items such as gloves and masks
- C. Dental textbooks
- D. Oral hygiene instructions

24. Choose the CORRECT option. Which statement best explains the relationship between healthcare and carbon emissions?

- A. Healthcare has no measurable environmental impact
- B. Dental practices are the largest global polluters
- C. Healthcare contributes approximately 4–5% of global greenhouse gas emissions
- D. Only hospitals contribute to carbon emissions

25. Select the CORRECT option. Which combination best reflects strategies aligned with green dentistry principles?

- A. Increased amalgam use, paper records, and film radiography
- B. Waste segregation, digital radiography, and preventive dentistry
- C. Frequent sterilization cycles using disposable instruments only
- D. Expansion of restorative treatments without prevention

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