Scientific Article

Caries Risk-based Fluoride Supplementation for Children

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Abstract: *Purpose: The purpose of this study was to evaluate primary care physicians' recommendation of fluoride supplements based upon a child's caries risk. Methods: A representative sample of family physicians (FPs) and pediatricians (PDs) in the United States was mailed a letter and a questionnaire that described case scenarios of 2-year-old children—one with low and the other with high caries-risk—as well as questions about opinions on fluoride supplement use. The physicians' opinions were compared with CDC experts' consensus on the same scenarios. Results: The response rates were 43% for FPs and 52% for PDs. FPs and PDs had a high agreement level (76% and 80%, respectively) with CDC experts regarding the need for fluoride supplementation of the high-risk child. For a low risk child, all physicians showed a significantly lower level of agreement with the CDC experts (15% for FPs; 7% for PDs). Conclusions: The majority of primary care physicians follow the current fluoride supplementation guideline without considering the caries risk status of a child. If caries risk status is to be used to tailor preventive regimens, then physicians need to be educated on how to identify children with the highest need for prevention. (Pediatr Dent 2007;29:23-31)*

KEYWORDS: CARIES RISK, FLUORIDE SUPPLEMENTS, DECISION MAKING, PRIMARY CARE PROVIDERS, FAMILY PHYSICIAN, PEDIATRICIAN

The trend of decreasing prevalence of dental caries has been consistently observed in recent decades in many developed countries.[1] The major attributable factor for this trend is considered to be the widespread use of fluoride from various sources.[2] Along with the decrease in prevalence of dental caries, there is evidence that the prevalence of dental fluorosis—a hypomineralization of the dental enamel caused by ingestion of fluoride during tooth development[3]—has increased during the last 2 decades.[4,5] A recent nationwide survey found that the prevalence of dental fluorosis (very mild or greater enamel fluorosis) was observed in 32% of persons 6 to 19 years old—a 9% increase in the prevalence from that reported in the 1986-87 survey.[6] Most of the fluorosis observed in the United States, however, is very mild in severity.

Despite the trend of overall decline, epidemiological studies of dental caries indicate that it remains a burden among underserved populations, especially among children from families of low socioeconomic status. Severe early childhood caries is a frequent reason for hospitalization of infants and toddlers among underserved populations.[7-9]

Family physicians (FPs) and pediatricians (PDs) more frequently than dentists see children before the age of 3 for: (1) well-child care; (2) vaccinations; and (3) treatment of childhood infections.[10,11] Accordingly, primary care physicians (PCPs) can play a major role in promoting the oral health of young children by screening for early signs of dental caries and recommending preventive care to mothers and children.[12,13]

Fluoride supplements may be prescribed by physicians and dentists for children who do not have benefits from fluoridated water. Use of fluoride supplements, however, has been associated with fluorosis in nonfluoridated communities as well as in fluoridated-communities.[14,15] Numerous studies report inappropriate supplement prescription practices among physicians and dentists.[15,16] Failure to determine the fluoride content in the drinking water or taking into account other fluoride exposures of a child before prescribing fluoride supplements can result in an increased risk of fluorosis.[17,18]

The current recommendations for fluoride use from the Centers for Disease Control and Prevention (CDC) stress a judicious prescription of fluoride supplements to the children "who are at high risk of dental caries and whose primary drinking water has low fluoride levels."[19] The implementation of this recommendation requires the active participations of PCPs in screening for risk factors of dental caries and early signs of dental caries. A national survey of PDs indi-

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cates that, while they are willing to perform this task, they are not adequately trained or have limited knowledge about oral health conditions.[20] These findings indicate that there is a gap between the vision to involve **primary care providers** in promoting oral health and the current status of their training as well as knowledge level.

The purpose of this study was to investigate family physicians' and pediatricians' ability to recommend supplemental fluoride use based on the caries risk status of infants and toddlers.

Methods

Questionnaire. The questionnaire used in this study was developed with the assistance of dental and medical experts in focus group meetings. The questionnaire included 2 case scenarios describing the oral condition (with photographs) and the general health status of 2 12-month-old children.

Case A was described as a healthy 12-month-old girl seen regularly by the practitioner since birth. This child from a nonfluoridated area belonged to a high socioeconomic status family. She had both an unremarkable birth history and medical history. Her physical examination was normal and she had a healthy dentition with no signs of early childhood tooth decay.

Case B was described as a 12-month-old boy being seen by a physician for the first time. This child from an area with trace levels of fluoride in the drinking water had presented with his second episode of acute otitis media. The child was from a low socioeconomic status family with both parents unemployed. The child had prescription coverage from Medicaid, and the practitioner prescribed antibiotics for resolution of the acute condition. The child was seen at a follow-up visit 2 weeks later when the practitioner noticed cavities on his front teeth. This description was supplemented with a color photograph of the maxillary anterior teeth showing dental caries lesions.

For the purpose of this study, Case A was designated as a child at low risk for dental caries while Case B was denoted to be a child with high risk for dental caries. These designations, however, were not revealed to the respondents in the survey questionnaire. The respondents were asked to decide whether they would recommend fluoride supplements for each case scenario. The respondents were also asked to select appropriate recommendations for tooth-brushing and fluoridated toothpaste use for each case scenario.

In addition to the 2 aforementioned case scenarios, a series of questions evaluated dental screening and referral practices—including whether, as part of regular practice, the respondent:

1. regularly prescribes fluoride supplements to infants and toddlers, and if so, what factors are considered before prescribing fluoride supplements;
2. checked for dental caries on the teeth of toddlers;
3. assessed the potential for infants and toddlers to develop tooth decay.

The questionnaire also includes questions to assess the respondents' knowledge, opinion, and barriers on prescribing fluoride supplements. The questionnaire was pretested with 50 FPs and 50 PDs practicing in either Toledo, Ohio, or southeastern Michigan.

Sampling. Sampling for the survey was based on the American Medical Association (AMA) Physician Masterfile that included the following data on 77,624 FPs and 50,656 PDs: (1) names; (2) addresses; (3) telephone numbers; (4) specialty status; (5) gender; (6) year of birth; and (7) year of graduation. From the AMA Masterfile, 2 separate files—including 60,864 FPs and 50,653 PDs who currently practice—were created. From these files, 2 separate simple random samples of FPs (N=1,500) and PDs (N=1,000) were selected.

Mail survey. Each sampled provider received a: (1) personal letter; (2) questionnaire; and (3) self-addressed and stamped envelope. After the first mailing, 3 follow-up questionnaires and a postcard reminder were mailed to the nonresponders within a period of 3 months.

This project was reviewed and approved by the Health Sciences Institutional Review Board (IRB) of the University of Michigan, Ann Arbor, Mich.

Statistical analysis. Statistical analysis was conducted using SAS programs (SAS Institute, Cary, NC) for descriptive analysis. Internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient. Items for background consideration rated 0.80, barriers to fluoride supplementation rated 0.64, and practice behavior rated 0.65.

The CDC's Division of Oral Health provided responses to 7 questions that followed the case scenarios (recommendations for fluoride supplements, fluoridated toothpaste, risk of fluorosis, and recommendations for dental referral). The CDC experts' consensus on the questions represented the gold standard for analysis of knowledge and decision-making of the FPs and PDs.

Results

Response rate, sample size, and respondents' characteristics. Of the 1,500 envelopes mailed to FPs, 1,439 sampled FPs had valid addresses—of which 622 responded (response rate=43%). Of those:

a. 8 reported that they had retired;
b. 7 returned the questionnaire unanswered; and
c. 224 reported that they did not provide care for infant and toddlers

Of the 1,207 eligible FPs, 383 answered the questionnaire (response rate=32%).

Of the 1,000 envelopes mailed to PDs, 957 PDs had valid addresses, of which 493 responded (response rate=52%). Of those:

a. 9 retired; and
b. 61 reported that they did not see infants and children (surgical specialties or administrators).

Of the 887 eligible PDs, 423 answered the questionnaire (response rate=48%).

Demographic characteristics of respondents. Of the responding FPs and PDs, more than 90% were board certified, and about 65% worked in group practices. The mean age of the responding physicians was 49 and 47 years, respectively. Of the FPs, 74% were males compared to 51 % of the PDs. On average, all respondents had about 20 years of experience and worked more than 30 hours per week. Pediatricians reported that, on average, they see 57 infants and toddlers per week, whereas family physicians reported they see 14 per week.

A comparison between respondents and nonrespondents based on the information in the AMA Physician Master file found that a significantly higher percentage of respondents were females compared with nonrespondents. Among responding PDs, the mean age and mean number of years since graduation were slightly lower than among nonrespondents (data not tabulated). There were no differences in the response rates by practice type and median household income of the area (by zip code) where the sampled physicians practiced.

Risk-based fluoride recommendations

Recommendation for fluoride supplements. About 76% of the FPs and 80% the PDs agreed with the CDC experts' high caries-risk fluoride recommendations. Even when the CDC experts did not recommend fluoride supplementation for a child with low caries-risk, however, about 77% of FPs and 90% of PDs indicated they would still recommend fluoride supplements (Table 1).

Recommendation for tooth-brushing and fluoridated toothpaste use. Seventy percent of FPs and 51% of PDs answered that they would recommend brushing with a small amount of fluoridated toothpaste for the high caries-risk child, whereas approximately 59% of FPs and 46% of PDs recommended brushing with a fluoridated toothpaste for the low caries-risk child (Table 2). Approximately 6% of both FPs and PDs did not recommend any tooth-brushing for high caries-risk children, and more than 10% of both physician groups did not recommend any tooth-brushing for low caries-risk children.

As a reference, the CDC experts recommended tooth-brushing with a small amount of fluoridated toothpaste for both high caries-risk and low caries-risk children in this case scenario.

Practice of prescription of fluoride supplements. The majority of the physicians (79% of FPs and 84% of PDs) answered that they sometimes or frequently prescribe fluoride supplements to their patients (Table 3).

There was variation in the factors physicians considered when determining the need for fluoride supplementation. Of those who prescribed fluoride supplements, 9 out of 10 physicians answered that they usually or always consider fluoride concentration in the drinking water supply of children. Less than half of both physician groups, however, always/usually checked whether the child used fluoridated toothpaste. When they decide whether fluoride supplements are needed, even fewer physicians considered factors such as:

1. dental caries experience of siblings or primary caregiver;

Table 1. FLUORIDE SUPPLEMENT RECOMMENDATION BASED ON RISK ASSESSMENT

		CDC Experts' Consensus	Family Physicians (N=383) %* (S.E)	Pediatricians (N=423) %* (S.E)
Child with *high* caries risk	Not recommend		15 (1.8)	12 (1.6)
	Recommend	~	76 (2.2)	80 (2.0)
	Not sure		10 (1.5)	8 (1.3)
Child with *low* caries risk	Not recommend	~	15 (1.8)	15 (1.8)
	Recommend		77 (2.2)	90 (1.5)
	Not sure		9 (1.4)	3 (0.9)

~ indicates the answer of the CDC experts.

* Percentages have been rounded to the nearest whole number.

Table 2. RECOMMENDATION OF TOOTHBRUSHING BASED ON RISK ASSESSMENT

		CDC Experts' Consensus	Family Physicians (N=383) %* (S.E)	Pediatricians (N=423) %* (S.E)
Child with *high* caries risk	Do not recommend brushing at this age (1 year)		6 (1.2)	6 (1.2)
	Recommend brushing without a toothpaste		18 (2.0)	29 (2.2)
	Recommend brushing with non-fluoridated toothpaste		7 (1.3)	14 (1.7)
	Recommend brushing with a small amount of fluoridated toothpaste	~	70 (2.3)	51 (2.4)
Child with *low* caries risk	Do not recommend brushing at this age		13 (1.7)	11 (1.5)
	Recommend brushing without a toothpaste		22 (2.1)	32 (2.3)
	Recommend brushing with non-fluoridated toothpaste		6 (1.2)	12 (1.6)
	Recommend brushing with a small amount of fluoridated toothpaste	~	59 (2.5)	46 (2.4)

~ indicates the answer of the CDC experts.

* Percentages have been rounded to the nearest whole number.

2. socioeconomic status; or
3. parental adherence (Table 4).

Barriers to proper prescription of fluoride supplements. When asked to rate the barriers to prescribing fluoride supplements, approximately 25% of both FPs and of PDs reported that they have significant problems with determining the fluoride concentration in the drinking water. Approximately 5% of PDs indicate that they have significant difficulty with their knowledge level on fluoride compared to 17% of FPs. When asked whether they were concerned about parents' adherence to a fluoride supplement schedule, 22% of FPs and 17% of PDs reported that they foresee adherence as a significant barrier. Less than 10% of FPs or PDs reported that parents might have a concern about dental fluorosis. Lack of time was a significant barrier for some FPs (23%) and PDs (8%; Table 5).

Discussion

This survey provides new information on FPs' and PDs' recommendations of fluoride use and prescribing patterns of fluoride supplements for infants and toddlers. The authors' findings indicate that physicians tend to follow existing fluoride supplementation guidelines without considering a child's caries risk status. Thus, children with low caries risk may be unnecessarily exposed to the possibility of dental fluorosis from prescribed fluoride supplements.

The majority of FPs and PDs indicated they would recommend fluoride supplements to the children presented in the case scenarios, regardless of the child's caries risk status.

Interestingly, the recommendations for the use of fluoridated toothpaste were much lower than expected; only 75% of FPs and 60% of PDs in the present study answered that they would recommend the use

Table 3. FLUORIDE SUPPLEMENTS PRESCRIPTION AS PART OF REGULAR PRACTICE

	Family Physicians (N=383) %* (S.E)	Pediatricians (N=423) %* (S.E)
Never	22 (2.1)	16 (1.8)
Sometimes	41 (2.5)	41 (2.5)
Frequently	38 (2.5)	43 (2.5)

* Percentages have been rounded to the nearest whole number.

Table 4. RESPONSES OF PHYSICIANS WHO PRESCRIBE FLUORIDE SUPPLEMENTS TO QUESTIONS ON FACTORS THAT THEY CONSIDER BEFORE PRESCRIBING

		Family Physicians (N= 297) %* (S.E)	Pediatricians (N=341) %* (S.E)
Fluoride concentration of the main drinking water source	***Never/Rarely***	3 (1.0)	2 (0.8)
	Sometimes	4 (1.2)	2 (0.7)
	Usually/Always	92 (1.5)	96 (1.1)
Tooth brushing with fluoridated toothpaste	***Never/Rarely***	39 (2.8)	36 (2.5)
	Sometimes	19 (2.3)	18 (2.1)
	Usually/Always	45 (2.9)	45 (2.6)
Tooth decay history of siblings	***Never/Rarely***	39 (2.8)	42 (2.6)
	Sometimes	26 (2.5)	24 (2.3)
	Usually/Always	36 (2.8)	34 (2.5)
Tooth decay history of the mother or primary caregiver	***Never/Rarely***	53 (2.9)	58 (2.6)
	Sometimes	20 (2.3)	18 (2.1)
	Usually/Always	27 (2.6)	24 (2.3)
Socioeconomic status of the family	***Never/Rarely***	46 (2.9)	61 (2.6)
	Sometimes	19 (2.3)	15 (1.9)
	Usually/Always	36 (2.8)	24 (2.3)
Parental adherence with fluoride supplements' daily regimen	***Never/Rarely***	31 (2.7)	40 (2.6)
	Sometimes	25 (2.5)	28 (2.4)
	Usually/Always	44 (2.9)	33 (2.5)

* Percentages have been rounded to the nearest whole number.

of a fluoridated toothpaste for a high caries-risk child. Fewer FPs and PDs (60% and 50%) answered they would recommend the use of fluoridated toothpaste for a child at low risk of dental caries. The data suggest that FPs and PDs are well aware of the fluorosis risk from the high fluoride concentration of children's toothpaste (as described in the CDC recommendation) however, the risk of fluorosis resulting from fluoride supplements appears to be less known.

These findings may reflect the lack of knowledge among physicians about effective methods of caries prevention. Consistent with the authors' findings, Gift and Hoerman[13] reported that only a minority of physicians indicated that tooth-brushing with a fluoridated toothpaste is very effective in preventing caries. Since physicians are the main contact with parents of infants and toddlers before the first dental visit, it is vital that they become aware of the importance of preventive actions that could ultimately affect the child's oral health. The focus of the preventive strategy should be to:

1. promote tooth-brushing with fluoridated toothpastes or gels starting at the age of 12 months; and

Table 5. RESPONSES OF PHYSICIANS WHO PRESCRIBE FLUORIDE SUPPLEMENTS TO QUESTIONS ON FACTORS THAT THEY CONSIDER BEFORE PRESCRIBING

BARRIERS	LEVEL OF DIFFICULTY	FAMILY PHYSICIANS (N= 297) %* (S.E)	PEDIATRICIANS (N=341) %* (S.E)
YOUR OWN KNOWLEDGE OF FLUORIDE RECOMMENDATIONS	***Not at all to Minor***	83 (1.9)	95 (1.1)
	Significant	17 (1.9)	5 (1.1)
FINDING OUT THE FLUORIDE CONCENTRATION IN THE DRINKING WATER	***Not at all to Minor***	75 (2.2)	77 (2.1)
	Significant	25 (2.2)	23 (2.1)
COST OF TESTING FOR FLUORIDE CONCENTRATION IN THE DRINKING WATER	***Not at all to Minor***	66 (2.5)	69 (2.3)
	Significant	34 (2.5)	30 (2.3)
PARENTS' ADHERENCE TO FLUORIDE SUPPLEMENT SCHEDULE	***Not at all to Minor***	78 (2.1)	83 (1.8)
	Significant	22 (2.1)	17 (1.8)
PARENTS' CONCERN ABOUT DENTAL FLUOROSIS	***Not at all to Minor***	92 (1.4)	95 (1.1)
	Significant	8 (1.4)	6 (1.1)
COMPLEXITY OF FLUORIDE SUPPLEMENT SCHEDULE	***Not at all to Minor***	91 (1.5)	94 (1.1)
	Significant	9 (1.5)	6 (1.1)
COMPETING DEMANDS AND LACK OF TIME IN PRACTICE	***Not at all to Minor***	78 (2.2)	92 (1.3)
	Significant	23 (2.2)	8 (1.3)

* Percentages have been rounded to the nearest whole number.

2. refer to a network of dentists for detailed risk assessment and prescription of fluoride supplements.[19]

It is evident that more education on the benefits of prevention strategies should be directed toward physicians because of the importance of this healthy behavior on oral health throughout life.

The majority of FPs and PDs answered that they prescribed fluoride supplements; when they do, most physicians reported that they consider the fluoride concentration in the drinking water before recommending fluoride supplements. Supplementation decisions, however, are often made without an assessment of other sources of fluoride exposures and other caries risk factors. Similarly, Lewis et al[20] found that less than 75% of physicians assessed fluoride concentration in drinking water before recommending fluoride supplements. The Lewis study, however, did not investigate the physician's assessment of other fluoride exposures. It appears that increased education needs to be directed toward physicians concerning other potential fluoride exposures to ensure appropriate provision of fluoride supplements.

Clearly, information on the fluoridation status of a child's drinking water is important to allow for appropriate supplement prescribing. Major barriers for prescribing fluoride supplements included:

1. determining the fluoride level of drinking water, as indicated by 25% of physicians; and
2. the cost of fluoride analysis, as indicated by 33% of physicians.

The authors' results:

1. support previous investigations reporting that cost of fluoride assays may be problematic for prescribing physicians[21]; and
2. indicate the need for increased information on sources for determining the fluoride content of drinking water (eg, laboratory facilities, state and local health department contacts) for those who prescribe fluoride supplements.[17,18,22]

Approximately one third of respondents answered that they considered caries risk factors such as: (1) dental caries experience of siblings or primary caregivers; (2) socioeconomic status; or (3) parental adherence. Only 15% of FPs and 8% of PDs, however, agreed with the CDC experts' recommendation for fluoride supplementation for low caries-risk children from the case scenario. Therefore, it appears that—even when additional caries risk assessment information is considered by some physicians—the majority do not use the information when they determine the need for fluoride supplements for a child. This finding indicates that physicians follow the current American Academy of Pediatrics (AAP) guideline for fluoride supplement schedule, which specifies a child's age and water fluoride concentration with no consideration of caries risk assessment.[23] This may suggest the need to revise the current fluoride supplementation guideline,[24] which was endorsed by the AAP, the American Dental Association (ADA), and the American Academy of Pediatric Dentistry (AAPD) in 1994—to incorporate caries risk of a child.

The implementation of appropriate caries risk assessment for young children may require additional education for physicians to introduce information on risk assessment. Such an educational program may be difficult to implement, and an attempt to achieve a higher level of synthesis will require more time than what is currently available in average medical practices. A recent paper by Douglass and colleagues[22] investigated whether fluoride-prescribing patterns of physicians can be changed through oral health education within the "real world" challenges of pediatric and family medicine residency. The study showed that a physician's knowledge about fluoride supplements was increased at 1-year follow-up. Behavior changes regarding prescribing practices, however, were more difficult to achieve. It is well-known that changing physicians' practice behaviors is a very challenging task. Evidence shows that some educational methods, however, may have an impact on increasing adoption levels, such as: (1) small group discussion; (2) interactive workshop; (3) academic detailing; and (4) reminders.[25] Integration of these methods into traditional continuing medical education (CME) programs should be considered to achieve effective change in physicians' fluoride supplementation.

Time constraints faced by PCPs have been shown to reduce the delivery of preventive services in order to balance their patients' ongoing and immediate medical problems.[26] Despite this study's findings that lack of time posed no problem or only minor problems to the majority of physicians that prescribe fluoride supplement, a risk-based approach to prescribing fluoride supplements could add an additional time burden to their usual practice.

There are several limitations to this study that should be considered when the results are interpreted. The response rates after 4 mailings and 2 reminder cards were 43% for FPs and 52% for PDs. These response rates are slightly lower than those reported in similar surveys,[20,27,28] although low response rates are common in all health care provider surveys. While there is potential for a response bias, as with any surveys, however, the analysis of characteristics of respondents vs nonrespondents did not show significant differences (data available from the authors upon request).

Conclusions

Based on this study's results, the following conclusions can be made:

1. The results indicate that most primary care physicians prescribe fluoride supplements to young children.

They follow the existing fluoride supplementation dose guidelines, however, without considering the child's caries risk status.

2. The revison/development of a fluoride supplementation guideline to take a child's caries risk into better consideration is necessary.
3. If caries risk status is to be used to tailor preventive regimens, physicians need to be educated on how to identify children with the highest need for prevention.

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Abstract of the Scientific Literature

QLF Evaluation of Caries Lesions Post Orthodontic Treatment

Clinically characteristic decalcifications which precede cavitation are potential complications to orthodontic treatment. These white spots form more rapidly during orthodontic treatment than normally because of prolonged accumulation and retention of visually evident, voluminous, white colored soft plaque along the gingival margins. The purpose of this prospective study was to use quantitative light-induced fluorescence (QLF) to study the behavior of decalcifications that developed in patients during fixed orthodontic treatment, after the removal of those appliances. Data were collected from 58 consecutively recruited patients who were at least 12 years old and who had been treated with a fixed appliance for at least 1 year. Patients were examined with QLF for caries presence or absence and extent on the buccal surfaces of their teeth directly after debonding, 6 weeks, and 6 months. Fluorescence loss and area of lesions (mm^2) were determined for all lesions. A sample size of 421 carious lesions was recorded with an average fluorescence loss immediately after debonding (ΔF_0) of about 10%. Fifteen lesions were lost from QLF analysis due to restorative treatment and lack of image quality. Lesions varied from incipient ($\Delta F_0 < 10\%$, n = 257), to advanced ($\Delta F_0 > 25\%$, n = 12). A small lesion improvement was at week 6 after debonding ($P < .01$), and further lesion improvement was seen at month 6 ($P < .01$). Incipient lesions demonstrated smaller improvements (relative decrease, 2%) than lesions with $\Delta F_0 > 10\%$ (relative decrease, 12%). Authors concluded that the lesions that developed during orthodontic treatment improved once the fixed appliances were removed even when they were advanced.

Comments: *Decalcifications along the gingival margins of the dentition are considered clear signs of an active caries process even in the absence of frank cavitation. Removal of fixed appliances alone is not enough to induce adequate remineralization of lesions. Further, the caries process may be suspended via remineralization in advanced lesions. Active remineralization treatments are needed along with adequate prevention of caries during orthodontic treatment. RKY*

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van der Veen MH, Mattousch T, and Boersma JG. Longitudinal development of caries lesions after orthodontic treatment evaluated by quantitative light-induced fluorescence. Am J Orthod Dentofacial Orthop 2007;131:223-8.

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