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Quality of care
provided for young adults and adolescents
in the Finnish public oral health service

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Academic dissertation
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Helsinki 2000
SOON HE IS GOING TO DRILL.

FIRST PREMOLAR MISSING.

WHY DON’T YOU GET DOWN TO IT?

TO MENNO
Abstract


In this study, a model was designed to serve as a theoretical framework, with tools designed for assessing treatment practices in oral health care. The model and tools were applied in a real-life environment in order to assess dentists’ treatment selections and quality of treatment practices concerning oral health record-keeping, risk assessment, preventive and root canal treatment, and radiography.

Cross-sectional data on actual clinical examinations and treatment courses performed by 56 dentists came from original individual oral health documents. In total, 559 treatment courses performed in 1994-1996, and 312 radiographs taken between 1990-1997 were scrutinized in randomly selected study populations of young adults and adolescents. Data on the dentists came from employee files. Dentists’ perceptions of their treatment practices were obtained through a questionnaire.

The tools defining an individual score of quality points for each treatment case or for a radiograph employed assessment criteria conforming to good dental practice. Dentists’ treatment selections were evaluated in relation to patients’ oral health status and to dentist characteristics.

As indicated by the quality points, treatment practices varied considerably. Independent of their year of graduation and gender, dentists fell short of actually following preferable treatment practices. In the majority of treatment cases, patient risk-factor assessment was insufficient, fewer than half of the dentists performing any kind of risk-assessment measures. Preventive treatment was not individualized according to each patient’s oral health status, adolescents receiving more prevention than did young adults, of whom, one-fourth received none. Lack of diagnostic procedures was evident also in radiography and root canal treatments. Overall, dentists' perception of the quality of their treatment practices exceeded that found in patient documents.

With the shortcomings found in treatment practices in the present study, it was concluded, based on the relevant literature, that the quality of care was comparable to that found in similar assessments in other western countries. It was recommended that dentists should take an active role in assessing their processes of care as well as in improving them. The model and tools designed in this study may facilitate the assessment of actual practices and the follow-up of improvements made in any one oral health care setting.

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List of original publications

The thesis is based on the following original articles referred to in the text by their Roman numerals. In addition, the thesis includes unpublished data.


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## Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>Appr.C</td>
<td>number of approximal carious lesions</td>
</tr>
<tr>
<td>BW</td>
<td>bitewing radiograph</td>
</tr>
<tr>
<td>CPITN</td>
<td>community periodontal index for treatment need</td>
</tr>
<tr>
<td>DMFT</td>
<td>number of decayed-missing-filled teeth</td>
</tr>
<tr>
<td>DT</td>
<td>number of decayed teeth</td>
</tr>
<tr>
<td>ESE</td>
<td>European Society of Endodontology</td>
</tr>
<tr>
<td>I</td>
<td>number of incipient lesions</td>
</tr>
<tr>
<td>OP</td>
<td>panoramic radiograph</td>
</tr>
<tr>
<td>PA</td>
<td>periapical radiograph</td>
</tr>
<tr>
<td>PHA</td>
<td>Primary Health Act</td>
</tr>
<tr>
<td>RCT</td>
<td>root canal treatment</td>
</tr>
<tr>
<td>SI</td>
<td>status and intervention index</td>
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The concept of quality assurance as such came into Finnish dentistry in the early 1990s (Tala 1991). However, similar activities have long been conducted under various headings, especially in the public sector. The authorities have collected data and produced nationwide statistics on the treatments provided and on the oral health status of the patients entitled to receive public oral health services (The official statistics of Finland 1960, National Board of Health 1979, 1980, 1989). These statistics offer the possibility for one setting to compare its performance with that of other oral health service settings, allowing the acknowledgment of the best practices and thus offering the possibility to learn from them.

The profession’s role in developing quality assurance systems is essential for the profession’s support of a particular evaluation system (Bailit et al. 1974, Berwick and Nolan 1998). Such a role is embodied in the prevailing recommendations for Finnish dentists to assess their own professional performance, with supervision by authorities in any malpractice cases. This practice in Finland is in accordance with the member associations’ of Federation Dentaire Internationale (FDI Working Group 1995) overwhelmingly belief that dentists as experts should evaluate the quality of oral health care. Currently, the National Research and Development Centre for Welfare and Health (1994, 1999), and the Finnish Dental Association (1996) are promoting quality assurance activities for dental settings in the form of self-assessment and specific quality systems.

Legislation and ordinances on health care regulate the structure of health care in Finland. The curricula for oral health care professionals are statutory, and thus analogous in their essential portions in all settings providing such education. The authorities supervise professionals in oral health care by licensing; only persons fulfilling the requirements are allowed to practice the health care professions. The equipment and devices, as well as the settings providing care, are all regulated by legislation and supervised by means of authoritative accrediting. As well by legislation, health care providers are obliged to keep up with current knowledge and to use proven appropriate methods, while patients have the explicit right for good-quality care. This is mainly facilitated by research, informative guidance, and continuing education.

According to a WHO review group (WHO 1991), the high quality of the staff and of the physical facilities in the Finnish health services is unquestioned, but too little attention has been paid to the quality of care. More attention should be focused on the quality of services provided and to their capability to meet patients’ needs.

The present study set out to design a model of the oral health care process in a quality of care perspective, with tools for assessing treatment practices. The model and tools were applied in a real-life environment to assess the current treatment practices as one starting point of a wider quality assurance project in the Vantaa Public Oral Health Service, one of those dental settings which have accepted the challenge to assess and improve the quality of their services.
Theoretical background and review of the literature for the best practices

Quality of care

Definitions of quality
A number of attempts have been made to formulate a concise and generally applicable definition of the quality of health care. In his early attempt, Donabedian (1966) concluded that the definition of quality may be almost anything anyone wishes it to be, but also noted that any given definition is value-bound and reflects the goals of the medical care system as part of a larger society. Later, Donabedian (1980) has defined high quality care as “that kind of care which is expected to maximize an inclusive measure of patient welfare, after one has taken account of the balance of expected gains and losses that attend the process of care in its all parts.”

According to the American Institute of Medicine in 1990 (Lohr et al. 1992), quality is constituted by the “degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.” This definition emphasizes the professional point of view.

Another, more generally stated definition holds that “Quality is the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs.” (European Committee for Standardization 1994), allowing both provider and patient expectations to be taken into account when applied in health care.

This has been criticized by Øvretveit (1992) as to its considering the satisfaction of only those who receive the service and ignoring those left without. He defines quality as “Fully meeting the needs of those who need the service most, at the lowest cost to the organization, within limits and directives set by higher authorities and purchasers.”

Perspectives on quality of care
As apparent from the multiple definitions, there are several perspectives to the quality of care, also often called levels, at which the care-quality may be considered. Donabedian (1988) has molded these levels into three concentric circles. In the very center is the provider of care from whose point of view quality has three components: technical quality, interpersonal relationship, and amenities of care. Technical quality has been further divided into decision-making and performance (Blumenthal 1996). Amenities of care are seen as the desirable attributes of the setting within which care is provided. The interpersonal relationship enables the patient to communicate information necessary for a diagnosis and his or her preferences for treatment selection, as it enables the provider to implement the care and to motivate the patient to collaborate. The next one of Donabedian’s circles embraces patients and their families who all have their own perspective on quality of care as well as having their own responsibility for it. The outermost circle embraces the community, mainly in terms of accessibility to care (Donabedian 1988).

In addition to the perspectives of the patient, the family members, the provider, and the third-party payer, Dolan (1995) describes three levels for considering quality in dentistry: the policy level that concerns whether the proper things are done for the target population within the given resource frame; the dental program level seen as achievements and their maintenance; and the individual patient level with the spectrum of physiological, psychological, and sociological aspects.

According to Karjalainen (1995), there are three parties whose perspectives on quality differ based on their specific needs concerning health care. These parties are the patient, the organizational provider, and the payer. Communities in Finland responsible for organizing health care for their inhabitants have a dual function both as organizational providers and as payers for care. The patient’s perspective
is based on a personal health problem for which help is sought. As the care-payer, the community, and in larger sense the society, needs to preserve its citizens as healthy, content, and functional. The organizational provider has no needs but is the means to fulfill the other parties' needs concerning health care. How well an organizational provider performs this task forms its perspective on quality of care.

Frameworks for quality assessment
A variety of models and approaches has been presented in the literature to structure and conceptualize the assessment of and factors related to quality of care. The most enduring seems to be Donabedian’s (1966) conceptual framework including three dimensions: 1) structure – relating to the facilities, equipment, personnel, and organization available for provision of care, 2) process – referring to actual provision of care, 3) outcome – denoting effects of care on patients’ health status (Figure 1). Each of these dimensions can be assessed separately or in combination; and ideally, it can be argued that if both the structure and process elements are well attended to, we can then anticipate a positive health outcome for a patient receiving care in a particular provider system. In reality, agreement on the interaction of these elements is less clear (DiAngelis 1984, Donabedian 1988, Antczak-Bouckoms 1995). Starfield (1973) has stated: “Although outcome needs to be examined, it should not be used as the sole criterion for assessing medical-care services until more is known about how it is influenced by structural and process criteria.” In the opinion of Brook et al. (1996), “Process data are usually more sensitive measures of quality than outcome data, because a poor outcome does not occur every time there is an error in the provision of care.” Thus “assessment of quality should depend much more on process data than on outcome data, especially when those systems are used to compare health plans or physicians.”
**Assessment of quality**

Quality is assessed in order to find out whether it meets the standard set and to lay the groundwork for improving it. Assessment of quality can be outlined as a sequence of elements (Bailit and Gotowka 1983) (Figure 2).

**Selection of a topic.** The topics to be assessed should be selected based on significance, feasibility, correctability, and expected results (Bailit and Gotowka 1983). A topic may also be selected according to the anticipated and feasible health benefits that are not yet met, using the greatest “achievable benefit not achieved” as a selection criterion (Williamson 1978, Williamson 1991). Management of a tracer condition may be the topic selected to represent the quality of care. A tracer condition should fulfill the following requirements: be of sufficiently high prevalence, well defined and relatively easy to diagnose, and there should be a general consensus on its suitable management (Kessner et al. 1973, Øvretveit 1992). One more approach is to select a topic based on a case with an adverse outcome (Donabedian 1988).

**Development of criteria.** To be reliable, valid, and reasonable, the criteria to assess quality must produce similar judgments by more than one assessors independently evaluating the same data, the criteria should be specific and pertinent to the topic selected, and they should be based on sound scientific knowledge or evidence (Lembcke 1956, Bailit et al. 1974, Bailit 1985). Explicit, written criteria with sufficient precision and detail are preferable to implicit criteria in their verifiability (Lembcke 1956, Donabedian 1981, Brook et al. 1996, Marcus and Spolsky 1998). The list of criteria developed is not a full representation of quality nor a protocol for provision of care but a screening device to separate between care of doubtful and of probably acceptable quality, when the care provided is compared with objective, explicit criteria (Donabedian 1981, Shaw 1990).

**Sources of data.** Three sources to obtain process data are acknowledged: patient documents, direct observation of care provision, and surveys by questionnaires and interviews (Donabedian 1966, Brook et al. 1996). Each of these data sources has its weaknesses; for patient documents, those are incompleteness of recordings and incapability to document all aspects of provision of care. Direct observation is time- and resources consuming, and will probably affect the patient-provider encounters observed. Survey data carry the inherent subjectivity and limitations of memory of those responding (Donabedian 1988, Brook et al. 1996).

The dental record is seen as an important, as well as a practical source of process data (De Jong and Dunning 1970, Jerge and Orlowski 1985, Marshall 1995). It gives a chronological account of the cyclic patient care process, logically reflecting steps from patient assessment, via diagnosis, plan, and treatment, to outcome of care. Due to the chronic nature of the most common oral diseases and the repetitive documentation of them, well structured and properly kept records, together with good quality radiographs, are a reliable source for process data (Jerge and Orlowski 1985, Marshall 1995). However, the patient record fails to address one essential aspect of the patient-provider encounter, namely, the interpersonal process. But, although a satisfactory patient-provider relationship is important, it can never be accepted as a substitute for professional work which is poor (Morehead 1967). And on the other hand, as the patient-provider relationship is the vehicle of
implementing care, even good professional work can be harmed by an unsatisfactory interpersonal process (Donabedian 1988).

Treatment decisions

Substantial variation in dentists’ treatment decisions and treatment provided has been identified and acknowledged, but the understanding of the causes and implications have remained meager (Anusavice 1992, Bader and Shugars 1995, Dolan 1995).

Variation in treatment decisions and in treatment provided

In studies involving actual dental services and patients, variation has been documented at the level of dentists’ practice patterns (Bailit and Clive 1981, Grembowski et al. 1990), and of treatments planned for individual patients, as well as at the level of the individual tooth (Rytömaa et al. 1979, Elderton and Nuttall 1983, Bader and Shugars 1993).

Concern has been expressed as to whether or not the quality of care is acceptable and the rate of treatment procedures is optimal at both of the outermost extremes of variability (Bailit and Clive 1981, Wennberg 1986, Bader and Shugars 1995). This kind of quality and/or treatment distribution issue has been categorized in medicine under three headings: overuse –constituting provision of care whose risk of harm exceeds its potential benefit; underuse –failure to provide proven effective interventions; and misuse –avoidable complications of treatment (Chassin 1998). When positively viewed, treatment variation between dentists is the result of a mature decision-making process affected by differing factors in each treatment case (Kay and Nuttall 1995b).

Factors in treatment decision-making and provision of treatment

Variation in treatment decisions may stem from several uncertainties, including errors in and ambiguity of clinical data and variations in its interpretation, uncertainty about relations between clinical information and presence of disease, and from uncertainty about effects of treatment (Weinstein and Fineberg 1980). Kay and Nuttall (1995b) summarize effects of these uncertainties as perceptual and judgmental variation, the former occurring when dentists’ treatment decisions differ owing to their different perceptions of the condition they are facing, the latter, when dentists’ opinions about appropriate treatment differ, even in cases in which their perception of the condition is similar. Bader and Shugars (1995) have identified several differences among dentists which contribute to the variation in decision-making: skill and diligence in conducting the examination, diagnostic criteria employed, beliefs about course of the disease, about risk factors for disease, and about treatment effectiveness, and finally, their style of patient interaction.

Grembowski et al. (1988) has acknowledged Starfield’s (1973) model for dynamics of health outcome (Figure 1) as a basis for studying factors associated with dentists’ treatment decisions. According to Grembowski et al. (1988), as structural aspects of the practice may influence decision-making, “the interaction of the functional aspects of dental practice with the behavior of patients determines the process of care, or the nature of clinical decision making in the practice”.

This model has been criticized by Bader and Shugars (1992) because it fails to characterize the decision-making process and the specific factors directing decisions; and they set forth an explanatory model of dentists’ treatment decisions (Figure 3).

Their own model neglects structural or environmental factors (e.g., local market conditions) that are regarded as having similar effects on all patients and providers in a given area, whereas structural factors closely related to dentists are taken as dentist attributes. This model was originally purported to conceptualize dentists’ restorative treatment decisions but is not limited solely to that purpose; the sequence of clinical decision-making is ubiquitous. The three phases included in the process are: diagnosis or detection, decision to intervene (simply yes or no), and selection of treatment (Bader and Shugars 1995).
Good patient-provider relationship and the patient’s involvement in treatment planning promote high-quality treatment decisions (Kay and Nuttall 1995a). In addition, how much the patient values oral health care, together with the dentist’s values and personal treatment threshold, and the risk/benefit ratio, and the probability of success of treatment as well as the patient’s financial resources, all influence the complex decision-making process. “The dentist is the central character in the decision making but is not isolated from environmental or patient factors.” (Kay and Nuttall 1995b). The associations between treatment decision, treatment selection, and affecting factors are dynamic and bilateral; for example, when a decision is made that a filling should be placed, the patient may become more accepting of additional fillings, whereas the change of instruments to begin restorative treatment may lower the dentist’s threshold for detecting more teeth needing restorative treatment (Kay and Nuttall 1995b). The environmental factors are limited to the immediate set-up of equipment during provision of care.

Both Bader and Shugars (1992) and Kay and Nuttall (1995b) regard the yes-or-no decision to intervene as a step in the decision-making process, instead of regarding not-to-intervene as one treatment option with its own consequences, trade-offs, and value attachments, as decision analysis suggests (Weinstein and Fineberg 1980, Kent 1992).

By a qualitative method, interviewing in depth twenty general dental practitioners in Glasgow, Kay and Blinkhorn (1996) delineated broad areas of concern that influence dentists’ restorative treatment decisions beyond the level of pathology and probability of success. Concerning patient preferences, their dentists fell into two categories: those who acknowledged patient preferences but felt responsible to chance some of them, and those regarding patients’ preferences as very important and involving patients in the decision process. These dentists were worried about gaining a reputation not for over-treatment, but rather for under-treatment.

**Toward consistent and appropriate decisions and treatment**

Decision analysis, continuous quality improvement, and practice guidelines are all aimed at narrowing and shifting upwards the bell-shaped curve of treatment distribution, that is, to improve the consistency and appropriateness of treatment provided (Weinstein and Fineberg 1980, Berwick 1989, Field and Lohr 1990). Decision analysis offers an explicit, quantitative, and prescriptive method that helps providers to determine what they should do under a given set of circumstances by means of improving their insight into uncertainties and values pertinent to the situation (Weinstein and Fineberg 1980, Kent 1992). Continuous quality improvement builds on the understanding of and revision of the process of care based on data about the process itself (Berwick 1989, Batalden and Stoltz 1995). Practice guidelines provide statements to assist in provider and patient decisions about appropriate care (Field and Lohr 1990, Chassin 1993). The drawback in common for all these methods is that they do
not guarantee desirable outcomes (Kent 1992). Further, any effort aimed at improving dental treatment decision-making must acknowledge the dentist-patient interplay of clinical and psychosocial factors (Redford and Gift 1997).

**Transfer of scientific knowledge**

The failure of clinical practice to apply research findings and medical innovations in provision of care has been recognized as a gap between scientific knowledge and everyday practice (Lurie et al. 1987, Nowlen 1988, Horowitz 1995). Some research findings never gain acceptance in clinical practice, others are implemented only after a delay (Haines and Jones 1994). One possible explanation for this is the separate cultures of researchers and practitioners; researchers not feeling responsible for translating findings into terms relevant to appropriate care, with practitioners committing themselves only to the treatment of each individual patient (Nowlen 1988, Greer 1988, Haines and Jones 1994). Another explanation draws on the theory of diffusion of innovations: an innovation being communicated through certain channels over time among a social system (Rogers 1995). The diffusion takes time and has its own pattern before laggards have followed innovators, early adopters, and early and late majorities in a professional community. For example, dentists’ adoption of light-cured composite resins followed the theory-predicted phases: introduction, take-off, and maturation, but this innovation has not yet reached obsolescence (Fiset and Grembowski 1997).

Further, there is a discrepancy between what providers say they performed and documented on the patient records versus what they actually did in their daily practice (Hulka et al. 1979). Although a consensus may have been reached on the essential items belonging to optimal treatment, providers often fall short of adhering to their ideals (Hulka et al. 1979, McDonald et al. 1984, Grilli and Lomas 1994). Similarly they often fail to document the treatment provided to the full extent on records, with patient history getting the least attention (Rethans et al. 1994).

As a conclusion, a framework for the flow of scientific intelligence from research findings via the professional community to the individual provider and then to the single patient-provider encounter, finally ending as documented evidence in patient records (Figure 4).

![Figure 4. Flow of scientific intelligence in health care.](attachment://flowchart.png)

Measure to enhance the transfer of scientific knowledge to benefit an individual patient through the steps presented in Figure 4 range from legislation to continuing education and practice guidelines, and to information management and quality improvement systems (Williamson 1991, Poorterman et al. 1998).
Oral health record-keeping

Adequate oral health record-keeping is essential for research, for quality assurance, and for medico-legal reasons, but above all, adequate record-keeping facilitates patient safety, and continuity and comprehensiveness of care (Jerge and Orlowski 1985, National Board of Health 1986, Valenza 1994, Bader and Shugars 1997). A properly completed record provides a detailed account of collected information, diagnosis, treatment plan selection, and the actual treatment provided; such a record allows for assessment of the outcome of care previously given and for monitoring a patient’s oral health over time as well as for feedback to the provider (Bailit and Gotowka 1983, Bader and Shugars 1997).

Taking a patient’s medical history is an integral part of the dental treatment, and consequently, the patient health history is an important element in the oral health record. A health history questionnaire filled in and signed by each patient is useful to detect medical problems relevant to oral health care (McCarthy 1983). In Sweden, a medical history has been found to be included in 29 to 53% of oral health records (Rasmusson et al. 1994, Borrman et al. 1995).

In Finland, authorities have for decades provided dentists with instructions about record-keeping practice (National Board of Health 1967). These have by subtle changes evolved into the detailed instructions currently in force (National Board of Health 1980, 1985, 1986, Association of Finnish Local and Regional Authorities 1982, Ministry of Social Welfare and Health 1993). In Norway and Sweden, it has been found that the quality of oral health record-keeping is not always at the level purported, owing to dentists’ observance of the comparable instructions not always being optimal; patient records investigated were lacking considerable numbers of items that should had been recorded (Solheim et al. 1989, Rasmusson et al. 1994, Borrman et al. 1995). On the other hand, the Swedish dentists’ knowledge about the regulations concerning oral health record-keeping has been shown to be at least sufficient (René et al. 1994).

Oral health risk assessment

“Risk assessment is a systematic determination of all known factors that might have an effect on the course of disease and/or the response to therapy.” (Newman 1998).

There are two approaches to oral health risk assessment: population- and individual-based (Stamm et al. 1991). The population approach attempts to identify and quantify risk factors that compromise the population’s oral health. The individual approach attempts to generate quantitative risk predictions based on the presence or absence of identified risk factors of each individual, laying the groundwork for a prospective (prevention) instead of a retrospective (treatment of disease) care orientation (Stamm et al. 1991). Risk assessment is a tool for planning either a preventive or a health promotion program for an individual or for a population. To justify the effort and expense of identifying individuals believed to be susceptible to a particular condition, the occurrence of the condition must be relatively low, and practicable identification methods as well as effective and feasible preventive measures must be available for those identified as being at high risk (Stamm et al. 1991, Hausen 1997).

The term "risk factor" is used for certain exposures associated with an increased probability that disease or change in health status will occur (Beck 1990, Page and Beck 1997). Modification of a risk factor should result in a lower probability of disease occurrence. Factors that are associated with higher probability of disease but cannot be modified are called background characteristics, whose effect should be compensated for by alteration of present risk factors (Page and Beck 1997).

Several factors associated with the most common oral diseases have been identified, for example: past disease experience, socio-economic status, diet, oral hygiene, use of tobacco, use of alcohol, microbiological and salivary factors, and exposure to sun (Demers et al. 1990, Horowitz et al. 1996, Page and Beck 1997). Some of these factors, like tobacco, have been connected with more than one oral
disease, while exposure to sun is primarily associated with lip cancer (Horowitz 1996, Axelsson et al. 1998). All these factors are not risk factors because they are not part of the causal chain of an oral disease, nor do they bring an individual into contact with the causal chain; but rather they are risk predictors (Demers et al. 1990, Disney et al. 1992, Page and Beck 1997). In models developed to predict future caries or periodontal deterioration, a strong predictor has been past disease experience (Disney et al. 1992, Vehkalahti et al. 1996, Page and Beck 1997).

The multifactorial nature of oral health risks and need for early detection call for multiple identification and assessment procedures (Beck 1990, Horowitz 1996, Page and Beck 1997). No measure alone is sufficient for assessing oral health risks and predicting future development, but a combination of measures as used in a routine clinical examination and assessed by a dentist has been shown to be a reasonable tool (Binnie 1991, Lang 1991, Disney et al. 1992, Alanen et al. 1994, Worthington et al. 1997). When identifying individuals’ risk level, not only risk factors but all factors modifying a patient’s susceptibility to oral disease should be considered, and because many of those factors have the potential for being unstable over time, regular reassessments are needed (DePaola 1990, Suddick and Dodds 1997, Newman 1998).

In Finland, according to one questionnaire, the most common methods to identify caries high-risk patients are past caries experience and dentist’s subjective judgment (Kärkkäinen 1997). Nevertheless, dentists in Helsinki, Finland, assessing children and adolescents who had three or more decayed teeth, had explicitly stated in the patient record that only one patient out of five of these was at high risk (Varsio 1999).

**Prevention of oral disease**

The goal of prevention is to ensure that a disease process never starts, or to reverse the disease in its early stages. With early intervention, most oral diseases can be prevented, by known methods. The intervention, whether chemical, mechanical, or altered behavior, must be specific for the disease process and adjusted to the assessed risk level. By instruction and motivation, oral health promotion brings those preventive regimens available into use (Gift 1991, Erickson 1997). Oral health promotion should lead to improved knowledge and attitudes, and better self-care, and thus to better oral health status. Prevention of disease and promotion of health require health to be seen prospectively (Gift 1991, Stamm et al. 1991).

As a consequence from the two approaches to risk assessment, prevention and health promotion can be also pursued at both individual and population levels. Relying on the current knowledge of risk factors and disease processes, oral health promotion and prevention should utilize both approaches. The population approach attempts to alter social norms and increase knowledge about the diseases without screening of individuals for risk factors (Fejerskov 1995). Caries and periodontal disease seem to affect some individuals more severely, and some are more exposed to oral health risk factors than are others (Bowen 1991, Bałum 1991, Brown and Löe 1993, Downer 1996, Vehkalahti et al. 1997, Axelsson et al. 1998). These vulnerable patients should receive individualized innovative prevention, because they will benefit most (Axelsson et al. 1993, Page and Beck 1997). Targeting oral health promotion and prevention of disease to particular groups is feasible only if the target group shares the same risk factors and is uniform in disease occurrence, and if interventions are equally effective (Gift 1991).

Individuals can take an active part in preventing oral disease, or they can remain the passive recipients of professionally provided preventive care. To sustain optimal oral health requires lifetime practice of self-care skills, a preventive regime, and motivation to seek professional care. Both passive and active measures are therefore required. A dental profession’s role is significant in motivating and instructing patients to adopt active personal behavior favorable for oral health as well as providing of individually adjusted passive
Evidence suggests that active measures added to dental care better prevent the progression of caries and periodontitis in adults than do only passive measures and traditional dental care (Axelsson and Lindhe 1981). It has also been shown that prevention of caries by individual tailoring of preventive measures based on carefully assessed risk factors can be successful and cost-effective (Axelsson et al. 1993). On the other hand, the least variation in treatment seems to occur in clinical examinations and prevention most of which are based on scheduled routines rather than on patients’ individual needs (Bader and Shugars 1995). Targeting of prevention according to patients’ needs has been reported as insufficient: such prevention is similar for all, or patients in good oral health receive even more prevention than those at higher risk, with some of high-risk patients left without any prevention (Vehkalahti et al. 1992, Källenstål and Holm 1994, Kärkkäinen 1997, Varsio 1999). In fact, according to one questionnaire, dentists in the Finnish public oral health service claimed that they apply current scientific knowledge, gained mainly through continuing education, in individualized caries prevention (Kärkkäinen 1997). And indeed, as attested by patient records, dentist’s explicit judgment of a patient’s high risk for caries does lead to intensified prevention, both active and passive measures (Kärkkäinen 1997, Varsio 1999).

**Root canal treatment**

“Endodontic treatment encompasses procedures that are designed to maintain the health of all, or part of the pulp. When the pulp is diseased or injured, treatment is aimed at preserving normal periradicular tissues. When pulpal diseases have spread to the periradicular tissues treatment is aimed at restoring them to health.” (European Society of Endontology, ESE, 1994).

Follow-up studies assessing the treatment outcome of endodontic therapy report success rates ranging from 46% up to 98% (Friedman 1998). This variation may depend on study design, on lack of standard criteria for evaluation of the periapical healing, and on interpretation of radiographs, but it may depend also on the presence of apical periodontitis prior to treatment and on length of the observation period, as well as on treatment procedures (Strindberg 1956, Reit and Hollender 1983, Reit 1987, Sjögren et al. 1990, Smith et al. 1993, Friedman 1998).

The effect of treatment procedures naturally reflects the operator’s skills and experience, whether a student, general practitioner, or specialist (Stabholz 1990, Friedman 1998). The root canal preparation technique, and the technical quality of root canal obturation influence the treatment outcome (Strindberg 1956, Grahnén and Hansson 1961, Kerekes and Tronstad 1979, Sjögren et al. 1990), and the technical quality of the coronal restoration may be even more important for apical periodontal health than that of root canal obturation (Saunders and Saunders 1994, Ray and Trope 1995). Complete elimination of bacteria before obturation of the root canal system is essential and may be difficult to achieve in a single visit without the support of interappointment disinfection (Pekruhn 1986, Friedman et al. 1995, Sjögren et al. 1997).

Findings of Matsumoto et al. (1987) and Caplan and Weintraub (1997) show that endodontic failure and subsequent loss of root-canal filled teeth are related to occlusal trauma, number of proximal contacts for the tooth treated, number of missing teeth, and periodontal status both locally and in the whole mouth; none of these being an endodontic or postobturation factor. This suggests that factors ascertainable at the time of treatment planning effect the outcome and should be considered. Caplan and Weintraub (1997) conclude that risk-based guidelines could aid providers in recommending treatment.

In cross-population studies, inadequate root canal fillings have been a frequent finding, the rate of optimal fillings varying from 31% to 67% (Friedman 1998). Based on this kind of findings it has been suggested that dentists do not adhere to appropriate root canal treatment procedures in their everyday practice, and that improvement in the quality of treatments is

The European Society of Endodontology (1994) has introduced guidelines for endodontic treatment, addressing the appropriate treatment modality and quality of treatment rendered. According to these guidelines, before the treatment, a patient’s medical and dental history should be taken, the patient clinically examined, diagnosis made, and the treatment planned in regard to indications for each patient’s treatment. During the treatment, an aseptic technique and a rubber dam are to be used. Recordings of symptoms, observations, and treatment rendered should logically adhere to a process of root canal treatment that, at the very least, includes preoperative radiography, determination of working length, elimination of micro-organisms, interappointment disinfection (if applicable), and radiological verification of the quality of obturation. Clinical and radiological assessment of the treatment should be done after one year, and if success is doubtful, a subsequent follow-up period of three years is recommended before any decision for re-treatment.

In-depth interviews among twelve general dental practitioners in the northern and Yorkshire region of the United Kingdom (McColl et al. 1999) identified a complex web of influences affecting dentists’ endodontic practice and explored perceived barriers to good practice. Affecting dentists’ adherence to good endodontic practice, as delineated by ESE guidelines, were factors such as constraints on choice of techniques and materials, expected clinical outcome, perceptions of patients’ expectations, and anxieties arising from lack of expertise. One major issue concerned British National Health Service remuneration scales for endodontic treatment not reimbursing dentists the time required to carry out optimal work, especially in molars. To overcome this, dentists had two approaches: avoiding endodontic treatments, e.g., by extractions and referrals to specialists, or rendering sub-optimal treatment compared to recommendations of the guidelines. Another perceived barrier was limitations in knowledge and skills. Dentists recognized that their undergraduate endodontic training was insufficient, neither was continuing education assumed to be capable of closing the gap between theory and on-site real-life practice.

Radiograph quality

Supplementary to history taking and clinical examination, dental radiography is a useful aid in the diagnosis of dental diseases, providing information about teeth and jaws that is unavailable by other means (Langland and Langlais 1997, Brocklebank 1998). Though the risk to a patient from the use of dental radiography is small, it is not negligible (Smith 1992, Brocklebank 1998). Good practice in the use of ionizing radiation presupposes 1) justification –no practice shall be adopted unless its introduction produces a positive net benefit to the patient 2) optimization –all exposures shall be kept as low as reasonably achievable; known as ALARA or ALARP, where P stands for practicable 3) dose limitation –the dose to individuals shall not exceed the limits recommended by the International Commission on Radiological Protection (Smith, 1987; Brocklebank, 1998). Good practice is achievable by appropriate selection criteria for patients and equipment, by dose-limitation methods, by derivation of maximum diagnostic yield from each radiograph, and by quality assurance of radiographic techniques and film processing (Smith 1987, Horner 1994).

Recommendations have been presented on the selection criteria for patients for dental radiography ([American] Council on Dental Materials, Instruments, and Equipment 1988, Pitts and Kidd 1992). Though the importance of the professional judgment of a dentist is emphasized in these recommendations, they have been criticized for leading mainly to routine screening (Smith 1992, Rushton and Horner 1996). In view of clinical responsibility, the Finnish Radiation Act (1998) emphasizes professional judgment and justification for the use of radiological examinations in medicine. The Finnish Centre for Radiation and Nuclear Safety (1991) has given for medical
radiological settings, instructions and guidance, and also provided detailed instructions for monitoring the reliability of radiological equipment and processing conditions, in order to ensure the technical quality of medical radiography.

The diagnostic yield of each radiograph depends on several elements. First is the dentist’s ability to judge the situation: whether or not there is an indication for radiographic examination and whether it is reasonable to expect a radiograph to provide additional information beside history-taking and clinical examination, and subsequent selection of the most appropriate type of radiograph (Douglas et al. 1986, Brocklebank 1998). Second is the dentist’s skills in observing and interpreting deviations from normal in the image. There is evidence that different dentists interpret radiographs differently (Reit and Hollender 1983, Lambrianidis 1985, Petrikowski et al. 1998), and that this subjectivity in interpretations may be greater source of variation in diagnostic accuracy than are the technical aspects of a radiograph (Okano et al. 1985, Molander et al. 1992). Third, the diagnostic quality of a radiograph is pertinent to its diagnostic yield.

Langland and Langlais (1997) have summarized the features for maximum diagnostic yield as viewed on a film: the image will not be too light or too dark overall (density), the five basic tissues (enamel, dentine, pulp, alveolar bone, and soft tissue) are visible (contrast), the apical periodontal membrane space, lamina dura, and individual trabeculae are visible (detail, sharpness), the buccal cusp tips are superimposed (distortion, anatomical accuracy), all needed structures for an accurate diagnosis are visible (coverage). These features, as well as the rating scale for dentists’ subjective quality assessment of radiographs recommended by the British National Radiological Protection Board (1994), address diagnostic utility – the scale running from unacceptable via diagnostically acceptable to excellent. A diagnostically acceptable radiograph may have some technical errors that do not detract from diagnostic use.

Previous studies have recognized noteworthy quantities of dental radiographs as being of marginal or non-diagnostic quality (Beideman et al. 1976, Bailit et al. 1979, Gröndahl et al. 1980, Schiff et al. 1986, Brezden 1987, Eliasson et al. 1990, Åkesson et al. 1992, Svensson et al. 1994, Szymkowiak et al. 1995). Causes of film faults may be mainly two: equipment, and operator’s exposure and film-processing techniques, however, no level of improvement in radiographic equipment can compensate for poor operator techniques (Whaites and Brown 1998).
Aims of the study

The general aim of the present study was to assess the quality of oral health care and the variety in dentists’ treatment selection and treatment practices in public oral health care.

More specifically, the aims were:

• to design a quality assessment model for oral health care
• to design practical tools for assessment of treatment practices
• to apply the model and the tools in a real-life environment
• to describe –by using these tools– quality variation concerning oral health record-keeping, risk-factor assessment, preventive treatment, root canal treatment, and radiological practices
Design of the quality assessment model

Drawing on the works of Starfield (1973), Grembowski et al. (1988), Bader and Shugars (1992), and Kay and Nuttall (1995b), a conceptualization including elements from models both for assessment of quality of care and for investigation of factors associated with dentists’ treatment decisions forms the basis for the present study (Figure 5).

For this study, environmental factors such as administrative guidance and financial incentives are assumed to be similar for each dentist in a setting providing oral health care. Further, in this model (Figure 5) "dentist education" denotes both basic and continuing education, while patient’s "clinical status" denotes general and oral health. For treatment selection, not-to-intervene is regarded as one treatment option, parallel to intervention; both have their consequences and value attachments. It is also to be noticed that assessment as well as treatment selection and each intervention are processes in themselves, which are characterized by subsequent choices to be made. The quality of any of these processes at any one moment in time can be captured by cross-sectional data on patient, provider, and the care provided.

In order to apply this model of the oral health care process at the individual-patient level, the cyclic nature of oral health care must be taken into account. (For the traditional patient care loop see Jerge and Orlowski 1985 or Marshall 1995). In the present model, patient and risk factor assessment, treatment selection, intervention, and consequences of treatment form a cycle that feeds into the subsequent assessment as altered patient factors. Deviating from the traditional care loop, in this model, patient and risk factor assessment comprises the gathering of all relevant information, and a diagnosis is an inherent conclusion of assessment, just as a particular plan for optimal treatment is that of treatment selection. Likewise, immediate output is the conclusion of intervention; outcome in terms such as longevity and disease is to be evaluated in the future patient assessments. All these phases may be affected by the dentist, patient, and environmental factors, as presented in Figure 5.

![Figure 5. A model of the oral health care process in a quality of care perspective.](image-url)
Design of the quality assessment tools

Tools defining an individual score of quality points for each treatment case or for a radiograph were developed. The assessment criteria of the tools were derived from Finnish health legislation, authoritative instructions, practice guidelines, and from the relevant literature to conform to good dental practice.

Tool for assessing oral health record-keeping practices

Finnish health legislation (Primary Health Act, PHA, 1972) and instructions given by the National Board of Health (1985), and by the local authorities in the Public Oral Health Service of Vantaa (1991) require detailed recordings concerning each patient’s clinical examination and treatment; thus, a record-entry was acceptable if it was noted on a patient's oral health document. Indicators contributing to quality points awarded to each record-keeping case and criteria for their measurement are presented in Table 1.

Table 1. Indicators contributing to quality points for oral health record-keeping and criteria for their measurement. Maximum number of points per record-keeping case is nine.

<table>
<thead>
<tr>
<th>Cluster Indicator</th>
<th>Criteria</th>
<th>Contribution to points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient identification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Name recorded in all enclosed documents</td>
<td>0 – 2</td>
</tr>
<tr>
<td>Date of birth</td>
<td>Date of birth recorded in all enclosed documents</td>
<td></td>
</tr>
<tr>
<td>General health assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient health history</td>
<td>Up-to-date health history enclosed</td>
<td>0 – 1</td>
</tr>
<tr>
<td>Indices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I index</td>
<td>Number of incipient carious lesions recorded</td>
<td>0 – 4</td>
</tr>
<tr>
<td>DT index</td>
<td>Number of decayed teeth recorded</td>
<td></td>
</tr>
<tr>
<td>DMF index</td>
<td>Number of decayed-missing-filled teeth recorded</td>
<td></td>
</tr>
<tr>
<td>CPITN index</td>
<td>Community periodontal index for treatment need recorded</td>
<td></td>
</tr>
<tr>
<td>Treatment planning</td>
<td>Cost estimation for treatment enclosed or recorded</td>
<td>0 – 1</td>
</tr>
<tr>
<td>Cost estimation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity of care</td>
<td>Check-up interval recorded in a completed treatment course</td>
<td>0 – 1</td>
</tr>
<tr>
<td>Check-up interval</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criteria based on Finnish health legislation (PHA 1972) and instructions given by the National Board of Health (1985), and by the local authorities in the Public Oral Health Service of Vantaa (1991).
Tool for assessing risk assessment and preventive treatment practices
Criteria of the tool for assessing risk assessment and preventive treatment practices were based on instructions given by the National Board of Health (1985) and the local authorities in the Public Oral Health Service of Vantaa (1993). Indicators and criteria for quality points are presented in Table 2.

Tool for assessing root canal treatment practices
Because evaluations of the process of root canal treatment (RCT) are rare, the indicators and criteria for the tool assessing RCT practices were designed for the present study in accordance with the consensus report (1994) of the European Society of Endodontology. Table 3 shows the indicators and criteria for RCT practice quality points.

Tool for assessing radiological practices
A tool was developed to assess the clinical utility of radiographs. For this purpose, some quality indicators were selected from among features recognizable in the end result of dental radiography, including more than one aspect of the technical quality (Table 4). Assessment criteria for the technical quality of radiographs were based on the relevant literature (Beideman et al. 1976, Eliasson et al. 1990, Svenson et al. 1994, Szynkowiak et al. 1995, Langland and Langlais 1997), and each radiograph was rated according to a scale modified from that suggested by the British National Radiological Protection Board (1994). A diagnostically acceptable radiograph was allowed to have some technical errors not detracting from its diagnostic use.
Table 2. Indicators contributing to quality points for oral health risk assessment and preventive treatment and criteria for their measurement. Maximum number of points per treatment case is nine.

<table>
<thead>
<tr>
<th>Cluster Indicator</th>
<th>Criteria</th>
<th>Contribution to points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal assessment</td>
<td>Dietary habits assessed and recorded</td>
<td>0 – 4</td>
</tr>
<tr>
<td>Diet</td>
<td>Oral hygiene habits assessed and recorded</td>
<td></td>
</tr>
<tr>
<td>Oral hygiene</td>
<td>Use of fluoride assessed and recorded</td>
<td></td>
</tr>
<tr>
<td>Fluoride</td>
<td>Smoking habits assessed and recorded</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical examination</td>
<td>Result of examination for soft tissues recorded</td>
<td>0 – 2</td>
</tr>
<tr>
<td>Soft tissues</td>
<td>Result of examination for occlusion recorded</td>
<td></td>
</tr>
<tr>
<td>Occlusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiological assessment</td>
<td>If any incipient carious, decayed, or filled lesion(s) found on approximal surface, then BW radiographs taken within ±6 months from clinical examination; or if no lesions, then no BWs.</td>
<td>0 – 1</td>
</tr>
<tr>
<td>Bitewings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventive treatment</td>
<td>Active preventive treatment given at least once</td>
<td>0 – 2</td>
</tr>
<tr>
<td>Active</td>
<td>Passive preventive treatment given at least once</td>
<td></td>
</tr>
<tr>
<td>Passive</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criteria based on instructions given by the National Board of Health (1985) and the local authorities in the Public Oral Health Service of Vantaa (1993).

Table 3. Indicators contributing to quality points for the root canal treatment process and criteria for their measurement. Maximum number of points per treatment case is nine.

<table>
<thead>
<tr>
<th>Cluster Indicator</th>
<th>Criteria</th>
<th>Contribution to points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Clinical findings and/or patient complaint / symptoms recorded</td>
<td>0 – 4</td>
</tr>
<tr>
<td>Clinical examination</td>
<td>Preoperative radiograph taken</td>
<td></td>
</tr>
<tr>
<td>Preoperative radiograph</td>
<td>Postoperative radiograph taken</td>
<td></td>
</tr>
<tr>
<td>Postoperative radiograph</td>
<td>Follow-up within one year</td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root canal preparation</td>
<td>Working length determined and recorded</td>
<td>0 – 2</td>
</tr>
<tr>
<td>Working length</td>
<td>Master file size recorded</td>
<td></td>
</tr>
<tr>
<td>Instrument size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>Type of disinfectant recorded</td>
<td>0 – 3</td>
</tr>
<tr>
<td>Interappointment</td>
<td>Type of temporary restoration recorded</td>
<td></td>
</tr>
<tr>
<td>disinfection</td>
<td>Type of filling material recorded</td>
<td></td>
</tr>
<tr>
<td>Temporary restoration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root canal filling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criteria based on the consensus report of the European Society of Endodontology (1994).
Table 4. Indicators contributing to quality points for radiographs and criteria for their measurements. Maximum number of points per radiograph is nine.

<table>
<thead>
<tr>
<th>Indicator Measurement</th>
<th>Criteria</th>
<th>Contribution to points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration practice</td>
<td></td>
<td>0 – 4</td>
</tr>
<tr>
<td>Mounting / storage</td>
<td>PA/BW mounted, OP in envelope</td>
<td></td>
</tr>
<tr>
<td>Patient identification</td>
<td>Radiograph identified by patient name</td>
<td></td>
</tr>
<tr>
<td>Radiograph identification</td>
<td>Radiograph identified by date</td>
<td></td>
</tr>
<tr>
<td>Radiological evaluation</td>
<td>Radiological evaluation recorded</td>
<td></td>
</tr>
<tr>
<td>Density and contrast</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td></td>
<td>Image not too dark or light overall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enamel, dentine, pulp, alveolar bone and soft tissue distinguishable</td>
<td></td>
</tr>
<tr>
<td>Coverage (only PA/BW)</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td>Film positioning</td>
<td>PA showing the entire crown and root with 3 mm of surrounding alveolar bone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BW showing in the maxilla area from the mesial contact point of the first premolar to the mesial of the second molar, in the mandible from the distal of the first premolar to the mesial of the second molar, including the marginal bone line</td>
<td></td>
</tr>
<tr>
<td>Cone cut and collimation</td>
<td>The entire film exposed</td>
<td></td>
</tr>
<tr>
<td>Distortion</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td>Vertical beam angulation</td>
<td>Labial and lingual cementoenamel junctions of the anterior teeth superimposed, and buccal and lingual cusp tips superimposed in posterior teeth on PA/BW</td>
<td></td>
</tr>
<tr>
<td>Horizontal beam angulation</td>
<td>No approximal surfaces of crowns overlapping to the extent that the enamel of one tooth overlaps the dentine of an adjacent tooth on PA/BW</td>
<td></td>
</tr>
<tr>
<td>Film bending</td>
<td>No distortion or deliberate film bending</td>
<td></td>
</tr>
<tr>
<td>Patient positioning</td>
<td>No discrepancies between vertical and horizontal magnification on OP</td>
<td></td>
</tr>
<tr>
<td>Ghost images (only OP)</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td></td>
<td>No ghost images reducing the diagnostic quality of OP</td>
<td></td>
</tr>
<tr>
<td>Developing and handling</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td></td>
<td>Film free of signs of inadequate film processing procedure, such as stains from clips or solutions, and free of scratches and stripes</td>
<td></td>
</tr>
<tr>
<td>Artifacts</td>
<td></td>
<td>0 – 1</td>
</tr>
<tr>
<td></td>
<td>Film free of any artifacts such as creasing, the imposition of jewelry, or prostheses. Also misplacing the film back-to-front</td>
<td></td>
</tr>
</tbody>
</table>

PA = periapical radiograph, BW = bitewing radiograph, OP = panoramic radiograph.
Criteria based on Beideman et al. (1976), Eliasson et al. (1990), Svenson et al. (1994), Szymkowiak et al. (1995), and Langland and Langlais (1997).
Application of the model and tools

Setting

In Finland, oral health services are delivered either in the municipal health centers or in private dental settings. According to law, communities are responsible for providing oral health services for their inhabitants, the highest priority given to those under 19 years of age. Thus, eligibility for public services is based on a subject’s year of birth and each community’s resources for providing services. In the larger cities, public services are often available only for children and young adults, whereas rural communities may provide these services for their entire population, in total, 34% of the Finnish population receives public oral care (Widström et al. 1998). Practically all children under the age 19 use the free-of-charge services in municipal dental clinics. In 1997, 82% of those under 19 and 31% of the age group 19-41 had used public services. Of all the patients of municipal dental clinics, 56% were under 19 and 29% 19 to 41 (Widström and Erkinantti 1998). For adults born after 1955, the basic services are more subsidized in the municipal dental clinics than in private offices. The effect of subsidization on young adults’ choice of sector (public or private dental care) has, however, been marginal (Arinen and Sintonen 1990). In 1998, approximately 20% of the adults born after 1955 had been reimbursed from the national health insurance for private dental care (Social Insurance Institution 1999). Public services are widely accepted, and participation rates in all eligible patient groups are high.

Sampling and sources of data

Oral health documents

These cross-sectional data on actual clinical examinations and treatment courses carried out in the public dental clinics came both from original individual oral health documents requested from the clinics and ones photocopied according to a definite protocol. The oral health documents reviewed relate to the following study populations.

The basic population for young adults consisted of all patients born from 1966 to 1971 who were clinically examined in 1994 (n=3,248). A random computerized selection of 239 young adults produced 208 (87%) eligible oral health documents. The selection was stratified to give a similar number of cases treated by each dentist. All notes concerning the most recent clinical examination and the following treatment course performed between 1994 and 1996 were scrutinized.

Young adults receiving radiographs was a 120-subject sub-population of young adults,
comprising those who had had radiography between 1990 and 1997. The sample of 312 radiographs consisted of bitewing (n=178), periapical (n=88), and panoramic (n=46) radiographs.

The basic population for young adults receiving root canal treatment consisted of all patients born from 1966 to 1971 who received root canal treatment in 1994 (n=448). A random computerized selection stratified dentist-by-dentist produced 134 young adults whose oral health documents were requested. Of these documents, 125 (93%) included eligible information on 148 root-canal-treated teeth between 1994 and 1996.

The basic population for adolescents comprised all those born from 1981 to 1982 who were in the seventh grade in 1996 (age-cohort around 2,000). For sampling of these adolescents, every tenth oral health record in each clinic was drawn from the alphabetically ordered patient files after a randomly selected starting point. This resulted in 206 patient documents, 203 (98.5%) of these including eligible recordings on the most recent clinical examination and the following treatment course between 1994 and 1996.

Characteristics and oral health parameters of these study populations as recorded at the most recent clinical examination are shown in Table 5. No statistical difference existed in the oral health parameters between male and female subjects, except in young adults for CPITN, females having more healthy sextants (2.6 vs. 1.9; p=0.01), and in young adults receiving root canal treatment for DT, males having more decayed teeth (6.0 vs. 3.2; p=0.001).

<table>
<thead>
<tr>
<th>Patient population</th>
<th>Total</th>
<th>Male</th>
<th>Age at onset of treatment</th>
<th>DMFT</th>
<th>DT</th>
<th>Healthy sextants by CPITN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>(%)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Adolescents</td>
<td>203</td>
<td>56</td>
<td>13.1 (0.5)</td>
<td>2.0 (2.4)</td>
<td>0.7 (1.5)</td>
<td>3.6 (2.3)</td>
</tr>
<tr>
<td>Young adults</td>
<td>208</td>
<td>34</td>
<td>26.6 (2.0)</td>
<td>12.0 (5.2)</td>
<td>1.8 (2.5)</td>
<td>2.2 (2.1)</td>
</tr>
<tr>
<td>Young adults receiving radiographs</td>
<td>120</td>
<td>17</td>
<td>26.7 (2.1)</td>
<td>13.0 (5.1)</td>
<td>2.1 (2.6)</td>
<td>2.4 (2.2)</td>
</tr>
<tr>
<td>Young adults receiving RCT</td>
<td>125</td>
<td>51</td>
<td>27.4 (1.8)</td>
<td>15.5 (5.2)</td>
<td>5.0 (4.8)</td>
<td>1.5 (2.2)</td>
</tr>
</tbody>
</table>

**Employee files**

Data from the employee files of the Vantaa Oral Health Service provided information on the 56 dentists rendering care to the study populations. These data were coded to preserve anonymity but allowed for linking dentist factors to each treatment provided and to patient factors.

**Questionnaire**

In 1996, as a repetitive part of quality assurance activities, the dentists were presented with a questionnaire concerning the overall state of their practice in oral health care and services. This questionnaire, compiled by the setting’s quality team and completed anonymously during dentists’ working hours, asked a number of questions directly applicable to their treatment practices (Appendix 1).

The questionnaire responses represented dentists’ perceptions of their treatment practices. These data were aggregated, so linking data to individual dentists was impossible.
Data on dentists and patients

**Dentist factors**

Data on dentists as derived from the employee files covered dentist gender, the year and month of birth, and year of graduation. The dentist’s age (or duration of career) was defined separately at the time of each clinical examination or at initiation of each root canal treatment.

Of the 56 dentists rendering treatment for both adolescents and young adults, 13% were male, and performed 17% of the clinical examinations in each patient age-group. Dentists’ ages ranged from 30.3 to 62.3 years (mean 43.3; SD 7.3; median 40.7). Root canal treatments were given by 47 dentists, of whom 17% were male, performing 13% of the treatments. Mean age at the outset of RCT was 41.3 years (SD 7.0; median 39.0). The year of the dentists’ graduation ranged from 1958 to 1995.

**Patient factors**

Information on each patient’s oral health status as diagnosed at the most recent clinical examination was collected from the detailed notes made in individual oral health records. A patient’s past caries experience and current oral health status served to define the high- and low-risk groups (Blinkhorn and Geddes 1987, Bratthall and Ericsson 1994). Subjects were considered as being highly susceptible to oral health risk factors and belonging to the high-risk group, independently by each indicator, as presented in Table 6.

<table>
<thead>
<tr>
<th>Oral health indicator</th>
<th>High susceptibility</th>
<th>Low susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMFT</td>
<td>&gt;3 (^1), &gt;15 (^2)</td>
<td>0 (^1), &lt;7 (^2)</td>
</tr>
<tr>
<td>DT</td>
<td>&gt;2</td>
<td>0</td>
</tr>
<tr>
<td>Appr. C (^3)</td>
<td>&gt;3</td>
<td>0</td>
</tr>
<tr>
<td>No. of healthy sextants by CPITN</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

\(^1\) For adolescents
\(^2\) For young adults.
\(^3\) Approximal carious lesions comprising both enamel and dentine lesions.

**Assessment of treatment practices and quality of care**

All of the data concerning the selected practices were collected according to written, pretested protocols from the oral health documents. The model presented in Figure 5 was applied to study the associations between dentist- and patient characteristics and treatment selections.

The tools designed to define an individual score of quality points for each treatment case, or for a radiograph, were applied in the assessment of treatment practices. A mean of quality points by treatment type was calculated for each dentist. This was used to evaluate the associations between quality of treatment and dentist factors.

**Oral health record-keeping practices (I)**

All notes concerning the young adults' most recent clinical examination between 1994 and 1996 were scrutinized (see Table 1).

**Oral health risk-factor assessment practices (II)**

Recordings concerning a patient’s diet, oral hygiene habits, and use of fluoride, as well as on use of tobacco, saliva tests performed, and bitewing radiographs illustrated the selection of measures for assessing oral health risk factors (see Table 2). This was evaluated in relation to each young adult’s past susceptibility to those factors, with current oral health status as the risk indicator.
Preventive treatment practices (III)
Dentists’ choices as to mode of preventive treatment were evaluated in relation to age groups (adolescents and young adults) and to each patient’s oral health status. Preventive measures were defined as active or passive (Silversin and Kornacki 1984, Vehkalahti 1997). Active prevention included any kind of motivation or instructions concerning home self-care. Passive prevention was topical application of fluoride, either with or without a preceding tooth cleaning by dental professionals (see Table 2). The proportion of patients receiving prevention at least once during a treatment course illustrated coverage of preventive treatment, and number of preventive measures per patient during a treatment course the density of preventive measures.

Root canal treatment practices (IV)
For the indicators and criteria for assessment of RCT practices see Table 3.

The technical quality of root canal fillings was assessed on postoperative radiographs according to methods frequently described in the relevant literature (Strindberg 1956, Kerekes and Tronstad 1979, Marques et al. 1998).

For studying the inter-examiner reliability, the author of this thesis (SEH) assessed all of the postoperative radiographs, and an endodontist separately assessed, with the same written criteria, a 60% sub-sample. The inter-examiner reliability of assessments was considered to be agreement as to the technical quality of the root canal filling.

Radiological practices (V)
Criteria for each radiograph’s technical quality are presented in Table 4. Owing to the long period during which the radiographs had been taken, linking radiological practices to individual dentists was impossible.

In order to evaluate the intra- and inter-examiner reliability of the assessments of the technical quality of radiographs, SEH evaluated all of the films once, and after three months time had elapsed a randomly selected sub-sample (comprising 10% of the intraoral radiographs and 25% of the panoramic films) for a second time. This sub-sample was also viewed by a radiologist using the same written criteria. The intra- and inter-examiner reliability was considered as agreement about ratings of aspects of technical quality.

Statistical methods
Intra- and inter-examiner reliability was studied by kappa statistics, and by proportions of agreement; asymmetry in assessments was evaluated by McNemar’s test (Fleiss 1981). In the analyses, comparison of group means was done by Student’s t-test; significance of difference in frequencies between groups was tested by means of the chi-square test. A difference was considered statistically significant at the level of 5%. Associations between variables were demonstrated by the use of the Pearson correlation coefficient. A linear regression model was applied to analyze oral health record-keeping practice. Logistic regression models were separately fitted to evaluate factors related to oral health risk-factor assessment practice and to preventive treatment practice. Odds ratios and the corresponding 95% confidence intervals were calculated.
Findings of the application in a real-life environment

Oral health record-keeping practices (I)

In the majority of oral health documents, the administrative entries concerning a patient’s identification were recorded; name in 90%, as checked from all documents enclosed; social security number in 80%; occupation in 66%; and address in 99%.

Recording of treatment-related entries varied greatly. A questionnaire concerning each patient’s up-to-date health history was included in 26% of the oral health records, in 21% it had been filled in during some former treatment course, but 53% lacked such a questionnaire. Check-up interval was recorded in 21% of the completed treatments. No written cost estimation for treatment was available. Frequency of recording indices describing the oral health status ranged from 93% (CPITN) to zero (SI) (Figure 6).

Oral health risk-factor assessment and preventive treatment practices (II-III)

The young adults’ oral health risk-factors were scarcely ever assessed: oral hygiene habits had been recorded in 14%, use of fluoride in 8%, and diet in 7% of the cases. No salivary tests had been done, nor had patient’s use of tobacco been assessed. During the most recent clinical examination and the three years preceding it, 25% of the patients had been examined by bitewing radiographs (Figure 7).

In dentists’ preventive treatment practices for adolescents and young adults, passive prevention was more prominent than active, 77% of the patients receiving passive prevention at least once while only 24% received active.

Risk assessment and preventive treatment in relation to patient factors (II-III)

There was no difference in the dentists’ assessment practice by group for susceptibility to oral health risk factors as defined by oral health indicators. Patients with high susceptibility based on DT tended to have been more frequently examined by BW than those in the low susceptibility group, the difference being nearly statistically significant (p=0.059) (Table 7). Whether a patient belonged to the high- or low risk-group made no difference in coverage of active prevention. Difference in coverage of passive preventive measures by numbers of D teeth was obvious, but fewer patients in the high-risk group had received passive prevention than had those in the low-risk group (Table 7).
Table 7. Frequency of risk assessment (young adults, n=208) and coverage of preventive treatment (adolescents, n=203, and young adults, n=208) by susceptibility to oral health risks as defined by oral health indicators during the most recent treatment course.

<table>
<thead>
<tr>
<th>Susceptibility by oral health indicator</th>
<th>Risk assessment</th>
<th>Preventive treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥1 risk factors(^1)</td>
<td>≥1 radiological(^2)</td>
</tr>
<tr>
<td>By DMFT</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>High</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>Low</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>By DT</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>High</td>
<td>57</td>
<td>16</td>
</tr>
<tr>
<td>Low</td>
<td>84</td>
<td>17</td>
</tr>
<tr>
<td>By CPITN</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>High</td>
<td>66</td>
<td>9</td>
</tr>
<tr>
<td>Low</td>
<td>21</td>
<td>24</td>
</tr>
</tbody>
</table>

\(^1\)Risk factors: patient oral hygiene habits, use of fluoride, and diet.

\(^2\)Bitewing radiographs at the time of the most recent clinical examination and three previous years.

\(^3\)Active prevention: instructions on motivation for patient home self-care.

\(^4\)Passive prevention: topical application of fluoride.

Statistical evaluation between groups with high and low susceptibility to oral health risk factors by the chi square test: all non-significant, except **p=0.001.

More adolescents had received both active and passive prevention than had young adults, this difference being statistically significant for passive prevention (85% vs. 70%; p=0.002). Of the adolescents, 7% and of the young adults 25% had received no preventive treatment (p<0.001) (Figure 8).

There was no difference in density of preventive treatment, neither for active nor for passive measures, between the high- and low-risk groups based on any of the oral health risk indicators. Density of preventive actions was smaller for active than for passive measures (p<0.001) in both age groups. The mean number of active preventive measures per adolescent patient during a treatment course was 0.3 (SD 0.6) and of passive 1.0 (SD 0.5). For young adults, density of active measures was 0.2 (SD 0.5) and of passive 0.8 (SD 0.6) per patient.

Figure 8. Coverage of preventive treatment given at least once during the most recent treatment course.
**Root canal treatment practices (IV)**

In 40% of the RCTs, at least one of each patient’s complaints, symptoms, or clinical findings had been recorded, while 28% of the treatments had been started without any indication recorded and in the absence of any preoperative radiograph. Figure 9 shows the proportions of RCTs in which the RCT process-related recordings were to be found, by individual scrutinized items. Follow-up had been recorded as having been done within 15 months from the termination of treatment for 8% of the completed RCTs.

The overall kappa statistics for the inter-examiner reliability of assessment of root-canal-filling quality was 0.63; the proportional agreement was 87%. McNemar’s test indicated no asymmetry in these ratings (McNemar’s chi-square 0). Of the postoperative radiographs, 75% allowed for assessment of the technical quality of root canal fillings. On these radiographs, 52% of root canal obturations were optimal: filling length within 0-3 mm from the radiological apex, no voids, and no lumen.

**Radiological practices (V)**

The majority of the radiographs had been identified by patient’s name and date of exposure; but on patient documents, for less than one in five radiographs (intraorals 17%, OPs 11%) had a radiological evaluation been recorded.

For the ratings of radiograph quality, the overall kappa statistics for intra-examiner reliability was 0.63, the proportional agreement being 83%. For inter-examiner reliability the values were 0.42 and 71%, respectively. McNemar’s test showed no asymmetry in the intra- and inter-examiner ratings (chi-square 0 and 1.94, respectively).

Nearly all radiographs were rated at least as diagnostically acceptable (Figure 10). Most of the unacceptable ratings were given for PAs (film positioning 23%, density and contrast 8%, and developing and handling 5%). There was no statistically significant difference between quality ratings for year of radiograph exposure for any of the aspects of technical quality.
**Quality points for treatment practices (I-V)**

Dentists’ practices in oral health record-keeping, risk assessment and preventive treatment, and in root canal treatments and the clinical utility of radiographs were assessed in the young adult populations of the study by the tools defining an individual score of quality points for each treatment case or for a radiograph. Some radiographs (13%) scored the maximum of nine quality points, but none of the treatment cases scored the maximum for record-keeping, risk assessment and preventive treatment, nor for root canal treatments. One case scored zero for record-keeping, and 13% of the treatment cases got zero points for risk assessment and preventive treatment (Figure 11).

---

**Dentist factors and quality of treatment (I-IV)**

When scrutinized at the level of single treatment cases, differences in practice patterns were detectable between dentists. In the oral health documents, the youngest quartile of dentists had noted down more information than had the oldest, as had female dentists compared to male. Though younger dentists tended to perform and record oral health risk-factor assessments more often than older ones, in each age group there were dentists who had not assessed them, and altogether, fewer than half (44%) of the dentists had chosen to perform any kind of risk assessment measures. Active preventive treatment had been more frequently chosen by male dentists (for 35% of the adolescents and young adults) than by females (for 22%) (p<0.02), and passive prevention had been applied more frequently by females (82% vs. 52%) (p<0.001). Male dentists tended to give more active prevention per patient than did females, but only for female dentists did the mean number of preventive measures (active and passive combined) performed per treatment course exceed one in all patient age- and risk groups.
When aggregated to mean quality points by treatment type per dentist, there was no correlation between oral health record-keeping practices and dentist’s year of graduation and gender. Mean quality points for risk assessment and preventive treatment correlated slightly with graduation year ($r=0.22$) and with dentist gender ($r=0.29$), treatments given by females scoring more points. Dentist’s year of graduation ($r=0.49$), but not gender, correlated with mean quality points for root canal treatments (Figure 12).

No correlation appeared between any type of treatment by mean quality points per dentist (Figure 13).

![Figure 12. Mean quality points per dentist by treatment types in relation to year of graduation. Each circle represents one dentist.](image)

**Dentists' perception of their treatment practices versus evidence in oral health documents**

Dentists’ perceptions of the treatment they rendered were assessed through the medium of a questionnaire. Based on the responses, 77% of the dentists claimed to follow the prevailing instructions on oral health record-keeping in their daily practice (82% if the responses indicating at least partial compliance are included). Preventive treatment was claimed to have been planned according to diagnosis by 78% (by 85% at least in part) of the dentists. Most dentists (88% categorically yes, 95% at least partly) perceived their knowledge gained through education as being applied in practice; no one answered no. The proportions of responses on questions that referred to treatment practices assessable also in the oral health records are shown in Figure 14, together with the corresponding findings in patient documents. Discrepancies were found in all instances; generally, dentists’ perception of the quality of their treatment practices exceeded that found in patient documents. Taking a postoperative radiograph in root canal treatments was an exception; more radiographs were found than dentists were sure they took.
Oral health record-keeping

**Figure 13.** Relation of mean quality points per dentist by treatment type. Each circle represents one dentist.

Patient health history

Radiological evaluation recorded

Postoperative radiograph in RCT

Working length and master file size recorded

Preoperative radiograph in RCT

Cost estimation

Saliva tests

Risk assessment for each patient

Active prevention if bleeding on probing

Proportion of dentists claiming to apply this item in practice

Proportion of dentists claiming to apply at least partly this item in practice

**Figure 14.** Treatment practices as perceived by dentists vs. those as assessed in oral health documents.
Discussion

The model

The model that was designed to conceptualize the process of oral health care in a quality of care perspective combines essential elements from acknowledged models for quality assessment (Donabedian 1966, Starfield 1973) and treatment decision-making (Bader and Shugars 1992, Kay and Nuttall 1995b), including the cyclic nature of oral health care (see Jerge and Orlowski 1985, Marshall 1995). Due to the cyclic, repetitive nature of oral health check-ups, assessment of the consequences of treatment previously provided, and assessment of patient and oral health risk factors and treatment selection are coincident, followed by possible interventions, which in turn feed into the subsequent outcome. Each patient’s oral health record is the intermediator between the steps of the care cycle, especially in bridging the time elapsed between the previous intervention and the next assessment. In the present study, the consequences of treatment previously provided, as defined by each patient’s oral health status, served as the starting point for the process assessed.

Cross sectional data capture the quality of processes and the factors affecting them at a moment in time exactly as they are. The patient and dentist factors were chosen among those known to play a role in treatment selection and also feasible to verify in the data sources of the present study. Owing to uniform administrative guidance, financial incentives, availability of information, and equal distribution of resources and equipment in the Vantaa Oral Health Service, the structure aspect of care, or environmental factors can be presumed to be similar throughout the setting.

The tools

It is feasible to believe that dentists do not record all the treatments provided, but variation in recording practices based merely on patients’ oral health is harder to imagine. Despite under-recording, the overall tendencies and directions in treatment provided remain visible in the patient documents. The lack of correlation between the quality of record-keeping practices and other types of practice, as defined by the tools designed in this study, increases the validity of both tools and data, and allows one to presume that the tools do measure the treatment practices, not only record-keeping practices. The breadth and the normal or near-normal shapes of distributions of quality points (Figure 11) confirm the capability of the tools to distinguish between different treatment practices within a particular treatment type (Morris et al. 1988).

For phenomena that tend to follow a normal distribution, the value of the random variable is the cumulative result of a large number of individually small random variables. Log normal distribution approximates distributions of a number of positive random variables that usually have values clustered around the mean, but may also have very high (low) values, the random variable being the product of a large number of individual random variables. The shapes of these kinds of distributions approximate those that have been generally observed for processes (Daellenbach et al. 1983). Inversely, based on the shapes of the quality-point distributions (Figure 11), the tools may be considered to measure performance of processes. One explanation for the skewed shape of the radiograph quality-point distribution is the possible discarding of unsuccessful films despite instructions to archive them in a similar manner as for those which were successful. The shape of the distribution of quality points for risk assessment and preventive treatment which truly indicates low quality may be explained by previous findings; the quality of preventive treatment processes in the Finnish public oral health service, though not that of outcomes, has been reported to be dubious (Kärkkäinen 1997, Varsio 1999).
Assessment criteria

Assessment of quality of care is performed by comparing treatment provided to explicit criteria derived from sources that conform to scientific evidence and facilitate good treatment practice. The tools designed for this study compared the everyday practice to criteria that define adequate care as delineated in authoritative instructions, consensus guidelines, and relevant literature. Concerning the relation of quality assessment and selection of criteria, Donabedian (1988) has noted: “Even if the actual consequences of care in any given instance prove to be disastrous, quality must be judged as good if care, at the time it was given, conformed to the practice that could have been expected to achieve the best results.” The information used for the criteria in the present study has been readily available for dentists from several sources and in a timely manner.

Sources of data

As a prerequisite for quality-assessment systems, the cost of evaluation must be reasonable in terms of time and money, and the basic dentist-patient relationship must remain intact (Bailit 1974). Of the several viable methods for evaluating the process of oral health care, reviewing the patient records does not disturb patient treatment procedures. Reviewing oral health records is also less threatening to the dentist than is straight observation of treatment or direct examination of his or her patients. Owing to the precise instructions for dentists in the public oral health service on documentation of findings and the treatment provided, the structured oral health records serve as a salient source of quality assessment data (Jerge and Orlowski 1985). Results reflecting actual treatment practices under real-life conditions facilitate the groundwork for quality improvement activities.

Generally, questionnaires are of best use when small amounts of fairly well-structured information concerning individual attitudes and opinions are to be obtained; they are less useful in obtaining factual information about behaviors, especially in the presence of expectations of what ideally should be done (Shortell and Richardson 1978, Lydeard 1991). Thus, the questionnaire responses in the present study may present more closely dentists’ perceptions of ideal/optimal practice than they reflect their actual everyday practice. Treatment decisions reported on questionnaires have turned out to differ from those made in actual practice (Kay et al. 1992, Kay and Nuttall 1994). Treatment rendered is a reflection of treatment decisions which is likely to be more truthful than any response on a questionnaire. Patient documents depict the treatment performed, the recorded oral health status of each patient illustrating the situation in which a dentist made that particular treatment selection.

Sample as a representation of actual practice

As in all retrospective studies, the reliability and validity of data in the present study largely depend on the completeness of the documentation at the time when dentists unaware of this study performed the actual treatment procedures. But then again, this retrospection contributes to the sample’s accurate representation of actual everyday practice. These data were collected from the original oral health records of randomly selected samples, and the recordings had been made during actual treatment courses. Furthermore, the samples were confined to narrow age-groups, homogeneous in respect to the type of oral health problems but large enough to offer variation in severity of problems within each group. Young adults were selected to represent those who were entitled to public oral health services but were no longer receiving these free of charge nor being regularly invited to check-ups. Adolescents represent those whose care was very organized, as well as being a group evaluated in other studies and settings (Kärkkäinen 1997, Varsio 1999), thus contributing to data-compatibility. Because the dentists had been treating these patients as part of their daily routine, the data therefore can be considered representative of real-life treatment practices.
Public reporting of results

These data were collected to assess current treatment practices concerning certain selected topics as part of a larger quality assurance project in the Public Oral Health Service in Vantaa. Oral health record-keeping, risk assessment, and preventive treatment practices were selected to be assessed because they concern all patients in comprehensive care. It can also be said that when risk assessment and the following preventive treatment are successful, the best possible quality oral health care is provided. As with all the topics assessed, root canal treatment and radiography both have a definite process that repeats itself for all patients treated and yet includes enough choices for a dentist to make to allow for assessment of treatment practices.

Allowing publication of findings from one oral health care setting requires an openness that is to the credit of that public service. Such findings, however, also can be interpreted in superficial and misleading ways if the character of the data as one contribution to quality improvement, not as some absolute measurement of quality of care, is misunderstood (Chassin et al. 1996). In Finland, communities are responsible for providing oral health services for their inhabitants. Eligibility for public services is based on a subject’s year of birth, independent of that subject’s socio-economic status. Public services are widely accepted, and participation rates in all eligible patient groups are high. To the author’s knowledge, there is no reason to assume the quality of oral care in Vantaa differs greatly from that in other public settings. For example, measured as the mean number of DMF teeth of 18- and 30-year-olds in 1997, Vantaa with 5.0 and 14.7 was slightly above the respective figures, 4.3 and 11.9, for Helsinki. The mean number of D teeth of 30-years-olds in Vantaa was 1.4, while in Helsinki it was 1.3 (Helsinki City Health Department 1998, Vantaa Health and Social Welfare Department 1998). In addition, dentists’ mean age was comparable to that (44 years) in public oral health care settings throughout Finland (Finnish Dental Association 1999).

Treatment practices and quality of care

Good quality of care requires the appropriateness of services provided. Appropriateness includes the decision about care for each patient (quality of decision-making) and the skills to execute this care for each patient (quality of performance) (Blumenthal 1996).

Although comparison between quality assessment studies may be fallacious because of varying criteria and subjectivity in evaluation, tendencies can, however, still be observed. The quality of care as assessed in the present study seems to be rather similar to that found in other countries. The level of dentists’ observance of instructions on oral health record-keeping in general and the quality of record-keeping are comparable to those in Norway and Sweden (Solheim et al. 1989, Rasmussen et al. 1994, Borrman et al. 1995). A Swedish study (Källestål and Holm 1994) reported the preventive treatment as not being individualized and appropriately targeted. Still, both Sweden and Finland are at the top in world-wide statistics concerning decreasing numbers of DMF-teeth in 12-year-olds (WHO 1999). The proportion of optimal root canal fillings made by dentists in the present study favorably relates to the range found in cross-population studies elsewhere (Friedman 1998). If the radiographs assessed in the present study were rated on a binomial scale, rejecting technically erroneous but still diagnostically useful films, the proportions of radiographs of unacceptable quality would had been close to those reported in previous studies (Svenson et al. 1994, Szymkowiak et al. 1995).

Findings of quality assessments may deviate relative to the focus of assessment; a focus on care delivered by any one individual provider produces different findings from a focus on the totality of care received by patients (Scholle et al. 1996). Data obtained from patient records give no indication about what happened outside of the particular care-providing setting (Donabedian 1988), nor is an indication of patient preferences that are likely to affect treatment selection to be found in patient records (Kay and Nuttall 1995c).
example, young adults in the present study might have refused salivary tests, application of fluoride, or radiographs. The patient perspective is essential to defining what is the optimal level of care or health for a particular individual (Crall 1989). Findings of the present study do not allow evaluation of the quality of the totality of care from the patient’s perspective.

One way to define good quality oral health care might be that both preventive and operative treatment are adapted to the needs of the patient (Källestål and Holm 1994). This adaptation requires comprehensive patient assessment in order to identify such needs. As early identification and elimination of risk factors are critical to the prevention and prognosis of most oral diseases (Silverman and Gorsky 1990, Horowitz 1996, Page and Beck 1997), the paucity of recordings on risk factors and the status of soft tissues, and the total absence of tobacco assessments in the present study would not indicate optimal patient assessment practices. A similar lack of diagnostic procedures was seen in root canal treatments initiated without any indication recorded, and seen in the majority of radiographs, in which radiological evaluations remained unrecorded. Dentists seem to consider patients in terms of treatment options instead of concentrating on accomplishing a full diagnosis for each patient (Bader and Shugars 1995). Assessment of the current status of each patient, and the factors contributing to it, and careful treatment planning a few years ahead, combined with sufficient documentation, would facilitate meeting patient’s needs.

Whilst routine tasks can be delegated to auxiliaries, the dentist’s role should be as the major diagnostician and treatment planner (Kress 1980, Moskona et al. 1999). Some variation in treatment selections is evident and expected, owing to differences in patients and factors related to them (James 1993, Kay and Nuttall 1995b). There are no right or wrong treatment selections in absolute terms, but there is a need for decisions to be transparent so that arguments and considerations are explicit and are communicated to the patient. This should contribute to the provision of optimal care (Kay and Blinkhorn 1996).

**Dentist and patient factors in treatment selection**

The treatment decision-making process is complex and embraces many more facets than merely the detection of pathology of a certain degree (Mileman et al. 1992, Fyffe and Nuttall 1995a, 1995b). In the present study, although the majority of dentists claimed to plan preventive treatment according to diagnosis, dentists scarcely modified their preventive treatment selection to match each patient’s oral health. As assessed in the patient records, either the risk assessment and diagnosis were not done or the preventive treatment was not given in accordance with the patient’s susceptibility to oral health risk factors. When selecting restorative and preventive treatment for a patient, most dentists claim that factors like patient age, caries rate, periodontal status, and medical history are dominant (Grembowski et al. 1988). However, when assessed in patient records as in the present study, a patient’s oral health status is often an insignificant factor in provision of preventive treatment (Vehkalahti et al. 1992, Källestål and Holm 1994, Kärkkäinen 1997, Varsio 1999). The paucity of up-to-date health histories in the present study, as well, offers evidence that a patient’s general health is not a major factor in treatment selection.

In a study of Dolan et al. (1992), varying a hypothetical patient’s age altered dentists’ treatment-planning decisions. Treatment recommended for older adults was more limited than that for younger ones, regardless of the fact that the case history and clinical diagnosis remained identical. Dentists in the present study gave more preventive treatment—which, however, was not targeted according to a patient’s oral health—to adolescent than to adult patients. This is probably a relic of the time when caries was commonplace in children and adolescents, and prevention of caries for this group was emphasized in order to allow the new generations to grow up with good oral health, rather than being the result of meticulous judgment on an individual’s need for preventive measures. The improved oral
health of children and adolescents should facilitate the preventive treatment of adults. However, according to Kärkkäinen (1997), preventive strategies locally agreed upon in the public oral health service concern children and adolescents, instructions on adults’ preventive treatment being rare. The finding of the present study, that one-fourth of the young adults is left without any preventive measures, demonstrates negligent practice in young adults’ preventive treatment.

In medicine, physician’s age has been associated with the quality of care delivered, younger physicians providing care of better quality. Also, physician gender has been associated with differences in quality and type of services provided, differences being noted especially in such areas of practice as preventive and psychiatric management (Tamblyn and Battista 1993). In Finland, female dentists report performing more both active and passive preventive measures, while males do more technical restorative procedures (Murtomaa et al. 1990, Kärkkäinen 1997). The methods used in this study are able to indicate slight differences in treatment practices between dentists according to age, year of graduation, or gender, but are not meant to specify any cultural or attitudinal explanation for such differences. Moreover, detecting such differences is rather of academic interest; pointing out individuals who perform less optimally than others is not in accordance with the philosophy of quality improvement that presumes individual providers as trying hard but being limited by inadequate processes (Berwick 1989, Batalden and Stoltz 1995).

Transfer of scientific knowledge

Dentistry considers the delivery of good quality care to patients as part of its code of ethics, and a central focus of dental care is the one-on-one interaction between the dentist and the patient (Burakoff and Demby 1985, Voelker 1988). Ideally, good quality care occurs when a dentist advises a patient on factors affecting oral health, available treatment options, and likely outcomes, so that the patient can make informed decisions. In order to provide to the patient treatment options to choose from, the dentist must make a synthesis from the patient’s current status, a vast amount of related factors, and patient preferences and scientific evidence that first should had been discovered and comprehended. This is an excessive task for the unaided human mind (James 1993).

Practice guidelines, legislation, and other authoritative instructions as well as continuing education represent means to enhance the transfer of scientific knowledge into everyday treatment practices to benefit individual patients. Generally, no evidence shows that legislation, authoritative instructions, or practice guidelines are always scientifically correct and contribute to optimal treatment (Crall 1989, James 1993, Varonen and Mäkelä 1997). Such lack of compliance with most types of instructions as found in the present study may result from absence of a professional consensus and of scientific evidence on outcomes. The existence of a guideline does not mean that all dentists know enough about it, agree with it, and are confident enough to follow it in practice. They may see instructions and guidelines as impractical or as a threat to their autonomy. Additional barriers to compliance are the belief that the practitioner cannot perform the actions set out by a guideline and the expectation of failing to achieve the desired outcome. These latter two barriers notably relate to guidelines that involve preventive health education and counseling (Cabana et al. 1999). It may be frustrating to a dentist to lecture about behavior favorable to oral health, while anticipating that this patient will appear at the next check-up with bleeding gums and a couple of new cavities, putting down a cigarette just at the doorway. Perhaps oral health promotion efforts need to be directed more toward practice-related factors rather than toward patient education (Gift 1991). Changing and improving the process of patient- and risk-factor assessment, and the subsequent treatment selection towards a more transparent and communicative interaction not only may make dentists better aware of each patient’s needs but also make patients aware of their own responsibility for maintaining their oral health.
Mere distribution of information and practice guidelines, educating people, and providing incentives to health-care providers produce only slight changes in actual treatment practices. Since the performance of individuals is only as good as processes allow it to be, the aim of organizational quality improvement should be to manage and improve processes, not to manage dentists (James 1993, Berwick, 1996). Dentists, as the experts on their own work, should take a decisive role in recognizing and solving problems and remedying whatsoever constrains them in their treatment processes, as well as in implementing organizational changes at their workplaces (Bejerot 1998, Berwick and Nolan 1998).

Successful quality improvement requires cooperation of all parties involved in the process of care, participation both in planning and implementing changes, and measurement of progress towards this aim (Berwick and Nolan 1998). The tools to measure progress in quality send an implicit message regarding many things that should happen in the dental practice (Morris et al. 1988). Therefore, those who participate in the provision of care should be the ones to create the measurement criteria. Practice guidelines are explicit descriptions of preferred clinical processes. Correspondingly, involvement in delineating local practice guidelines improves practitioners’ observance of them, which can be further enhanced by timely feedback in a constructive atmosphere (James 1993).

For most practitioners, financial benefits are secondary to provision of good care (James 1993, Kay and Blinkhorn 1996). The success of attempts to alter practitioners’ desire to provide optimal care by appealing to financial self-interest is doubtful (Eisenberg 1985), however, the remuneration systems should not work against provision of optimal care (McColl et al. 1999). Though more complicated to define and measure, additional fees in the public oral health service for appropriateness of care and treatment outcome instead of fees for items of service paid might be more motivating for dentists. For an organizational provider, provision of good quality care is not more expensive than that of lower quality (Starfield et al. 1994). Cost containment and quality improvement are intertwined; investment in quality improvement pays in elimination of services that do not add health benefits and in ensuring delivery of services that contribute to achievable health benefits.

Questionnaire responses more towards the prevailing instructions than towards actual treatment recorded (Figure 14) can be interpreted as dentists’ acceptance of the instructions, while dentists’ falling short of performing and recording treatment according to the optimal may be a reflection of other constraints than lack of knowledge and good intentions. It has been found that chief dental officers report more prevention as being provided than do their subordinate dentists (Kärkkäinen 1997). Moreover, when assessed in patient records, the amount of prevention provided was even smaller than the latter had reported. It is very human to perceive one's own work as conforming to that known to be desired. This belief tends to persist until some impact, say, feedback on the discrepancy between desired and actual practice, motivates the practitioner to seek alternative practices. Mere education and provision of information about desired treatment practices do not seem to transfer into everyday practice. Knowledge and skills gained must be helped to become everyday practice by changing the process of care.
Conclusions

The model of oral health care process in a quality of care perspective and the tools for assessing the quality of treatment practices were applicable in a real-life environment.

Based on the findings of the application of the model and tools and on the relevant literature, the quality of care involving oral health record-keeping, risk assessment and preventive treatment, root canal treatment, and radiological practices is similar to that found in comparable studies in other western countries.

As assessed from patient documents, each patient’s clinical status is not a dominant factor in treatment selection. This seems to be owing to a lack of comprehensive diagnostic procedures in everyday treatment practices.

Dentists’ perception of the treatment they provide differs from the image their patients’ oral health documents offer. Overall, dentists perceive the quality of oral health care to be better than that appearing in patient documentation.

Dentists seem to be confident that they apply in practice their knowledge gained through education and they follow the instructions given. However, the present study offers evidence that this knowledge and authoritative guidance are not fully transferred to benefit each individual patient.

Recommendations

Dentists should assume an active and decisive role in assessing the actual treatment practices at their workplaces. They should agree upon the treatment procedures desired, implement the needed changes, and follow up the impact that these changes make on the quality of care on a continuous basis. The model and tools designed in the present study may facilitate the assessment of actual practices and the follow-up of impacts of changes made in any one oral health care setting. Organizational support should enable this assessment, monitoring, and management of processes of care, allowing each participant in the process to achieve optimal performance. Numerous methods and techniques to manage and improve the processes are available; they only require the commitment of leaders and personnel.

Particularly, as a starting point, improving patient- and risk-factor assessment and diagnostic processes, notwithstanding type of treatment, would probably benefit the most patients.
Summary

Good quality of care requires appropriate treatment selection and the skills to execute care for each patient according to individual needs.

The aim of the present study was to design a model of the oral health care process in a quality of care perspective with tools for assessing dentists’ treatment selections and quality of practices. This conceptual model draws on established models both of quality assessment and of treatment decision studies. The tools were designed to assess the quality of real-life treatment practices concerning oral health record-keeping, risk assessment, preventive and root canal treatment, and radiography.

The model and tools were applied in a real-life environment in cooperation with the Public Oral Health Service in Vantaa, Finland. The cross-sectional data on actual clinical examinations and treatment courses came from original individual oral health documents. In the basic populations, consisting of all patients born from 1966 to 1971 who were clinically examined (n=3,248) or received root canal treatment (n=448) in 1994, a stratified random selection of 239 young adults produced 208 eligible oral health documents with recordings on clinical examination and treatment course between 1994 and 1996. In this patient population, radiographs (n=312) taken between 1990 and 1997 were also reviewed. Further, of young adults receiving root canal treatment, a similar selection produced 134 subjects, of whose oral health documents 125 included eligible information on 148 root-canal-treated teeth between 1994 and 1996. For sampling of the adolescents, in the basic population of those born from 1981 to 1982 (age-cohort around 2,000), in each dental clinic every tenth oral health record was drawn from the alphabetically ordered patient files after a randomly selected starting point. This resulted in 206 patient documents, 203 of which included eligible recordings. In total, 559 actual treatment courses were scrutinized. Data from the employee files of the Vantaa Oral Health Service provided information on the 56 dentists rendering care to the sample populations.

Dentists’ perceptions of their treatment practices were obtained through a questionnaire that they anonymously completed during their working hours.

The tools defining an individual score of quality points for each treatment case, or for a radiograph, employed assessment criteria derived from Finnish health legislation, authoritative instructions, practice guidelines, and from the relevant literature, to conform to good dental practice. Dentists’ treatment selections were evaluated in relation to patients’ oral health status and to dentist gender and year of graduation. Certain aspects of the treatment practices assessed in the oral health documents were compared to dentists’ perceptions of treatment provided.

As indicated by the quality points, treatment practices varied considerably. Independent of their year of graduation and gender, dentists fell short of following the prevailing instructions concerning record-keeping as well as preferable treatment practices. In the majority of treatment cases, patient risk-factor assessment was insufficient, fewer than half of the dentists performing any kind of risk-assessment measures. Preventive treatment was not individualized according to each patient’s oral health status, those in good oral health on average receiving more preventive measures than those in a risk group. In general, more adolescents received prevention than did young adults, one-fourth of the young adults, however, receiving no preventive measures. Lack of diagnostic procedures was evident also in radiography and root canal treatments, almost one-third of the root canal treatments being started without any indication recorded and in the absence of a preoperative radiograph. For less than one-fifth of the radiographs was a radiological evaluation recorded. Overall, dentists perceived the quality of treatment provided to be better than that appearing in the patient documentation.

With the shortcomings found in treatment practices in the present study, it was concluded, based on the relevant literature, that the quality of care was comparable to that found in similar assessments in other western countries. Because
it seems that legislation, authoritative instructions, and practice guidelines do not transfer into good quality for each patient's individualized treatment practices, it is recommended that dentists should take an active role in assessing their processes of care as well as in planning, implementing, and following up changes in their care processes. The model and tools designed in the present study may facilitate the assessment of actual practices and the follow-up of impacts of changes made in any one oral health care setting.

**Tiivistelmä**

Laadukkaassa suun terveydenhuollossa hoito- päätökset perustuvat potilaan terveydentilaan ja kokonaistilanteeseen sekä olemassa olevaan tietoon yleisesti hyväksytystä ja tehokkaista diagnoosi- ja hoitomenetelmistä.

Tutkimukseni tavoitteena oli luoda suun terveydenhuollon prosessia laadun näkökulmasta kuvaava malli ja kehittää helppo- käyttöisiä kriteeristöjä työkaluiksi hoitokäytäntöjen arvioimiseen. Malli luotiin yhdistämällä elementtejä laadun ja hoitopäätösten tutkimiseksi aiemmin esitetystä malleista. Mallin ja työkalujen avulla arvioitiin hammaslääkärien hoitovalintoja ja hoitokäytäntöjen laatua koskien potilaskirjanpitoa, potilaan sairastumisriskin arviointia, ehkäisevää hoitoa, juureenhoitoja ja röntgenkuvia.

tilaan suun terveydentilan mukaisesti. Tervesi-
set saivat keskimäärin enemmän ehkäisevää
hoitaa kuin huonosta suun terveydestä kärsivät
ikätoverinsa. Koululaiset saivat enemmän eh-
käisyä kuin nuoret aikuiset, jopa neljännes nuo-
rista aikuisista jää täysin ilman ehkäiseviä toi-
menpiteitä. Diagnostisen prosessin vajavaisuus
kävi ilmi myös arvioitaessa röntgenkuviin ja
juurenhoitoihin liittyviä käytäntöjä. Lähde kol-
mannes juureenhoitoista oli aloitettu ilman al-
kukuvaa ja kirjattua hoidon indikaatiota. Alle
viidennekselle röntgenkuvista oli kirjattu diag-
noosia tai minkäänlaista arviointia osoittava
merkintä. Kyselyn perusteella hammaslääkärien
käsitys heidän noudattamien hoitokäytäntöjen
laadusta on parempi kuin potilasasiakirjojen
perusteella arvioidut käytännöt osoittivat.

Vaikka tämän tutkimuksen mukaan hoito-
käytännöissä ei aina onnistuttu noudattamaan
suositeltavia käytäntöjä, osoittivat tulokset
hoitokäytäntöjen laadun olevan verrattain sa-
manlainen kuin muualla aiemmin tehdyissä
tutkimuksissa havaittu laatu sekä kotimaassa
ettiä kansainvälisesti. Vaikuttaa siltä, etteivät
viranomaishjeet ja hoitosuositukset yksin riitä
johdattamaan hyvälaatuisiin ja potilaan yksilöl-
lisen tarpeen mukaiseen annettuihin hoitoihin.
Tämän vuoksi hammaslääkärien tulisi perus-
teellisesti kartoittaa omat hoitokäytäntönsä,
suunnitella tarvittavat muutokset, toteuttaa ne ja
seurata muutosten vaikutusta hoitoproses-
seihinsa. Tutkimuksessa luodut malli ja
työkalut saattavat olla tässä hyödyllisiä.
References


Primary Health Act 66-67/72. Helsinki 1972


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Baden, Switzerland, March 2000

Sari Helminen
### Appendices

**Appendix 1a.** Questions concerning treatment practices in the questionnaire part of a quality assurance project in the Vantaa Public Oral Health Service.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>Sometimes</th>
<th>Partly</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A patient’s health history is considered in the treatment plan</td>
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<tr>
<td>Treatment choices and a cost estimation are included in the treatment plan</td>
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<tr>
<td>Instructions on oral health record-keeping are followed</td>
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<tr>
<td>Saliva tests are used to diagnose high-risk patients</td>
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<tr>
<td>Each patient’s risk-level and need for prevention is assessed</td>
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<tr>
<td>Preventive treatment is planned according to diagnosis</td>
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<tr>
<td>Home-care instructions are provided if bleeding on probing</td>
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<tr>
<td>Preoperative radiograph is taken in root canal treatments</td>
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<tr>
<td>Working length and file size are recorded on patient documents in RCTs</td>
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<tr>
<td>Postoperative radiograph is taken in root canal treatments</td>
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<tr>
<td>Radiological evaluation is recorded on patient documents</td>
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<tr>
<td>Knowledge gained through education is applied in practice</td>
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</tbody>
</table>
Appendix 1b. Hoitokäytäntöjä koskevia kysymyksiä laatukyselyssä, joka oli osa Vantaan Suun terveydenhuollon laadunvarmistus projektiä.

<table>
<thead>
<tr>
<th>Kysymys</th>
<th>Kyllä</th>
<th>Joskus</th>
<th>Osit-tain</th>
<th>Ei</th>
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</thead>
<tbody>
<tr>
<td>Anamneesi huomioidaan potilaan hoitosuunnitelmaa tehtäessä</td>
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<tr>
<td>Kustannusarvio/-vaihtoehdot huomioidaan potilaan hoitosuunnitelmassa</td>
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<tr>
<td>Potilaskortin täyttämisessä noudatetaan ohjeita</td>
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<tr>
<td>Tehdään sylkitestejä kariesriskipotilaiden löytämiseksi</td>
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<tr>
<td>Jokaisen potilaan kohdalla arvioidaan tehostetun ehkäisevän hoidon tarve</td>
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<tr>
<td>Ehkäisevä hoito-ohjelma tehdään diagnoosin perusteella</td>
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<tr>
<td>Potilaan huomio kiinnitetään jo yhteen vuotavaan ienpapillaan</td>
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<tr>
<td>Neulakuva otetaan juurihoidoissa</td>
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<tr>
<td>Avauspiituu ja avauslaajuus merkitään potilaskorttiin</td>
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<tr>
<td>Täytekuva otetaan juurihoidoissa</td>
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<tr>
<td>Röntgendiagnoosit kirjataan potilaskorttiin</td>
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<tr>
<td>Kouluutuksessa saatu tieto sovelletaan käytäntöön</td>
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