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System Safety in the Dental Operatory: A Scoping Review of Strategies to Prevent Wrong-Site, Wrong-Procedure, and Wrong-Patient Errors

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Abstract

Background: Wrong-site, wrong-procedure, and wrong-patient errors represent a significant and preventable category of adverse events in healthcare. In dentistry, wrong-tooth extraction remains the most frequently reported serious patient safety incident, with profound implications for patients, clinicians, and healthcare institutions. Despite increased attention to patient safety over the past decade, the implementation of systematic preventive strategies in dental settings—particularly in primary care—has lagged behind other healthcare sectors.

Aim: This scoping review aims to systematically examine and synthesize the available evidence on strategies designed to prevent wrong-site, wrong-procedure, and wrong-patient errors in the dental operatory, with a specific focus on interventions applicable across dental practices, dental schools, and dental hospitals.

Methods: A comprehensive scoping review was conducted, drawing upon peer-reviewed literature, clinical guidelines, and policy documents published between 2020 and 2026. The review employed a systematic search strategy across multiple databases, supplemented by hand-searching of reference lists and grey literature. Studies were included if they addressed preventive strategies for wrong-site, wrong-procedure, or wrong-patient errors in dental settings.

Results: The review identifies five principal categories of preventive strategies: (1) structured checklists and procedural protocols, including the WHO Surgical Safety Checklist, Local Safety Standards for Invasive Procedures (LocSSIPs), and computerized safety checklists; (2) the Universal Protocol framework, encompassing pre-procedure verification, timeout procedures, and site marking adaptations; (3) patient identification and verification systems; (4) human factors interventions addressing communication, hierarchy, and safety culture; and (5) emerging technological solutions, including artificial intelligence-based decision support systems. Evidence indicates that checklists can improve compliance with safety standards by up to 50%, though their effectiveness is contingent upon integration with a positive patient safety culture.

Conclusion: Preventing wrong-site, wrong-procedure, and wrong-patient errors in dentistry requires a multi-layered, systems-based approach that combines structured protocols, cultural transformation, and technological innovation. The successful implementation of these strategies depends on leadership commitment, staff engagement, and the cultivation of a blame-free culture that encourages incident reporting and continuous learning. Future research should focus on primary care dental settings, where the majority of dental care is delivered and where safety interventions remain understudied.

Keywords: patient safety, wrong-site surgery, dental errors, checklists, Universal Protocol, safety culture, human factors.

Introduction

Patient safety has emerged as a cornerstone of quality healthcare, yet its integration into dentistry has followed a delayed trajectory compared to other medical specialties. The fundamental principle that patients should not be harmed by the care they receive is universally accepted, yet dental procedures—ranging from routine extractions to complex implant surgeries—carry inherent risks that demand systematic attention. Among the most preventable and professionally devastating of these risks are wrong-site, wrong-procedure, and wrong-patient errors [1]. Wrong-site tooth extraction (WSTE) constitutes the most common serious patient safety incident in dentistry. A survey of dentists and dental therapists working in Wales found that 12% of clinicians had extracted the wrong tooth at some point in their careers, with only 25% using a recognized checklist for tooth extraction [2]. Wrong-tooth extractions account for approximately 25% of all wrong-site surgery incidents, underscoring the scale of this problem within the broader healthcare context [3]. These errors carry profound consequences: for patients, the loss of an incorrect tooth represents irreversible harm, psychological distress, and erosion of trust; for clinicians, involvement in such incidents can precipitate significant emotional and psychological trauma, often described through the "second victim" phenomenon [4]; and for institutions, they incur reputational damage, litigation costs, and regulatory scrutiny. The classification of wrong-tooth extraction as a "never

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event" by NHS England in 2015 reflected the healthcare system's commitment to eliminating entirely preventable errors. However, this designation was subsequently removed in February 2021, justified on the grounds that "the systemic barriers to prevent the removal of wrong teeth are considered not to be strong enough to prevent these from occurring" [5]. These barriers included a lack of standardization in types of tooth notation and difficulties with site marking [6]. This change, while controversial, acknowledges the complex, multifactorial nature of these errors and the need for comprehensive, systems-based solutions rather than simplistic prohibitions.

The dental operatory presents unique challenges for patient safety that distinguish it from hospital-based surgical settings. The ambulatory nature of dental care, the predominance of primary care delivery in small practices, the commercial pressures facing dental businesses, and the absence of standardized reporting systems have all contributed to a delayed focus on systematic safety interventions [1]. Moreover, the perception that dental procedures are less invasive and carry lower risks than medical procedures has historically diminished the urgency of implementing robust safety protocols [7]. Nevertheless, the consequences of errors—particularly irreversible procedures such as extractions, implant placement, and endodontic treatment—demand that dental professionals adopt the same rigorous safety standards expected in other healthcare domains. A recent analysis of dental adverse events in the Veterans Health Administration found that wrong-site surgery was the most frequently occurring safety incident, accounting for 40.48% of all reported events [8]. The same study identified lack of policy as the most common cause of adverse events, and the action most recommended was to develop or review a protocol [8]. This finding underscores the critical importance of systematic, policy-driven approaches to preventing wrong-site errors in dental practice. This scoping review aims to systematically examine and synthesize the available evidence on strategies designed to prevent wrong-site, wrong-procedure, and wrong-patient errors in the dental operatory. By drawing upon peer-reviewed literature, clinical guidelines, and policy documents published between 2020 and 2026, the review seeks to identify effective interventions, evaluate their evidence base, and provide practical recommendations for implementation across diverse dental settings—including general dental practices, dental schools, and dental hospitals. The review is structured around five principal categories of preventive strategies: structured checklists and procedural protocols, the Universal Protocol framework, patient identification and verification systems, human factors interventions, and emerging technological solutions.

Methods

This scoping review followed the methodological framework proposed by Arksey and O'Malley, which encompasses five stages: (1) identifying the research question; (2) identifying relevant studies; (3) study selection; (4) charting the data; and (5) collating, summarising, and reporting the results. The review was conducted in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines. The review was guided by the following research questions: What strategies and interventions have been developed and implemented to prevent wrong-site, wrong-procedure, and wrong-patient errors in dental settings? What is the evidence base for the effectiveness of these strategies?, What are the barriers and facilitators to the implementation of these strategies in different dental practice environments?, and What emerging technologies and approaches show promise for future prevention efforts?

Search Strategy

A comprehensive search was conducted across multiple electronic databases, including PubMed, MEDLINE, Embase, Cochrane Library, and Scopus, for literature published between January 2020 and April 2026. The search strategy employed a combination of Medical Subject Headings (MeSH) terms and keywords related to patient safety, wrong-site surgery, dental errors, and preventive interventions. The following search terms were used: ("wrong-site" OR "wrong tooth" OR "wrong procedure" OR "wrong patient") AND ("dentistry" OR "dental" OR "oral surgery") AND ("patient safety" OR "prevention" OR "checklist" OR "protocol" OR "timeout" OR "verification"). Additional searches were conducted for grey literature, including policy documents, clinical guidelines, and institutional reports from organizations such as the World Health Organization, NHS England, the Joint Commission, the American Dental Association, and the Royal College of Surgeons. Hand-searching of reference lists of included studies and relevant review articles was also performed to identify additional sources.

Studies were included if they met the following criteria: (1) addressed strategies for preventing wrong-site, wrong-procedure, or wrong-patient errors in dental settings; (2) were published in English; (3) were published between 2020 and 2026; and (4) were original research, systematic reviews, clinical guidelines, or policy documents. Studies were excluded if they: (1) focused exclusively on medical (non-dental) surgical settings; (2) addressed patient safety topics unrelated to wrong-site, wrong-procedure, or wrong-patient errors; or (3) were conference abstracts, editorials, or opinion pieces without substantive data or recommendations. Data were extracted from included studies using a

standardized data extraction form that captured: author(s), year of publication, study design, setting, intervention type, key findings, and recommendations. Due to the heterogeneity of study designs and outcome measures, a narrative synthesis approach was employed to collate and summaries the findings. Themes were identified through iterative reading and discussion among the review team, and strategies were categorized into five principal domains: checklists and protocols, the Universal Protocol framework, patient identification systems, human factors interventions, and technological solutions.

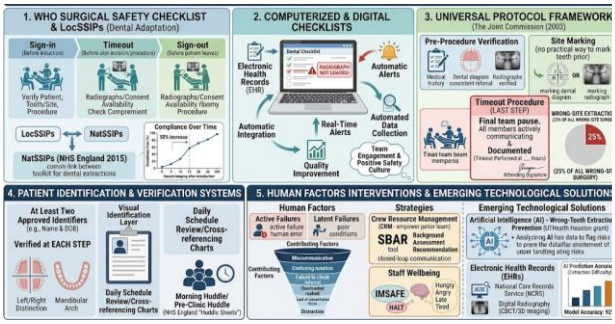

Fig. 1: Comprehensive Safety framework in dental surgery.

Results

The search yielded a total of 487 potentially relevant records. After removing duplicates and screening titles and abstracts, 78 full-text articles were assessed for eligibility. Of these, 42 studies met the inclusion criteria and were included in the final review. The included studies comprised 18 original research articles, 9 systematic reviews or meta-analyses, 7 clinical guidelines or policy documents, 5 quality improvement projects, and 3 implementation studies. The majority of studies originated from the United Kingdom, the United States, and Australia, reflecting the geographic concentration of patient safety research in dentistry.

WHO Surgical Safety Checklist

The World Health Organization Surgical Safety Checklist has been widely adopted in surgical settings globally and has been adapted for use in dental procedures. The checklist typically consists of three sections: sign-in (before induction of anesthesia), timeout (before skin incision), and sign-out (before the patient leaves the operating room). In dental settings, the checklist has been adapted to include verification of the correct patient, correct tooth/site, correct procedure, and availability of relevant radiographs and consent forms [9]. A quality improvement project implemented a computerized safety checklist for tooth extraction in primary care, which included a pre-operative safety check, a pause to re-confirm the surgical site, and a post-operative record-keeping proforma [2]. The checklist was linked to record-keeping software for use during tooth extraction. The introduction of the safety checklist resulted in a 50% increase in overall compliance with local best practice for tooth extraction record-keeping compared to baseline [2]. At week ten, 67% of records contained the computerized safety checklist [2].

Local Safety Standards for Invasive Procedures (LocSSIPs)

The National Safety Standards for Invasive Procedures (NatSSIPs) were introduced by NHS England in 2015 to provide advice to healthcare professionals regarding standardized safety checks, education, and training [5]. The NatSSIPs built on the WHO Surgical Safety Checklist and allowed individual NHS providers and organizations to develop their own Local Safety Standards for Invasive Procedures (LocSSIPs) [5]. The Faculty of Dental Surgery of the Royal College of Surgeons of England created a toolkit for LocSSIPs specifically for wrong-site extraction in dentistry [10]. The toolkit is aimed at all clinical dental teams involved in dental extractions and gathers together recommendations regarding the development of safety standards to minimize the risk of wrong-site surgery in all dental settings [10]. Some of the steps suggested to ensure patient safety include patient verification, surgical site verification, consent and documentation checks, and a pause immediately before the procedure to undergo safety checks [5]. Wrong-tooth extractions account for approximately 25% of wrong-site surgery, and the implications for the patient, the team, and the institution can be profound [3]. The development of national safety standards and specialty-specific LocSSIPs represents a significant step toward standardizing safety practices across dental settings [3].

Computerized and Digital Checklists

The transition from paper-based to computerized safety checklists represents an important advancement in patient safety in dentistry. A computerized safety checklist for tooth extraction in primary care has potential to improve patient safety by adopting measures to prevent WSTE and standardizing communication between clinicians [2]. Digital checklists offer several advantages over paper-based versions, including automatic integration with electronic health records, real-time alerts for missing information, and automated data collection for quality improvement purposes. The implementation of computerized checklists, however, requires careful attention to workflow integration and user acceptance. Studies have shown that checklists in isolation may be ineffective; only in combination with an environment which encourages a positive patient safety culture and the necessary team engagement and training will the efficacy of checklists become apparent [11].

The Universal Protocol Framework

The Joint Commission's Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery was established in 2003 and has been widely adopted across healthcare settings in the

United States and internationally [12]. The Universal Protocol consists of three principal components: (1) pre-procedure verification, (2) site marking, and (3) a timeout procedure [12]. A timeout is defined as an immediate pause by the entire surgical team to confirm the correct patient, procedure, and site [12]. The timeout is the last in a series of steps and is required for all accredited dental practices by the Joint Commission [13]. The timeout must involve active communication among all team members and must be documented in the patient's record [12]. Pre-procedure verification involves confirming the correct patient, procedure, and site before the procedure begins. In dental settings, this includes reviewing the patient's medical history, laboratory findings, applicable charts, and dental radiographs [13]. A day or two before the planned procedure, support staff should ensure that essential documents, such as the informed consent, referral form with dental diagram, and dental radiography, are available and complete [14]. The consent document should specify the tooth or teeth for removal by number, and the information on the referral form should be consistent with the consent form [14]. Dental images should be reviewed to ensure they are current, consistent with the referral form and consent, and represent the correct patient [14]. Reconfirmation that procedural documents are available for the correct patient should occur on the morning of the procedure [14].

Site marking presents unique challenges in dentistry compared to other surgical specialties. The Joint Commission and the American Dental Association have acknowledged that there is no practical or reliable way to mark teeth prior to the procedure [15]. Alternatives have been proposed, such as marking the radiograph or a dental diagram visible to the surgeon [15]. A system for marking the skin during oral surgical operations has been developed, identifying teeth to be extracted or exposed under general anaesthesia [16]. Two options for the site of marking were the cheeks and the forehead, or patients had the option to refuse marking [16]. Marking of the patient's teeth in the same way as in theatre may help to further endorse the site of operation, particularly if there is a change of clinical staff during the procedure [16]. The lack of standardization in types of tooth notation and difficulties with site marking were cited as reasons for the removal of wrong-tooth extraction from the NHS never events list [6]. Ambiguity regarding the notation of molar teeth, especially in heavily restored dentition with missing and migrating teeth, contributes to the risk of error [6].

The timeout is conducted immediately before starting the invasive procedure or making the incision [13]. All members of the team (attending and/or student, and dental assistant) conduct a final verification (timeout) before the procedure begins [17]. The timeout involves verifying the patient's identity, the correct procedure (verified with consent), and the correct site [17]. The timeout is initiated by a designated member of the treatment team, usually the dentist, and begins with a pre-procedural verification of the patient [18]. The timeout must be documented on the progress notes or surgery form as "Timeout Performed at ___ Hours" by the person completing the chart entry and followed by an attending signature [17]. In a review of dental malpractice claims, the two main contributing factors to wrong-site and wrong-tooth procedures were poor practitioner communication and documentation [14]. Practitioner communication factors included failing to review the dental or referral record before the procedure, discrepancies between the referral record and the accompanying diagnostic images or the patient's recollection, and miscommunications regarding the patient's condition [14]. Documentation factors involved inadequate or missing informed consent, failure to document clinical findings, and failure to document the decision-making process [14].

Patient Identification and Verification Systems

Correct identification of a patient promotes patient safety and prevents complications including wrong procedures, medication errors, and diagnostic testing errors [19]. The use of at least two approved patient identifiers (e.g., name and date of birth, or name and service number) is recommended for all patient encounters [19]. In dental settings, patient identification must be verified at each step in the patient journey and prior to the procedure commencing [20]. Site marking is essential in cases where there is the potential for error involving left/right distinction, multiple structures (fingers, toes, or lesions), or levels (spine) [20]. For dental procedures, this principle extends to distinguishing between adjacent teeth, left and right quadrants, and maxillary versus mandibular arch.

Reviewing the daily schedule during morning huddle and cross-referencing charts and treatment plans is an effective strategy for preventing patient identification errors [21]. Morning huddles provide an opportunity for the entire dental team to discuss the day's schedule, identify potential safety concerns, and ensure that all necessary documentation and materials are available. Pre-clinic huddles allow team members to discuss their roles for the session and provide an opportunity to discuss matters that will affect the running of the clinical session, for example, the types of cases, the materials required and availability of materials and equipment, staff absence, and travel issues that may affect patient attendance [22]. NHS England has published "huddle sheets," which provide a tool to discuss and reflect on matters which may affect patient safety [22]. Consideration has been given to taking patient photos for identification purposes and including them in the

charts [21]. Visual identification can serve as an additional layer of verification, particularly for patients with similar names or in busy clinical settings. However, the implementation of patient photographs must be balanced with privacy considerations and patient consent requirements.

Human Factors Interventions

Human factors play a significant role in wrong-site errors in dentistry. The causes of WSTE are multifactorial and can be classified into active failures, such as human error, and latent failures which occur due to poor workplace and organizational conditions [2]. Common contributing factors include confusing notation and communication, failure to check referral letters, and loss of concentration [23]. A study investigating wrong-tooth extraction revealed that the two most common causes were system-related, specifically miscommunication and inadequate referral [5]. Other causes were operator-related and included being overworked and rushed, lacking focus or experience, and being distracted [5]. Another study found that confusion and miscommunication between clinicians were responsible for all erroneous tooth extractions [5]. A cross-sectional study identified reasons for errors including miscommunication (21.43%), multiple badly decayed teeth (14.29%), rushed procedures (14.29%), distractions (9.52%), and inadequate referrals (9.52%) [24]. The prevalence of wrong-tooth extraction was 21.1%, with the three most common reasons being miscommunication (31.6%), inadequate referral (28.9%), and exhaustion of an overworked dentist (28.9%) [25].

Hierarchy can be problematic when team members fail to speak out when they perceive that patient safety or quality is compromised [11]. To overcome this, strategies include dedicated induction talks discussing the concept of speaking up and not being afraid of reprimand; engaging in theatre briefs and morning huddles, ensuring that names and roles of clinicians are visible; and recommending junior clinicians plan complex cases and discuss these with more senior clinicians before surgery [11]. The concept of crew resource management (CRM), which originated in aviation, has been adapted for healthcare settings. CRM empowers junior team members to participate in and significantly intervene in decisions made by senior clinicians that are perceived to affect operations negatively [11]. This approach recognizes that safety is a shared responsibility and that all team members have a right to voice concerns when they believe patient safety is compromised [11].

The SBAR (Situation, Background, Assessment, Recommendation) communication tool has been adapted for use in dental settings to ensure effective communication and handover [26]. SBAR provides a standardized framework for communicating critical information, reducing the risk of miscommunication that can lead to errors. One study found that nurses who used the SBAR communication method had a better patient safety culture [27]. The use of structured communication tools such as SBAR or closed-loop communication is recommended to enhance patient safety in dental settings [28].

Factors such as fatigue, poor wellbeing, hubris, overconfidence, and ego contribute to medical error [11]. The acronyms HALT (Hungry, Angry, Late, Tired) and IMSAFE (Illness, Medication, Stress, Alcohol, Fatigue, Emotions) have been used to describe the circumstances in which staff might become unsafe [11]. Burnout describes emotional, physical, and mental exhaustion caused by excessive and prolonged stress [29]. Clinical teams and management should be aware of how burnout can affect individuals and, as a result, clinical teams and patient outcomes. There must be processes in place to allow clinicians who are at risk of becoming unsafe to gain support and mitigation of these feelings [11].

Emerging Technological Solutions

Artificial intelligence (AI) emerges as a promising tool for preventing wrong-tooth extractions. A multidisciplinary team at UTHealth Houston has received a research support grant to develop an AI system to prevent wrong-tooth extractions [30]. The proposed system would analyze patient records and imaging data to flag potential concerns, similar to how electronic health records alert providers to allergies or medication interactions [30]. The AI system is designed to identify high-risk situations before a procedure begins, providing clinicians with an additional safety layer [30]. As noted by one researcher, "Preventing wrong-tooth extraction requires more than checklists alone. By combining clinical data, imaging, and workflow information, we can build intelligent systems that identify risk before an irreversible error occurs" [30]. The system would function as a warning system, prompting clinicians to double-check when a situation carries elevated risk [30]. Because wrong-tooth extractions are relatively rare, developing an effective predictive model requires sophisticated methods to train the AI system. The research team plans to use existing clinical data to identify patterns associated with past errors, then generate simulated cases to expand the dataset for training and validation [30]. AI models have demonstrated accuracy in predicting the need for extractions, with some models achieving accuracy rates of 92% [31]. AI-based models can effectively predict extraction difficulty and postoperative morbidity, facilitating personalised treatment planning [32]. The integration of AI into clinical decision support systems represents a significant advancement in patient safety, though careful attention must be paid to validation, user acceptance, and integration with existing workflows.

Electronic health records (EHRs) with embedded clinical decision support can help prevent errors by alerting clinicians to potential safety issues.

The use of EHRs allows for automatic verification of patient identity, medication allergies, and relevant medical history. Integration of dental and medical records can provide a more complete picture of patient health, reducing the risk of errors related to incomplete or inaccurate information. The NHS England Primary care patient safety strategy includes provision for dentists to access the National Care Records Service, which provides the summary care record (current diagnoses, medications, and allergies) and other important health-related information [11]. Allowing dentists to access this service will be a progressive step towards maintaining and improving patient safety and quality of care [11]. Digital radiography and advanced imaging technologies provide opportunities for improved verification of the correct tooth or site. Cone-beam computed tomography (CBCT) and other three-dimensional imaging modalities allow for more precise identification of anatomical structures and can reduce the risk of site errors. However, the interpretation of these images requires appropriate training and expertise, and the images must be correctly labelled and associated with the correct patient.

Discussion

This scoping review has identified a range of strategies for preventing wrong-site, wrong-procedure, and wrong-patient errors in the dental operatory. The evidence suggests that a multi-layered, systems-based approach is most effective, combining structured protocols, cultural transformation, and technological innovation. No single intervention is sufficient; rather, the integration of multiple strategies across the patient care pathway is essential for achieving meaningful improvements in patient safety. Checklists and protocols represent the cornerstone of patient safety in dentistry. The WHO Surgical Safety Checklist, LocSSIPs, and computerized safety checklists have all demonstrated effectiveness in improving compliance with safety standards and reducing the risk of errors [2,5]. However, the evidence also indicates that checklists in isolation may be ineffective; their efficacy depends on integration with a positive patient safety culture and team engagement [11]. The implementation of checklists requires careful attention to workflow integration, user acceptance, and ongoing monitoring and feedback. Computerized checklists offer advantages over paper-based versions, including automatic integration with electronic health records and real-time alerts. However, the transition to digital checklists must be accompanied by appropriate training and support to ensure successful adoption. The findings of this review underscore the critical importance of patient safety culture in preventing errors. A positive or generative patient safety culture is one where safety is prioritized, resourced, and practised by the team and its leaders [11]. In a positive patient safety culture, safe care is delivered through continuous learning and improvement of safety risks, supportive and psychologically safe teamwork, and enabling and empowering speaking up by all [11]. Patient safety culture in dentistry appears to lag compared to medical specialties, especially in general dental practice [11]. This may be due to several reasons: dentistry is perceived as lower risk than medicine and surgery; the outpatient nature of dentistry makes following-up on complications challenging; data collection can be difficult due to variations in dental care records; and around 90% of dental care is carried out in dental practices which are run as businesses, and reporting of harms may have a commercial or financial impact [11]. Building a patient safety culture in dentistry involves encouraging an open culture where all members of the team feel empowered to speak up on issues; bringing safety to the agenda during meetings; encouraging incident reporting, even for incidents considered to be low harm or near misses; investigating safety incidents using a transparent process; learning from these investigations and adopting a "just culture" and supportive processes for managing those involved; providing training for the team on patient safety; and moving from a reactive culture to a proactive one [11].

Human Factors and Error Prevention

The review highlights the significant role of human factors in wrong-site errors. Miscommunication, inadequate referral, fatigue, distraction, and hierarchy issues all contribute to the risk of error [5,24,25]. Interventions that address these human factors—such as structured communication tools, team briefings, and strategies to address hierarchy—are essential components of a comprehensive safety programme. The "second victim" concept, which describes the psychological harm experienced by clinicians involved in patient safety incidents, underscores the importance of providing support to those affected by errors [4]. Emotional and psychological support can help second victims to progress through the recovery cycle more rapidly and reduce the risk of future incidents [11]. Emerging technologies, particularly AI-based decision support systems, offer promising opportunities for enhancing patient safety in dentistry. AI systems can analyze patient records and imaging data to identify high-risk situations before a procedure begins, providing clinicians with an additional safety layer [30]. However, the development and implementation of these technologies require careful attention to validation, user acceptance, and integration with existing workflows. The use of electronic health records with embedded clinical decision support can also help prevent errors by alerting clinicians to potential safety issues. Integration of dental and medical records can provide a more complete picture of

patient health, reducing the risk of errors related to incomplete or inaccurate information [11].

Barriers to Implementation

Several barriers to the implementation of patient safety strategies in dentistry have been identified. These include the lack of standardized reporting systems and comprehensive data collection specifically focused on patient safety incidents in dental settings [1]; the perception that dental treatments are less invasive and carry lower risks than medical procedures [7]; the ambulatory nature of dental patients and the dispersed nature of dental practices; concerns about the private nature of dental care impacting clinic profits; and the absence of a widespread safety culture explicitly addressing patient safety in dentistry [1]. Addressing these barriers requires a multi-faceted approach involving leadership commitment, staff engagement, and the cultivation of a blame-free culture that encourages incident reporting and continuous learning [1]. Regulatory bodies and professional organizations have an important role to play in promoting patient safety by developing and disseminating guidelines, providing training and education, and supporting research in this area.

The findings of this review have several implications for dental practice. First, dental practices should adopt a systematic approach to patient safety that includes the use of checklists, the Universal Protocol framework, and structured communication tools. Second, practices should cultivate a positive patient safety culture that encourages open communication, incident reporting, and continuous learning. Third, practices should address human factors by providing training on error prevention, managing fatigue and burnout, and addressing hierarchy issues. Fourth, practices should stay informed about emerging technologies and consider their potential to enhance patient safety. Finally, practices should participate in incident reporting systems and quality improvement initiatives to contribute to the broader knowledge base on patient safety in dentistry.

This review has several limitations. First, the search was limited to English-language publications, which may have excluded relevant studies published in other languages. Second, the review focused on literature published between 2020 and 2026, which may have excluded earlier foundational studies. Third, the heterogeneity of study designs and outcome measures limited the ability to conduct a quantitative meta-analysis. Fourth, the majority of studies originated from the UK, US, and Australia, which may limit the generalizability of findings to other healthcare systems. Fifth, the review focused on wrong-site, wrong-procedure, and wrong-patient errors specifically, and did not address other aspects of patient safety in dentistry. Future research should focus on several priority areas. First, there is a need for more rigorous evaluations of patient safety interventions in dental settings, particularly randomized controlled trials and quasi-experimental studies. Second, research should focus on primary care dental settings, where the majority of dental care is delivered and where safety interventions remain understudied. Third, there is a need for research on the implementation and sustainability of patient safety interventions, including the barriers and facilitators to adoption. Fourth, research should explore the potential of emerging technologies, including AI and electronic health records, to enhance patient safety. Fifth, there is a need for research on patient safety culture in dentistry, including the development and validation of measurement tools and the evaluation of interventions to improve safety culture.

Conclusion

Preventing wrong-site, wrong-procedure, and wrong-patient errors in the dental operatory requires a comprehensive, multi-layered approach that combines structured protocols, cultural transformation, and technological innovation. The evidence reviewed in this scoping review supports the use of checklists, the Universal Protocol framework, patient identification systems, human factors interventions, and emerging technological solutions as components of a comprehensive patient safety programme. The successful implementation of these strategies depends on leadership commitment, staff engagement, and the cultivation of a blame-free culture that encourages incident reporting and continuous learning. Dental practices, dental schools, and dental hospitals all have important roles to play in promoting patient safety and preventing errors. By prioritizing patient safety and implementing evidence-based strategies, dental professionals can significantly reduce the risk of wrong-site, wrong-procedure, and wrong-patient errors, improve treatment outcomes and foster trust and confidence among patients. Patient safety is a collective responsibility that requires the commitment and collaboration of all stakeholders, from healthcare professionals to administrators and patients themselves. With a steadfast dedication to patient safety, dental organizations can create an environment that not only promotes optimal patient care but also cultivates a culture of excellence, accountability, and continuous improvement.

References:

[1] Padmanabhan V, Islam MS, Rahman MM, Chaitanya NC, Sivan PP. Understanding patient safety in dentistry: evaluating the present and envisioning the future - a narrative review. BMJ Open Qual. 2024;13:e002502.

[2] Jacob O, et al. Preventing wrong tooth extraction. Acta Stomatol Croat. 2021;55(3):316-324.

[3] Liew J, Beech AN. Implementation of "local safety standards for invasive procedures (LocSSIPs)" policy: not merely a tick-box exercise in patient

safety. Br J Oral Maxillofac Surg. 2020;58(4):421-426.
[4] Ullström S, Andreen Sachs M, Hansson J, Overveit J, Brommels M. Suffering in silence: a qualitative study of second victims of adverse events. BMJ Qual Saf. 2014;23:325-331.
[5] Wrong site tooth extraction: no longer a never event. Faculty Dental Journal. 2021;12(4).
[6] Wrong-site tooth extraction removed from the list of NHS never events – implications for OMFS. Br J Oral Maxillofac Surg. 2021.
[7] Yamalik N, Perea Pérez B. Patient safety and dentistry: what do we need to know? Fundamentals of patient safety, the safety culture and implementation of patient safety measures in dental practice. Int Dent J. 2012;62:189-196.
[8] Lo E, et al. An analysis of dental adverse events in the Veterans Health Administration. J Am Dent Assoc. 2025;156(10):851-861.e2.
[9] Saksena A, Pemberton MN, Shaw A, Dickson S, Ashley MP. Preventing wrong tooth extraction: experience in development and implementation of an outpatient safety checklist. Br Dent J. 2014;217:357-362.
[10] Tagar HK. Preventing wrong tooth extraction in primary care oral surgery: developing local safety standards for invasive procedures (LocSSIPs). Primary Dental Journal. 2022 Sep;11(3):31-8.
[11] Bailey E, Dungarwalla M. Patient safety in dentistry–a decade in the making: Patient safety in dentistry–a decade in the making. British Dental Journal. 2025 May 23;238(10):814-21.
[12] Saufl NM. Universal protocol for preventing wrong site, wrong procedure, wrong person surgery. Journal of PeriAnesthesia Nursing. 2004 Oct 1;19(5):348-51.
[13] Ho JC, Chai HH, Lo EC, Huang MZ, Chu CH. Strategies for effective dentist-patient communication: a literature review. Patient preference and adherence. 2024 Dec 31:1385-94.
[14] Bailey E, Dungarwalla M. Developing a patient safety culture in primary dental care. Primary dental journal. 2021 Mar;10(1):89-95.
[15] Hempel S, Maggard-Gibbons M, Nguyen DK, Dawes AJ, Miake-Lye I, Beroes JM, Booth MJ, Miles JN, Shanman R, Shekelle PG. Wrong-site surgery, retained surgical items, and surgical fires: a systematic review of surgical never events. JAMA surgery. 2015 Aug;150(8):796-805.
[16] Knepil GJ, Harvey CT, Beech AN. Marking the skin for oral surgical procedures: improving the WHO checklist. British Journal of Oral and Maxillofacial Surgery. 2013 Jul 1;51(5):413-5.
[17] Seiden SC, Barach P. Wrong-side/wrong-site, wrong-procedure, and wrong-patient adverse events: are they preventable?. Archives of surgery. 2006 Sep 1;141(9):931-9.
[18] Meginniss A, Damian F, Falvo F. Time out for patient safety. Journal of Emergency Nursing. 2012 Jan 1;38(1):51-3.
[19] Riplinger L, Piera-Jiménez J, Dooling JP. Patient identification techniques–approaches, implications, and findings. Yearbook of medical informatics. 2020 Aug;29(01):081-6.
[20] DeVine J, Chutkan N, Norvell DC, Dettori JR. Avoiding wrong site surgery: a systematic review. Spine. 2010 Apr 20;35(9S):S28-36.
[21] Devi AV. *Dental Utilization and Oral Hygiene Behaviors Among Mexican-Identifying Young Adults: Examining the Roles of Health Literacy, Acculturation, and Psychosocial Factors* (Doctoral dissertation, University of California, San Diego).
[22] Montague J, Crosswaite K, Faisal M, McDonach E, Mohammed MA, Randell R, Cracknell A, Lovatt A, Slater B. Patient Safety Huddles to Improve Teamwork and Communication: Frontline Staff Perspectives. Journal of Patient Safety & Quality Improvement. 2023 Oct 1;11(4):189-97.
[23] Lin YM, Simms ML, Atkin PA. Oral medicine in regional oral and maxillofacial surgery units: a five-year review. British Dental Journal. 2023 Apr 11:1-5.
[24] Khan MM, Khan T, Butt AA, Kanwal S, Afridi A, Karim A. Identifying the factors contributing to incorrect tooth extraction: A cross-sectional study. International Annals of Health Sciences. 2025 Apr 28;2(1).
[25] Jan AM, Albenayan R, Alsharkawi D, Jadu FM. The prevalence and causes of wrong tooth extraction. Nigerian Journal of Clinical Practice. 2019 Dec 1;22(12):1706-14.
[26] Jevon P, Shamsi S, Cornforth S. Devising a protocol for calling 999 from a dental practice and using SBAR to ensure effective communication and handover. British Dental Journal. 2020 Nov;229(10):661-6.
[27] Arbianti K, Amalia R, Hendrartini J, Kuntjoro T, Aulia GB, Khotimah GT. Patient Safety Culture Analysis at Sultan Agung Islamic Dental Hospital to Improve Patient Safety. JMMR (Jurnal Medicoeticolegal dan Manajemen Rumah Sakit). 2024 Mar 23;13(1):24-42.
[28] Kumari S, Prabha C. Integration of sensors/networks to digital twins. InFoundations of Digital Twins 2026 Jan 1 (pp. 93-104). Elsevier.
[29] Muheim F. Burnout: History of a phenomenon. Burnout for experts: Prevention in the context of living and working. 2012 Sep 5:37-46.
[30] Kalenderian E, Ramoni R, White J, Walji M. Carrying the torch: Dr Lucian Leape's enduring legacy in patient safety–lessons from dentistry. BMJ Quality & Safety. 2026 Jul 7.
[31] Nordblom NF, Büttner M, Schwendicke F. Artificial intelligence in orthodontics: critical review. Journal of dental research. 2024 Jun;103(6):577-84.

[32] Karadiguddi P, Sanadi SA, Manas A, Mulla M, Mulla M, Azad AK, Mohapatra SP, Mahabob N. Artificial Intelligence in Predicting Surgical Problems and Postoperative Morbidity in Mandibular Third Molar Extractions. Annals of African Medicine. 2026 Mar 16;25(4):801.