

# Preventing adverse events (AE's) and promoting safer outcomes for patients in dentistry

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## Key words

Patient safety, adverse events, dentistry, ethics, harm, risks, errors, safety culture, human error, risk management

## Executive Summary Importance

- Minimizing risks and preventing AE's are enshrined in the fundamental ethical principle of 'non-maleficence' (first do no harm).
- Promoting patient safety is an ethical and legal obligation.

## Key points

- Patient safety in dentistry is multifactorial and complex.
- Humans are the most critical component of the health care system and constantly interacting with one another and other system components.
- Humans are fallible and errors are to be expected.
- Most preventable AE's stem from human and organisational problems.
- Adverse events in dentistry are primarily caused by a small number of erroneous behaviours.
- Overconfidence and time pressures were responsible for most of incorrect or careless behaviour.
- Preventing errors and AE's should be targeted on changing behaviours and the conditions under which dental practitioners work in the clinical setting.

## Practical applications

- Establish a patient safety culture.
- Devise systems that limit AE's.
- Continuing education and skills development.
- Respond to AE's and share experiences.
- Targeting preventable patient harm could lead to major service quality improvements

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## Background

Dentistry is not immune to AE's, accidents, errors, and patient injuries that may occur at any point in treatment.<sup>1</sup> Managing and minimizing risks and dangers inherent in treatment, avoiding the occurrence of possible complications, and preventing harm are enshrined in the Hippocratic principle "Primum Non Nocere" (first do no harm).<sup>2</sup> Furthermore, promotion of patient safety is an ethical and legal obligation in any health care profession.<sup>2</sup> When patients attend a dental appointment, they assume that care will be performed in a safe and effective manner.<sup>3</sup> In dentistry, the knowledge, skills, and experience of the practitioner have traditionally been relied upon in order to protect patients from harm when receiving treatment.<sup>4</sup> Although the ethical and legal obligation for patient safety is fundamental to the practice of the health care professions, "its transformation into a specific body of knowledge is relatively recent and thus patient safety may be considered as a comparatively 'new' discipline."<sup>5,6</sup> Its main objectives are to avoid or limit the occurrence of preventable AE's.<sup>5</sup> According to recent estimates, the social cost of patient harm can be valued at US\$ 1-2 trillion a year. A human capital approach suggests that eliminating harm could boost global economic growth by over 0.7% annually.<sup>7</sup>

A landmark study that signalled the emergence of patient safety as a specific area of knowledge is the publication of the Institute of Medicine study "To Err is Human: Building a safer Health System in 2000"<sup>8</sup> This study estimated between 44,000 and 98,000 people died each year from medical errors in the USA.<sup>8</sup> The public shock generated by the publication of these figures raised the issue of patient safety up the agendas of health professionals, hospital managers and politicians. As a result, patient safety became a major concern for everyone involved in health care,<sup>5,6</sup> and thus the number one priority throughout healthcare today.<sup>1</sup>

Patient safety measures and attempts at promoting a culture of safety in the dental field can be considered as quite immature and largely unexplored in comparison with those in medicine.<sup>4,5,6,9</sup> The main cause why dentistry has been lagging behind medicine, is the perception of relatively minor damage to dental patients, compared to those who receive medical treatment, especially in hospital, and the geographical dispersion of dental practices where care is usually provided with little communication between them.<sup>6</sup>

A remarkable milestone in global efforts to take concerted action on patient safety and to reduce the burden of patient harm due to unsafe health care, was the adoption of a resolution by The World Health Assembly (WHA) in May 2019 entitled "Global action on patient safety".<sup>10</sup> In July 2019, the introduction of the NHS Patient Safety Strategy<sup>11</sup> saw the primary focus on continuously improving patient safety based on foundations of a safer culture and safer systems. In recent years, dental organizations world-wide have implemented diverse initiatives and strategies to increase the safety of patients attending dental practices.<sup>12-15</sup> A recent systematic scoping review of patient safety incidents (PSI's) reported that the relative percentage of research substantially increased from 15% (n=6 publications) in the first four years (1994-1998) to 37.5% (n=15 publications) during the period 2011-2015.<sup>9</sup>

Besides promoting patient safety and increasing quality of care,<sup>1</sup> strategies and initiatives are also focussed on promoting health and welfare of healthcare providers as it is known that adverse events also have a negative impact on professional, emotional and financial aspects of health care providers.<sup>16,17</sup>

The purpose of this narrative review is to summarize and raise awareness and understanding of the key elements of the core body of scientific knowledge relating to preventing adverse events and promoting patient safety in dentistry.

## Complexity, nature, and frequency of adverse events

### • Complexity

Patient safety in dentistry is multifactorial and complex<sup>5,17</sup> and practiced in a challenging and diverse healthcare environment where multiple system factors involving people, technology, procedure, culture and workplace environment, interacting through various processes aiming to deliver high quality of care while maintaining patient and staff safety.<sup>5,18</sup> When interactions between these systems fail, both patient and team safety is compromised resulting in undesired outcomes with a commonly held action being one of 'blame'.<sup>18</sup> Most preventable AE's stem from human and organisational problems.<sup>19</sup>

Although there are several publications in the field of dentistry, promoting human and environmental or organizational factors in patient safety, the cognisance of these factors and their impact on patients and subsequent effect on dental team members remains poorly recognised.<sup>4,18</sup>

### • Nature of AE's

AE's are defined as "Unexpected results of medical or dental treatment that cause the prolongation of treatment, any type of morbidity, mortality or any other damage to which the patient should not have been exposed"<sup>5</sup> or "an injury that was caused by medical management that resulted in measurable disability."<sup>1</sup> AE's are a broad concept understood as damage/harm to patients as a result of dental treatment and independent of disease process, that includes unexpected outcomes such as

medical errors,<sup>1,5,15</sup> near miss,<sup>5,18</sup> mishaps,<sup>18</sup> never event,<sup>9,18,20</sup> accidents,<sup>5,15</sup> and negligence.<sup>5</sup>

AE's or medical errors can occur at any point along the continuum of care: pre-treatment (pre-operative), treatment (intra-operative), and post-operative treatment.<sup>9</sup> Alternatively, mistakes affecting quality of care and safety may occur before the patient arrives at your office, during an office visit, or after the patient has left.<sup>9</sup> According to Ensaldo-Carrasco and co-workers the five main causes of AE's identified were medical errors in diagnosis and examination, treatment planning, communication, procedural errors and the accidental ingestion or inhalation of foreign objects.<sup>9</sup> The latter causes (contributing factors) resulting in unsafe care were also confirmed in a scoping review by Corrêa and co-workers.<sup>17</sup>

## AE's may be preventable or unavoidable.

### • Preventable (avoidable) AE's

An example of a preventable AE given our current state of medical knowledge, is the prescription of an antibiotic to which the patient is allergic and goes into anaphylactic shock as a result of failing to consult clinical records.<sup>5</sup>

Research clearly shows that the majority of medical errors can be prevented. A landmark study on medical errors indicated 70% of AE's found in a review of 1,133 medical records were preventable, 6 % were potentially preventable, and 24 % were not preventable. A recent study, based on a chart review of 15,000 medical records, found that 54 % of surgical errors were preventable.<sup>1</sup>

Perea-Pérez and co-workers reported that the causes which led to preventable AE's, are primarily caused by a small number of erroneous behaviours. Overconfidence was responsible for most of incorrect or careless behaviour.<sup>6</sup> The most common incorrect behaviours found in their series were:<sup>6</sup>

- Not allowing for enough time to perform or update clinical quality records, or not adequately consulting them before making a treatment.
- Inadequate, irregular or absence monitoring of procedures for cleaning, disinfection and sterilization of clinical instruments.
- Making incomplete/or illegible medication prescriptions.
- Systematic realization of complete radiological tests to all patients, regardless of their specific situation.
- Reuse of products or devices designed for single use.
- Failure to protect patients against the possibility of eye damage or ingestion or inhalation of materials or instruments.
- Inaccuracies in patient referrals to other professionals.

### • Unpreventable (unavoidable) AE's

Unpreventable AE's on the other hand, result from a complication that cannot be prevented given the current state of knowledge. Many drugs which are used appropriately may have undesirable side effects. For example, the occurrence of nausea is considered an AE, but it is not considered to be a medical

error to have given the antibiotic if the patient had an infection which was expected to respond to a specific antibiotic.<sup>1</sup> Another example of a non-preventable adverse event is “an adverse reaction to the administration of a local anaesthetic in a patient without clinical pathology of allergy history”,<sup>5</sup> However, “the fact that an adverse event is not preventable does not mean that a clinician should be unprepared to act quickly and appropriately if it occurs.”<sup>5</sup>

#### • Prevalence and incidence of AE's

Estimated prevalence of adverse events in dentistry is rare and mostly underreported and difficult to fathom, as fear of litigation is a common barrier to reporting such incidents.<sup>16</sup>

American Dental Association studies show that in 2005, approximately one third of adult patients experienced medical errors during dental treatment. This compares with 25% medical errors reported by patients in other countries.<sup>1</sup>

The National Reporting and Learning System (NRLS), set up in 2003 for the NHS in England and Wales, is one of the largest and most comprehensive voluntary reporting systems in the world.<sup>21</sup> Analysis of data from the NRLS database revealed that the largest number of reported AE's fell within the pre-procedural category (communication, records, consent forms) (48%). The most commonly reported AE's due to a dental procedure were injuries [n=210] (10,4%), medical emergencies [n=111] (5,5%), adverse reaction [n=80] (4%) (mostly due to application of local anaesthesia), inhalation/ingestion of a foreign object (i.e., endodontic files, burs, crowns) [n=72] (4%), and wrong site surgery [n=36] (2%).

In another study pain was identified as the most common harmful AE (27,1%) followed by nerve injury (16,9%), hard tissue injury (15,2%) and soft tissue injury (15,2%)<sup>22</sup> Person (training, supervision and fatigue – 31,5%) was the most common contributing factors associated with harmful AE's, followed by patient (non-compliance and unsafe practices at home - 17,1%) and professional to professional collaboration (15,3%).<sup>22</sup>

In a retrospective study of private or public employed dentists in southern Finland, nearly one third of the dentists reported some AE's in the previous 12 months. Of the 872 reported events, 53% were classified as (AE's), 45% as near misses and 2% remained unclassified. Nearly half of the AE's had occurred during some form of dental treatment. One third of the AE's were related to dental equipment, devices and supplies. Most of the reported AE's resulted in little or no permanent harm to patients. However, 13% of AE's were considered as serious enough to potentially cause severe harm or did in fact cause permanent harm.<sup>23</sup>

#### Frequency of local AE's:

In a recent study of endodontic malpractice litigation conducted in the USA from 2000 to 2021, the most common AE's related to intraprocedural causes were improper instrumentation or obturation (n=36/88; 40,9%), broken instruments (n=18/88;

20,4%) and injury to anatomy (n=12/88; 13,6%). Most common AE's related to post procedural causes were infections (n=20/39; 51,3%), paraesthesia (n=8/39; 20,5%) and root cracks (n=5/39; 12,8%).<sup>24</sup> The risks and ultimate clinical and economic impacts to patients due to clinical usage, device breakage and malfunction, and other cause-related AE's occurring from use of endodontic devices remain largely underreported and unknown at the present time.<sup>25</sup>

Although uncommon, ingestion or inhalation of foreign objects during dental procedures can be potentially life-threatening, therefore increasing awareness is important. Sharp objects such as endodontic files, burs, implant instruments ingested or inhaled during dental procedures can cause impaction, obstruction, haemorrhage, or perforation, and may need endoscopic or surgical intervention.<sup>26</sup> Although the true incidence of accidental ingestion or inhalation of instruments or foreign objects during dental procedures are rare (estimated between 0,00012% and 0,004%), complications can be serious and potentially fatal.<sup>26</sup>

Patient safety incidents in dento-maxillofacial imaging are only rarely reported, and mostly, they are perceived of causing little or no harm.<sup>27</sup>

#### Frequency of systemic AE's:

Most systemic adverse effects are due to LA, GA, sedation, and medication (drug to drug and drug to disease interactions). The highest frequencies of reported systemic adverse events outcomes were: adverse reactions to local anaesthesia, prolonged sedation, and GA.<sup>9</sup> (Syncope, cardiovascular, and central nervous system reactions are common AE's.)<sup>28</sup> 70% of AE's are associated with Prilocaine. It is also reported that there is a risk of methaemoglobinemia to Prilocaine and Articaine.<sup>28</sup> Death was reported as a consequence of flaws in LA, Sedation and GA administration.<sup>15,29,30,31</sup>

#### Comparison of local versus systemic AE's:

Analysis of incident reports of a Dental University Hospital indicate that health care workers with less than one year of work experience have been reported to cause the most incidents.<sup>32</sup> The latter study reported that the most common AE's were 'drug-related' in particular after dental anaesthesia, in dental wards, rather than 'procedure-related' AE's in dental outpatient department.<sup>32</sup> Patients presenting with a 'poor physical condition' were also more prone to systemic adverse events.<sup>32</sup> Hypertensive patients were five time more sensitive to the effects of epinephrine.

#### Consensus and limitations:

The general consensus is that the incidence of AE's in dental practice and absence of major harm to patients is low.<sup>17,19,33</sup> Wright<sup>33</sup> reported that the main factor involved in the aetiology of medical errors is time pressure. In addition to the low quality of recordkeeping resulting in underestimation<sup>19</sup>, and a limitation of voluntary reporting is that

dentists are reluctant to report errors, because it may impact on their practice due to fear of loss of earnings.

### Human errors, risk management and safe health care

Patient safety is defined as "The reduction (or elimination as far as possible) of damage to patients resulting from health care processes or accidents associated with them."<sup>5</sup> Typically when an adverse event occurs, it is usually simultaneously associated with several latent risks. According to the World Health Assembly<sup>10</sup> "the paradigm shift in thinking about safety in health care came with the realization that it was not completely different from other high-risk industries and when things went wrong, it was seldom due to an error by a single individual. Rather, the true cause of an accident in aviation or an adverse event in health care was due to human error embedded in a complex amalgam of actions and interactions between humans, processes, team relationships, communications, human behaviour, technology, organizational culture, rules and policies, as well as the nature of procedures, instruments and equipment used in the operating environment. With this realization, came a deeper understanding that the design and operation of systems could provoke human error or worsen its impact when it occurred."<sup>10</sup>

- **Human error**

Two models on the causes of human error has been proposed by Prof Reason, former Professor in Psychology at Manchester University, UK: The 'person approach' and the 'systems approach'. Understanding the fundamental differences between these two approaches has important practical implications for managing the ever present risk of errors and mishaps that occur in clinical practice.<sup>35</sup>

- **Person approach**

The person approach focusses on unsafe acts – active failures, errors or procedural violations by individuals in the clinical setting. It is suggested that such 'unsafe acts' arise primarily from aberrant mental processes such as forgetfulness, inattentiveness, poor motivation, carelessness and negligence. Also referred to as 'unwanted variability in human behaviour'.<sup>35</sup> Countermeasures for preventing such human errors are based on changing human behaviour.<sup>35</sup>

- **Systems approach**

On the other hand the basic premise in the 'systems approach' is that humans are fallible and errors are to be expected. Errors are seen as consequences rather than causes, having their origins not so much in the perversity of human behaviour (nature), as in the 'upstream systematic factors', or recurrent error traps in the workplace and the organizational processes.

In the systems approach, preventing or mitigating errors are based on changing the conditions under which humans (dental

practitioners) work in the clinical setting.

Defences, barriers and safeguards occupy a key position in the systems approach.<sup>35</sup> The holes in the defences arise for two reasons: active failures (slips, lapses, mistakes and procedural violations) and latent risk factors. Nearly all AE's involve a combination of the these two factors.

- **Latent risk factors - precursors to human errors**

Latent conditions or risk factors (personal or workplace related) are the inevitable or unfavourable 'resident pathogens' within the system that are proven to influence individuals into making mistakes or errors.<sup>35,36</sup> In combination they could act to amplify the risk of a specific practitioner.

- **Personal related precursors**

Personal related precursors of human error include elements such as (i) stress, fatigue, complacency, and distraction, and (ii) individual driven characteristics of health care professionals including lack of confidence and inexperience related to knowledge, skills and ability.<sup>35,36</sup>

- **Workplace related precursors**

Workplace related precursors include key elements such as (i) increased workload and time management pressures, (ii) understaffing and internal administrative pressures, (iii) lack of communication and team work, (iv) inadequate or unavailable equipment, and (v) ambiguous or conflicting protocols for procedures.<sup>35,36</sup>

- **Risk management**

Latent risk factors create holes or weaknesses in the defences. Latent risk factors are human factors that may not be directly visible nor manifest immediately in the working environment. They make the risk of 'mishaps' or errors more likely and potentially dangerous if they remain unidentified.<sup>18</sup> Latent factors pose a serious risk to safety therefore early identification is crucial to minimise any potential unforeseen complications and harm.<sup>18</sup> It is therefore suggested that focussing on eliminating precursors to human errors is more meaningful to manage risk in the workplace.<sup>1,37</sup>

Thus the principle proposed for development of a safety culture is based on the principle of: "We cannot change the human condition, but we can change conditions under which humans work."<sup>18</sup> Understanding and paying heed to 'how people feel', 'how they behave and 'how they interact with each other and their environment', acknowledges human limitations and is critical in fostering a safe environment to reduce 'mishaps'.<sup>18</sup>

According to Reason<sup>35</sup> "effective risk management therefore depends crucially on establishing a reporting and analysis culture. Without a detailed analysis of mishaps, errors, incidents, near misses, we have no way of uncovering error traps or of knowing where the "edge" is until we fall over it."

- **Clinical significance of analysing errors using root cause analysis**

Root cause analysis (RCA) is defined as “a process that seeks to explore all of the possible risk factors associated with an incident by asking what happened, why it happened and what can be done to prevent it from happening again.”<sup>1,38</sup> RCA of errors is an important method of evaluation because it helps health care professionals, managers, and organizations to determine underlying cause or precursors of adverse events and errors, resulting in harm. Secondly, it serves to identify system-based preventive strategies to reduce future medical errors and improve patient care and safety.<sup>1,38</sup> A RCA should focus on systems and processes rather than individual performance and avoid blaming individuals for errors. The goal of RCA is process improvement.<sup>1</sup> To avoid future errors, all staff must feel safe in reporting errors as well as near misses.

Fatigue alone does not cause loss of skill when performing a dental procedure. Yet fatigue is known to have a negative effect on judgment and decision-making. Distractions, procedural errors, and miscommunication may also impact judgment and decision-making abilities. To maintain a culture of safety, the dental team must avoid complacency and continually focus on prevention of errors.

### Key principles of preventing AE's and promoting safer outcomes

Developing and implementing evidence-based mitigating strategies specifically targeting preventable patient harm and promoting safer outcomes could lead to major service quality improvements in health care which could also be more cost effective.<sup>6,36,37,39</sup> Four critical elements have been demonstrated to limit the incidence and severity of AE's in healthcare:<sup>2,3,6</sup> (i) Establishing a culture of safety; (ii) systems/ routine/ protocols that encourage safety and limits AE's; (iii) knowledge, skills and equipment necessary to provide safe care; and (iv) effectively recognize and respond to AE's.

- **Establish a patient safety culture**

A practice or an organization's culture of safety is defined as the product of individual and group (team) values, attitudes, perceptions, skills and patterns of behaviour which lead to commitment, style, and ability in the management of health and safety of a practice or organization.<sup>5,6,10,17</sup> Those practices or organizations with a positive safety culture are characterized by identifying threats to patient safety, evaluating incidents and identifying best practices, communication and education about patient safety, and building a safety culture where priority is given to patient safety based on mutual trust, shared perceptions of the importance of safety, and trust in the effectiveness of preventive measures.<sup>5,6,39</sup>

These attributes can foster a culture where teams feel empowered to promote safe practice and to 'speak out' to challenge negative attitudes (openness) and report things when they are not working (just). These attitudes and behaviours along

with organisational philosophies that encourage open discussion amongst teams to share experiences (both positive and negative) will drive learning that minimises the recurrence of error without the fear of retribution or reprimand and restriction linked to the legal protection of intellectual property.<sup>35</sup> To maintain a culture of safety, the dental team must avoid complacency and continually focus on prevention of errors. All auxiliaries, hygienists and dental practitioners should undertake training, assimilate the culture of safety and share experiences related to AE's.<sup>2,3,5</sup>

- **Systems to limit AE's**

Devise systems, routines, safety instruction, checklists, and protocols that make clinical interventions potentially less dangerous. (“That make it more difficult to do the wrong thing, and easy to do the right thing”)<sup>5</sup> Routine protocols are essential to identify potential latent risks before beginning any procedure to confirm core elements such as the patients name, the planned procedure, the specific tooth or the site of the procedure, changes in medical history, physical disabilities etc. that may impact on safe delivery of care.<sup>3</sup>

- **Safe delivery of care**

The ability of any team to deliver quality and safe care depends on having knowledgeable and well-trained individuals who function as a team.<sup>3</sup> Continuing education and skills development should be a priority and targeted to grow and reinforce the knowledge and skills necessary to deliver safe and effective care.<sup>3</sup> The same level of priority should also apply to having the necessary instruments, equipment and protocols in place to support safe care delivery.

- **Recognition and response to adverse events - sharing experiences**

Every dental practice should employ an ongoing process to monitor and evaluate clinical performance, patient outcomes, and AE's in the effort to support continuous performance improvement and to ensure the best opportunity for favourable outcomes.<sup>5</sup> Sharing experiences in patient safety with our colleagues is a fundamental feature of a culture of patient safety.<sup>5</sup> All team members should be empowered to speak up when they identify AE's.<sup>3</sup> We should offer our colleagues the opportunity to learn from our mistakes. This should be accepted as an ethical duty. To do this, the most appropriate way would be to report and respond AE's in a timely and effective manner.<sup>3</sup> The timely reporting of mishaps is crucial to learning and helping team members in understanding what happened and what to do next to minimise the risk of recurrence.<sup>18</sup>

### Best patient safety practices in the clinical dental setting

The recommended basic and easily implemented best patient safety practices to mitigate most preventable AE's in a dental practice should include the following:

- **Establish safety instruction protocols**

Establish 'safety instructions' – these represent the 'red lines' over which dental practitioners should not step in everyday practice. In the event that we do (probably for an exceptional reason), we must justify this overstepping in the clinical record.<sup>5</sup>

- **Informed consent**

Actively engage the patient in the planned treatment and informed consent. Effective relationship/communication practices will help avoid problems and AE's.<sup>5,21</sup>

- **Maintain and check clinical records**

The patient record or chart is the single, most important document in your practice. Records must be accurate, factual, and complete.<sup>21</sup> Missing documentation or poorly written entries detracts from the credibility of the record. Faulty records jeopardize patient safety and could hinder a legal defense.<sup>1</sup> Best practices rely on an analysis of the assessment data which is collected during an initial or routine examination of a patient. The first line of defence for all medical and dental risk management is a thorough and current medical history.<sup>1</sup> Under no circumstances should a patient be treated or medication prescribed without having reviewed his/her medical history.<sup>2,5,6</sup>

- **Infection control measures**

Compliance with and recognition of the importance of infection control policies, procedures, and practices in dental health care settings are important in order to prevent transmission of viral or bacterial infection from provider to patient, from patient to health care provider, and from patient to patient. Establish clear protocols and have them available in writing. Periodically monitor procedures to ensure that they are carried out according to the standard operating protocols. Inform and train personnel in charge of, cleaning, disinfection, sterilization, and preservation to ensure their proficiency and awareness of the importance of these tasks. Conduct periodic chemical and bacteriological tests to ensure efficacy of sterilization cycles.<sup>6</sup>

- **Prescribing medication (Safety alert for High-Alert medicines)**

Never prescribe any drug without consulting patient clinical record and without directly asking the patient about allergies or other health problems or medications.<sup>2</sup> Several studies have demonstrated that up to 18% of serious adverse medication errors occur because the practitioner lacks sufficient knowledge of the medical history of the patient before prescribing, dispensing, and administering drug therapy. The responsibility lies with the practitioner to assess the need for a drug before prescribing one. Once the need is assessed, the next step is to select the correct drug.<sup>1</sup> In patients with polypharmacy, especially in elderly, make sure to document all medications the patient is taking and their possible interactions with the possible medication you prescribe.

Make sure that the doses used are correct, particularly for children and elderly, and patients with compromised metabolism or drug elimination (i.e., renal and/or hepatic failure). Always ask women of childbearing age about the possibility of pregnancy.<sup>2,5,6</sup> Prescriptions need to be written clearly and carefully, with intent to be well-understood by the pharmacist.

- **Exposure to ionizing radiation**

Limit the exposure of patients, especially children, to ionizing radiation to what is strictly necessary through adherence to the 'as low as reasonable achievable' (ALARA) principle, equipment inspection and maintenance and patient selection criteria. Avoid systematic use of radiographs without clinical suspicion of pathology. Protect patients from ionizing radiation anatomic areas that are not under study (i.e. cervical area), using barriers. Always be aware of a possible pregnancy among patients or staff to prevent exposure to ionizing radiation. Choose diagnostic systems that emit a minimal amount of ionizing radiation.<sup>2,6</sup>

- **Single use materials/disposables**

Never reuse packaging materials (sodium hypochlorite in local anaesthesia cartridges, impression trays, endodontic files) or substances intended for one clinical use only. Reuse of disposable clinical materials poses a risk of contamination with blood which may transmit viral infections to other patients. The reuse of containers to package materials (i.e. local anaesthesia cartridges) can lead to dangerous confusion.<sup>2,6</sup>

- **Eye protection**

Every dentist has seen different substances or fragments of material jump to the patient's eyes. Protecting the patient's eyes during dental procedures with goggles is one of the easiest and most effective patient safety measure.<sup>6</sup> Significant eye damage can also be prevented by never passing instruments over the patients face.

- **Barriers to prevent ingestion or inhalation of materials or small instruments**

Ingestion and inhalation of materials, tooth fragments or small dental instruments is a "classic" accident during dental care without the use of appropriate barriers such as rubber dams or threads.<sup>6</sup> Accidental ingestion and inhalation of materials and instruments can be severe and traumatic for both the patient and the provider. Establish barriers (i.e., rubber dam) to prevent ingestion or inhalation of materials (sharp porcelain fragments), infected tooth fragments and instruments (endodontic files and implant drill bits and tools).<sup>2</sup> Cases have been reported involving ingestion of an implant screw driver that caused intestinal perforation and a fatal peritonitis. In another case, a patient inhaled an endodontic file which became lodged in the secondary bronchi, causing an infectious focus. As it was impossible to extract this instrument bronchoscopically, the patient underwent removal of the affected lung lobe.<sup>6</sup>



- **Use a checklist in all oral surgical procedures**

Surgical procedures in the oral cavity, including placing implants, represent by far the largest source of adverse events in dentistry.<sup>6</sup> Dental team members present before surgical/invasive procedures should confirm the patient, planned procedure, and tooth/surgical site are correct. A checklist helps prevent and eliminate errors like wrong-side, wrong-patient and wrong procedure surgeries. (an erroneous intervention or in the wrong area, among other risks.)<sup>2,4</sup> Checklists are generally considered effective in the improvement of work processes, optimization of communication, reduction of stress levels and strengthening of a safety culture.<sup>17</sup>

- **Sedation and general anaesthesia**

Dentists who perform procedures utilizing sedation and general anaesthesia should take the necessary measures to minimize risk to patients. Prior to delivery of sedation/general anaesthesia, appropriate documentation should address the rationale for sedation/general anaesthesia, informed consent, instructions and dietary precautions, preoperative health evaluation, and any prescriptions along with instructions given for their use.<sup>40</sup> Emergency/rescue equipment should have regular safety and function testing and medications should not be expired.

- **Monitor the onset and progression of infection in the oral cavity**

Although most infectious diseases in the oral cavity are usually self-limiting, in exceptional cases, especially in medically compromised patients, infection complications may endanger the patient's life.<sup>6</sup>

- **Life threatening (medical) emergency protocol**

Medical emergency situations in the dental setting are fortunately rare. However, the tasks and manoeuvres to be performed when medical emergencies do occur, must be protocolized for the dental team to perform properly, and not chaotically.<sup>6</sup> Critical elements of such a protocol include staying with the patient, bring and operate vital emergency equipment, and call for external help. A person must be designated to keep medication and emergency equipment updated and ready.

- **Continuing professional development**

Continuing professional education by all registered dental professionals are essential to maintain familiarity and to develop their knowledge and skills with current regulations and standards of care, technology, and clinical practice.<sup>3</sup>

## Conclusion

Dentistry is delivered through a challenging and diverse healthcare environment where multiple system factors (people, technology, procedures, culture) interact through various processes, aiming to deliver high quality of care while maintaining patient and staff safety. In addition, dental treatment requires up to date clinical knowledge, high dexterity, precision and accuracy underpinned by optimally functioning daily operational systems characterized by advanced technology, time constraints, alongside the pressure of patient demand. When interactions between these systems fail, both patient and team safety is compromised resulting in undesired outcomes or AE's with a commonly held action being one of 'blaming' instead of 'learning' and 'preventing'.

Although AE's have a relative low incidence rate and absence of major harm to patients, they have an impact on patients, and the dental team, and this poses a serious problem for quality of health care. At this moment in time, patient safety measures and attempts at promoting a culture of safety in the dental field can be considered as quite immature and largely unexplored in comparison with those in medicine.

Dental practitioners have an ethical and legal obligation to set out on a path of safety (following mandatory patient safety standards) for their patients with the objective of preventing the occurrence of adverse events and errors, and promoting the quality and safety of oral health care in dental practice. To maintain a culture of safety, the dental team must avoid complacency and continually focus on exploring the root cause of possible risk factors resulting in AE's, and what can be done to prevent them from happening again.

Fortunately, most preventable adverse events during dental/oral health care are produced by a relatively small number of causes. Therefore by implementing a few basic safety procedures could significantly reduce these preventable AE's and errors.

There remains a pressing need for high quality primary research studies since current evidence cannot provide reliable estimates on the frequency of patient safety incidents in ambulatory dental care or the associated adverse outcome burden. Well-designed epidemiological investigations are needed that also at the same time investigate contributory factors.

## References

The full list of references 1-44 is available from:  
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