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An analysis of dental patient safety incidents in a patient complaint and healthcare supervisory database in Finland

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Abstract

Objective. Few studies of patient harm and harm-prevention methods in dentistry exist. This study aimed to identify and characterize dental patient safety incidents (PSIs) in a national sample of closed dental cases reported to the Regional State Administrative Agencies (AVIs) and the National Supervisory Authority for Welfare and Health (Valvira) in Finland. ***Materials and methods.*** The sample included all available fully resolved dental cases ($n = 948$) during 2000–2012 (initiated by the end of 2011). Cases included both patient and next of kin complaints and notifications from other authorities, employers, pharmacies, etc. The cases analyzed concerned both public and private dentistry and included incident reports lodged against dentists and other dental-care professionals. Data also include the most severe cases since these are reported to Valvira. PSIs were categorized according to common incident types and preventability and severity assessments were based on expert opinions in the decisions from closed cases. ***Results.*** Most alleged PSIs were proven valid and evaluated as potentially preventable. PSIs were most often related to different dental treatment procedures or diagnostics. More than half of all PSIs were assessed as severe, posing severe risk or as causing permanent or long-lasting harm to patients. The risk for PSI was highest among male general dental practitioners with recurring complaints and notifications. ***Conclusions.*** Despite some limitations, this register-based study identifies new perspectives on improving safety in dental care. Many PSIs could be prevented through the proper and more systematic use of already available error-prevention methods.

Key Words: *Degree of harm, dentistry, error prevention, incident type, malpractice*

Introduction

Limited knowledge exists on the broad issue of patient safety in dentistry [1–3] and the frequency and types of dental care-related patient harm remain unclear [4]. Recent data from dental claims suggest that even serious adverse events occur in dentistry [5]. Few studies have concentrated on preventability assessments and preventive methods of dental care-related harm to patients [1,4,5]. Thus, more information on patient safety and risk management in dentistry [6,7] and strategies that reduce the risks are needed [8].

Patient and family-generated complaints include various issues related to the quality and safety of care. Most patient and family-produced complaints about dentistry are lodged for seemingly well-grounded reasons [9,10]. Studying such complaints may improve healthcare. Yet, few studies of primary care complaints exist [11].

The main healthcare supervisory agencies in Finland include six Regional State Administrative Agencies (AVIs) and the National Supervisory Authority for Welfare and Health (Valvira), which operate under the Ministry for Social Affairs and Health [12]. These agencies have several tasks related to the supervision and guidance of healthcare professionals and units in the private and public sectors. AVIs handle most healthcare-related complaints, while Valvira handles

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the most severe cases (when treatment leads to a severe and permanent patient injury or when a patient dies after a suspected medical error or due to medical malpractice). Valvira also handles cases where an individual's right to practice may require restrictions. Healthcare supervisory data in Finland include both complaints and notifications from other authorities, employers, etc. and concern healthcare personnel and individual practices. These data provide a readily accessible, although not systematically studied, source of patient safety-related information and are likely to reveal the causes and types of errors made including serious errors.

In this study, we aimed to:

(1) characterize the types of dentistry-related patient harm, including patient safety incidents (PSIs), and their contributing factors in closed dentistry-related cases against dental professionals at AVIs and Valvira;
(2) determine the potentially preventable PSIs from the data;
(3) assess the severity of these PSIs; and
(4) analyze the associations between PSIs and dentist-specific variables.

Materials and methods

Study context: Dental workforce in Finland

In total, 4400 dentists, 3720 dental nurses, 1870 dental hygienists and 700 dental technicians [13,14] work in Finland. Most Finnish dentists are female (70%) [14]. More than half (56%) of all dentists work in public dental services, while less than half (44%) work from private clinics [14]. Most dentists are general dental practitioners (GDPs) (86%) and over 40 years of age (78%); their average age was 49.7 years [14]. The majority of hygienists and dental nurses are female and work in the public sector, whereas more than half of dental technicians are male and work primarily in private practices [13].

Study population

The data studied included a national sample of reactive supervised cases concerning dentistry (n = 948) and were resolved between 2000–2012 (initiated by the end of 2011) by one of the six AVIs or Valvira. Cases included both complaints lodged by patients or their next of kin and supervised activities initiated through notifications from other officials, pharmacies, employers, etc. Since we focused on cases against individual dental professionals (dentists, dental technicians, hygienists and dental nurses) or dental students, we excluded cases against municipal health centers or private practices (n = 177) from further analyses and, thus, did not report on them in this article.

All resulting decisions (n = 771) were reviewed. We created a data extraction form in order to collect data for variables related to the reasons for the complaint or supervision, possible detected PSIs and variables on the professional for whom a complaint was filed.

Most frequently (86%), cases were initiated due to suspicion of some PSI (an error in some dental treatment or due to some other safety hazard such as poor hygiene within the dental practice). We categorized PSIs according to previously detected common types of dental harm listed in the incident reports from dentists [4]. Each incident was assigned to one of eight types of PSIs (diagnostics, dental treatment, equipment and supplies, medications or prescription drugs, hygiene or infection control, communication, physical environment-related and other) most likely precipitating the incident. We also categorized PSIs according to other incident characteristics.

Definitions of patient safety concepts

We defined patient safety (PS)-related concepts according to internationally agreed classifications [15,16]. The concepts and terms we used most frequently are explained in detail in Table I.

Assessment of harm preventability

The PSI preventability assessments were based on dental and legal expert opinions included in the decisions from closed cases. Cases with multiple PSIs (involving multiple outcomes or hazards for a single patient or outcome(s) or hazard(s) for several patients) were assigned to the category that represented the preventability of the most severe PSI. If only unavoidable PSIs existed, this was recorded. PSI was evaluated as potentially preventable if it was:

(1) already assessed as preventable by the Finnish Patient Insurance Centre (FPIC) and the patient received compensation (evaluated as comparable to the level for which a credentialed and experienced healthcare professional could normally have reached);
(2) caused by malpractice resulting from, for instance, inadequate adherence to current clinical guidelines (substandard diagnostic or treatment methods), a failure to seek a consultation from a specialist or continuing professional development (CPD) was neglected in the clinical area in which PSI occurred; or
(3) caused by the incompetence of the professional related to performing a specific treatment.

Table I. Key concepts used in this article.

Concept	Definition [15,16]
Patient safety	The reduction of risk of unnecessary harm associated with healthcare to an acceptable minimum
Patient safety incident (PSI)	An event or circumstance that could have resulted, or did result, in unnecessary harm to a patient. An incident can be reportable circumstance, a near miss, a no harm incident or a harmful incident (adverse event)
Harmful incident (adverse event)	An incident which resulted in harm to the patient
No harm incident	An incident which involved the patient, yet resulted in no discernable harm
Near miss	An incident which did not reach the patient
Reportable circumstance	A situation in which there was significant potential for harm, yet no incident occurred
Contributing factor	A circumstance, action or influence that is thought to have played a role in the origin, development or increase the risk of an incident
Hazard	A circumstance, agent or action with the potential to cause harm

Degree of harm

The PSI severity assessments were also based on the dental and legal expert opinions included in closed cases. For the classification of harm, we used the World Health Organization's 'International Classification for Patient Safety' [15]. In this study, we assessed the severity of both direct adverse events and hazardous circumstances given that the recommended definition for PSI includes 'any event or circumstance that could have resulted or did result in unnecessary harm to a patient' [16]. Cases with multiple PSIs (involving multiple outcomes or hazards to a single patient or outcome(s) or hazard (s) for several patients) were assigned to the category that represented only the highest level of harm or hazard. We added an extra category for those cases where some patient harm occurred, but where a lack of detailed information hindered our ability to assess the severity. Therefore, harm severity categories recorded included death, severe, moderate, mild, no harm to patient and severity unknown (Table II).

Statistics

The data were statistically analyzed using IBM® SPSS® Statistics version 20. A chi-squared test was used for the comparison of differences between groups. Since most (92%) of the cases studied were against dentists, logistic regression models were used to explore the associations found between PSIs and different dentist-specific variables. We used dentist-specific variables (age, sex, GDP or specialist, private or public practice, working with or without an assistant and whether the dentist was a recidivist or not) to predict the risk of (1) any PSI, (2) moderate-to-severe PSI, or (3) possibly preventable PSI found in the complaint. A p-value of less than 0.05 was considered significant.

Ethical considerations

All data was kept strictly confidential and analyzed without the inclusion of personal details for the patient or professional. The Ministry of Social Affairs and Health granted permission for this research.

Results

One-third of all studied cases concerned public providers (32%), while two-thirds (68%) concerned private professionals. Most (83%) individual dental professionals had received only one complaint or notification during the study period. Cases filed

Table II. Harm classification based on the International Classification for Patient Safety [15].

Harm classification	Explanation
Death	Taking other factors into account, death was caused or brought forth in the short-term by the incident
Severe	Patient outcome is symptomatic, requires life-saving or major surgical/medical intervention, shortened life expectancy or caused permanent or long-term harm or a loss of function
Moderate	Patient outcome is symptomatic, requires intervention (e.g. additional operative procedures or additional therapeutic treatment), a longer stay in the care facility or caused permanent or long-term harm or loss of function
Mild	Patient outcome is symptomatic, symptoms are mild, loss of function or harm is minimal or intermediate, but short-term and no or minimal intervention (e.g. additional observation, investigation, review or minor treatment) is required
None	Patient outcome is not symptomatic or no symptoms are detected and no treatment is required

Table III. Preventability assessment according to PSI* category.

	Total	Possibly preventable	Non-preventable	Preventability could not be assessed
PSI category	*n* (% of PSIs)	*n* (%)	*n* (%)	*n* (%)
Dental or oral treatments	152 (38.9)	99 (65.1)	14 (9.2)	39 (25.7)
Diagnostics	63 (16.1)	48 (76.2)	2 (3.2)	13 (20.6)
Other, impairment of the professional	54 (13.8)	0 (0)	0 (0)	54 (100)
Hygiene or infection control	47 (12.0)	47 (100)	0 (0)	0 (0)
Medications or prescription drugs	31 (7.9)	19 (61.3)	0 (0)	12 (38.7)
Communication	18 (4.6)	13 (72.2)	0 (0)	5 (27.8)
Other, delay in care	16 (4.1)	15 (93.8)	0 (0)	1 (6.2)
Equipment and supplies	10 (2.6)	5 (50.0)	0 (0)	5 (50.0)
Falls, etc., physical environment-related	0 (0)	0 (0)	0 (0)	0 (0)
Total (%)	391 (100)	246 (62.9)	16 (4.1)	129 (33.0)

*Table includes PSIs that occurred among all dental professional groups. If the resulting case decision revealed several PSIs, only the most severe was taken into account.

against male dental professionals predominated (58%). The majority of cases (92%) were lodged against dentists. The likelihood of receiving complaints and notifications significantly differed by gender when compared to the non-complained against population of male and female dentists in Finland ($\chi^2 = 91.36$; df = 1; $p < 0.001$, OR for male dentists was 3.7). A total of 332 cases concerned recidivist professionals ($n = 89$), with > 1 case lodged to authorities during the study period, where most (98%) of the recidivists were dentists. Of all recidivist dentists, 54% were male.

Types of dentistry-related patient harm

More than half of all originally suspected cases (n = 391/659, 59%) included objectively detected PSI(s). Most (66%) cases included only one PSI, while others included multiple and several types of PSIs. Only the most severe harm or hazardous circumstance was recorded in cases with multiple PSIs. Tables III and IV present PSIs that occurred among all dental professional groups. Most (93%) PSIs occurred among dentists. PSIs (n = 391) were most often related to various dental treatment procedures and diagnostics

Table IV. PSI* severity classification according to dental clinical disciplines or conditions.

	PSI severity**					Total	
	Death	Severe	Moderate	Mild	Severity unknown	*n*	%
Clinical disciplines or conditions related to PSI							
Prosthodontics excluding implants	0	2	36	15	11	64	16.4
Impairment of the professional	0	44	0	0	10	54	13.9
Hygiene or infection control	0	17	20	3	7	47	12.0
Miscellaneous clinical***	0	4	18	5	19	46	11.8
Restorative treatment	0	2	15	13	7	37	9.5
Dental or oral surgery excluding implants	0	3	23	5	3	34	8.7
Implants	0	6	24	1	2	33	8.4
Medication or prescription drugs	0	7	2	1	19	29	7.4
Endodontics	0	0	17	5	4	26	6.6
Orthodontics	0	0	7	4	3	14	3.6
Periodontology	0	0	5	1	1	7	1.8
Total *n* (%)	0 (0)	85 (21.7)	167 (42.7)	53 (13.6)	86 (21.7)	391	(100)

*Table includes PSIs that occurred among all dental professional groups.
**Only the most severe PSI in each case decision was included.
***TMJ, acute care, tooth whitening, etc.

Table V. Distribution (%) of the most common patient safety incident (PSI) contributing factors among individual dentists* with one or more cases occurring during the study period.

PSI contributing factor	% of dentists with one case (n = 146)	% of dentist with several cases** (n = 71)	p-value
Poor, erroneous or insufficient patient records	35.6	71.8	*< 0.001*
Communication breakdowns	49.3	47.9	0.84
Current clinical guidelines not followed	32.2	64.8	*< 0.001*
Working without dental nurse	2.7	32.4	*< 0.001*
Some special CPD neglected	3.4	23.9	*< 0.001*
Incomplete or unchecked medical or dental history pre-operatively	15.1	28.2	*0.02*
Necessary X-rays not taken pre-operatively	13.0	25.4	*0.02*
Insufficient treatment planning	8.9	15.5	0.15
Specialist consultation or referral was necessary, but was not obtained/carried out	9.6	14.1	0.32
Insufficient post-operative monitoring or management	7.5	11.3	0.36

p-values in italics are statistically significant results (p-value <0.05).
*Because the majority of cases studied (92%) were lodged against dentists and most detected (93%) PSIs occurred among dentists, all dental professionals other than dentists were excluded from these analyses.
** Every recidivist dentist with two or more complaints or supervisory cases is counted here only once.

(Table III). PSIs occurred most frequently during prosthodontic treatments (Table IV).

Examples of the types of PSIs included the following:

- *Diagnostics*: The pre-operative assessment and examination before substantial bridgework were inadequate and no X-rays were taken, leading to moderate harm to the patient.
- *Dental treatment*: For orthodontic reasons, a patient was referred to a GDP for the removal of a lower canine, while the first premolar next to it was extracted.

Table VI. Patient safety incidents (PSIs) in relation to dentist-specific variables*.

	PSI detected			Potentially preventable PSI detected		
Dentist specific variable	n	OR (95% CI)	p	n	OR (95% CI)	p
Gender						
Male	406	1.4 (1.0 2.0)	*0.04*	221	1.2 (0.7 1.9)	0.57
Female	287	1		119	1	
Age						
41+	581	1.6 (1.0 2.4)	*0.04*	295	1.1 (0.5 2.1)	0.89
25–40	112	1		45	1	
Sector						
Private	468	0.8 (0.6 1.2)	0.29	245	2.2 (1.3 3.8)	*< 0.01*
Public	225	1		95	1	
Level of training						
GDP	543	1.8 (1.2 2.6)	*< 0.01*	284	1.8 (1.0 3.4)	*0.05*
Specialist	150	1		56	1	
Recurring complaints						
Yes	319	3.5 (2.5 4.9)	*< 0.01*	212	1.7 (1.0 2.9)	*0.04*
No	374	1		128	1	

p-values in italics are statistically significant results (p-value <0.05).
*Because the majority of cases studied (92%) were lodged against dentists and most detected (93%) PSIs occurred among dentists, all dental professionals other than dentists were excluded from these analyses.

- *Equipment and supplies*: A file fractured during endodontic treatment and the fragment was left there. The patient was not informed of this and a complication lead to moderate harm (acute infection, several antibiotic treatments and a prolonged recovery).
- *Medications/prescriptions*: In order to relieve anxiety before a dental appointment, an overdose of benzodiazepine (50 mg instead of 5 mg) was given to a pediatric patient. The child lost consciousness and was taken to hospital for further treatment. No permanent harm was caused, but the incident posed a severe risk.
- *Hygiene or infection control*: The private practice which was inspected did not have an autoclave nor sterilized instruments and the hand-piece was not changed between patients, which potentially caused severe risks to several patients.
- *Communication*: The dental treatment was delayed 17 months due to communication breakdowns within the organization. The level of harm to the patient is unknown.
- *Physical environment-related (falls, etc.)*: During neck palpation, the patient fainted and fell from the examination table. (In addition, a more severe dental treatment-related incident occurred to the same patient.)
- *Other, impairment of the professional*: A dentist treated patients on several occasions while drunk, which potentially caused severe risks to patients.

Possibly preventable harm

Most cases where PSIs were detected contained at least one potentially preventable PSI (Table III). When compared to all of the originally alleged treatment errors, nearly two out of five cases contained a possibly preventable PSI (n = 246/659, 37%). The preventability could not be assessed for one-third of all PSI-containing complaints due to missing information or the nature of the incident.

Severity assessment

No deaths occurred, but several PSIs were assessed as severe or posing severe risk to patients. More than two-fifths of cases with a PSI contained moderate levels of harm (Table III). Severe cases were more frequently related to harmful circumstances than the cause of actual severe physical harm. A frequent example of this kind included a professional's inability to work safely (e.g. working while drunk). Poor hygiene or infection control was another rather common cause for severe PSIs. Ingesting or inhaling a dental object (n = 2), extraction of the wrong tooth (n = 12), emphysema caused by dental treatment (n = 1) and severe infection or sepsis related to dental treatment (n = 4) were other reasons listed for severe incidents. Severe PSIs associated with prescription drugs were mainly caused by improper benzodiazepine and opioid pain relief prescribed to patients. We did not identify any near misses or incidents with no detected harm.

PSI-contributing factors

Since the majority of PSIs occurred among dentists, PSIs attributed to professionals other than dentists were excluded from further analyses (Tables V and VI). All of the PSIs among dentists had several contributing factors. The three most commonly found contributing factors included poor, erroneous or insufficient patient records (51.5% of cases with detected PSIs), not following current clinical guidelines (43.5%) and communication breakdowns (41.6%). Table V shows that several incident contributing factors were more frequently found among dentists with recurring cases than among dentists with only one case (Table V).

Associations between PSIs and dentist-specific variables

Being male, older than 41 years and a GDP were associated with the highest risk for any PSI (Table VI). Recidivist dentists carried a significantly higher risk for any PSI, potentially preventable PSIs or moderate-to-severe PSIs ($p < 0.01$; OR = 4.1; 95% CI = 2.9–5.9, results not shown in Table VI) than did other dentists. In other models (results not shown), dentists who worked alone without an assistant carried a higher risk for any PSI ($p < 0.01$; OR = 7.0; 95% CI =3.8–12.8) and for moderate-to-severe PSI ($p < 0.01$; OR = 6.7; 95% CI = 4.2–11.7) than dentists working with an assistant. We also constructed models in which only the most severe PSI for every individual dentist was taken into account. In these models, we found that being male, a recidivist, a GDP and working alone were associated with an increased likelihood of PSIs (results not shown).

Discussion

Our approach to dental complaints and data on supervised cases is novel, since we focused on determining the types of dentistry-related patient harm and hazards and their contributing factors. We also aimed to assess the preventability and severity of identified patient harm and hazards in these cases. In many countries, nation-wide healthcare supervisory and complaint or claim data are not easily accessible for research. Our national supervisory and complaint data covering all dental activities from a 12-year period are, therefore, unique.

Patient safety incident types

It appears that the types of dental incidents have both similarities and differences with other primary care incidents. In primary care other than dentistry, diagnostic errors account for the majority of malpractice claims followed by medication errors [11]. Wilson and Sheikh [17] showed that the key issues in primary care are related to diagnostics, prescriptions, communication and organizational change. Most dental patient allegations concern treatment and diagnostics [18], while PSIs are most often related to treatment, diagnostics, communication [2,4], dental equipment and medications [4].

The primary clinical areas of dental claims and complaints include prosthetic treatments, oral surgery and endodontic treatment [19–23]. In addition, in Finland these three clinical areas are most commonly granted compensation due to a detected dental treatment injury by FPIC [24]. We found that PSIs detected in the supervisory and complaint data were most frequently associated with dental treatments, diagnostics and impairment of the dentist followed by breaches of infection control practices. The larger scale of issues in our data could be explained by differing patient motives related to lodging a claim for monetary compensation to FPIC or by formal complaints to healthcare regulators. Comparisons between our data and insurance company statistics should be cautiously interpreted because our data also included notifications from individuals other than patients (employers or other officials).

Contributing factors

Healthcare errors in primary care are multifactorial by nature [11]. All of our PSIs had several contributing factors. The risks related to some PSIs, regardless of severity or preventability, were most likely found among male, middle-aged GDPs with recurring complaints and supervision. Our findings of complaints being lodged more often against male dentists than against their female colleagues and against private practitioners compared to public practice dentists are also supported by others [25]. If we compare the number of complaints and PSIs detected by gender across the entire population of dentists in Finland, where the majority of dentists are female, the gender difference is even clearer. Our finding that middle aged dentists carried a higher risk for PSIs than younger dentists could be explained simply by the fact that most Finnish dentists are over 40. Therefore, the detected age differences should be interpreted with caution. Other contributing incident factors were, for example, a dentist working alone without assistance and impairment of the practitioner. Often, both factors were found in the same case. The stress associated with managing an independent practice has been suggested as a contributing factor connected with a dentist's drug or alcohol misuse [26]. The lack of an assistant and peer support could be factors affecting or facilitating impairment of the dentist or contribute to the development of hazardous circumstances. These associations should be studied further. Additionally, given that more than half of Finnish dentists work in the public sector and in group practices (70%) with a dental assistant, our results showing a higher risk for PSIs among dentists working in the private sector without an assistant seem justified.

Many of the PSIs detected resulted from failures in communication. This finding is supported by other studies [27,28]. Frequently found problems in patient records did not always play a role in the origin or development of the current incident. Incomplete or erroneous patient records, however, accompany the potential to increase the risk of some other incident.

Preventability of PSIs

Most of the dental PSIs and risks we studied could be prevented from recurring. In a comparison of all alleged treatment errors and safety hazard cases, nearly two out of five cases were potentially preventable. A recent dental claims study by Perea-Pérez et al. [5] supports this, as do the findings of Virtanen et al. [24], who concluded that the same proportion of all dentistry-related claims to the Finnish Patient Insurance Center between 2000–2008 received compensation—that is, dental experts assessed them as preventable. It is important to note that inevitable PSIs also occur [29], some of which are the result of unavoidable risk-taking [19].

Finnish dentists have reported that a number of ways to prevent PSIs are already available, but the active use of them varies between individuals and organizations [30]. Our study showed that many dental PSIs could be prevented through the proper use of existing measures pre-operatively, peri-operatively or post-operatively. This is also supported by others [28]. Checking medical and dental history pre-operatively is one of the main components of preventing PSIs. Other important factors to prevent PSIs in dentistry include treatment planning and adherence to current guidelines. Guidelines, protocols and decision-making support tools can be useful in preventing diagnostic errors [17]. Furthermore, safety checklists can be effective in ensuring dental patient safety [31] and some attempts of this kind have recently been introduced [32–34]. Dentists should also adequately recognize their own limits [23]. Several of our moderate-to-severe harmful PSIs were caused by overconfidence with one's skills related to performing complicated treatments such as implants, fixed prosthetics or surgical procedures. In addition, dentists need to know the possible

complications associated with particular procedures and how to proceed if something goes wrong [20]. These findings call for active CPD.

The role of pharmacists in assuring safety [17] was evident in our study. Inadequate prescriptions or the potential for adverse drug reactions were often detected in pharmacies, thus preventing possible harm to the patient.

Severity of PSIs

One obstacle to patient safety research in dentistry has been the general apprehension that dentistry-related iatrogenic harm to patients is rare and less severe by nature than that which occurs in other healthcare sectors [1]. Our results showed that, most commonly, PSIs caused a moderate degree of harm to patients and that serious PSIs do occur. However, no fatal incidents occurred in Finland during the study period. In recent years, while rare, some severe PSIs in dental settings leading to a patient's death or brain death have been reported [5,21,27,28,35,36]. These devastating incidents have occurred, for example, due to pediatric dental anesthesia and sedation, oral and maxillofacial surgery and pneumonia associated with a dental unit waterline.

Limitations

This unique dataset covers all dentistry-related formal complaints and notifications from employers, etc. to two of the main healthcare regulators in Finland. However, a register-based study carries some limitations. The chosen study method seems to affect the number of detected PSIs, the types of PSIs and the degree of harm found. Our previous study on dentists' self-reports demonstrated a notably larger number of PSIs in a study period covering only 1 year [4]. These mainly included adverse events that only resulted in little or temporary harm to the patient and a few cases of serious or permanent harm. The main difference lies in the number of events causing severe or permanent harm and the existence of near-miss situations. In dentists' reports, almost half of all incidents were near misses (no harm was caused to the patient) and more than half resulted in adverse events. The relatively low number of cases in the data involving a mild degree of harm can be explained by the nature of our dataset. Administrative data such as this does not include information on the errors that did not result in harm to the patient. It is likely that our data includes the most severe cases because these are reported to Valvira. On the other hand, our data revealed issues (prosthetic treatments as the main clinical area connected to PSIs, hygiene or infection control problems, impairment of the professional) which were seldom seen in dentists' self-reports [4]. Therefore, different research methods and perspectives are needed in order to broaden the concept of patient safety.

Due to the limited data in some closed-case decisions, the preventability or severity could not be determined. Categorizing different events was not always unambiguous given that one incident could be assigned to several incident types. In addition, some information was lost since we chose to categorize only the most severe incident and its preventability in each individual case.

Conclusions

This study raises many important considerations related to patient safety enhancement in dentistry. Despite some limitations, many alleged PSIs were proven valid and evaluated as potentially preventable. Even severe patient safety risks in dentistry exist. PSIs were associated with several dentist-specific variables including the presence of an assistant, sex, level of training, recidivism and fitness to practice. Many of the PSIs discovered could probably be prevented through the proper and more systematic use of already available error-preventing methods, which include, for example, active CPD in the prevention of infections and working four-handed with a dental nurse. Patient safety issues, especially safe communication techniques (both verbal and written), should be emphasized in undergraduate curricula and CPD courses.

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