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ORIGINAL ARTICLE

Factors associated with reduced compliance of children to dental preventive measures

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Abstract The aim of this study was to record self-reported factors for non-compliance to 'dental home' preventive measures among pediatric patients, and to clarify whether number or frequency of recall appointments increases their long-term compliance to dental home. Children attending recall appointments in a pediatric dental clinic were interviewed regarding their compliance as well as factors for non-compliance with the previously recommended preventive measures. Files of 651 children were analyzed. A significant positive correlation was found between compliance with regular teeth brushing twice a day ($p < 0.0001$), using correct fluoride concentration toothpaste ($p < 0.0001$), drinking water between meals ($p < 0.0001$), using Elmex gel ($p < 0.0001$), flossing ($p < 0.002$) and number of recall appointments. The most common factor for non-compliance to 'dental home' was 'I forgot'. Not flossing was commonly justified by performance difficulty while non-compliance to Elmex gel or to mouth rinses was attributed mainly to 'bad taste'. Additional common reasons were 'it was finished', 'my parents did not purchase', 'I did not find it at home', 'I did not know I need to'. Frequency and number of recall appointments might improve compliance with dental preventive measures. Referring to the specific factors of personal non-compliance may increase compliance.

Keywords Recall appointment · Tooth brushing · Mouth rinse · Floss · Diet · Caries

Introduction

An important component in the maintenance of good dental health together with reducing individual risk for caries and periodontal diseases is the meticulous practicing of several daily home preventive measures [1]. These include avoiding frequent consumption of carbohydrates (sugary drinks and food) between meals, tooth brushing twice a day with fluoridated dentifrices, and flossing [1]. For high caries-risk children, rinsing with fluoride mouthwash and/or brushing with a high concentration of fluoride gel once a week are also recommended [2]. These home preventive measures are defined as "dental home". The American Academy of Pediatric Dentistry supports the concept of a "dental home" for all infants, children, adolescents, and persons with special health care needs [1]. Establishment of individual "dental home" is initiated by the identification and interaction between patients, parents and their dental professionals. This means that a child's oral health care is delivered in a comprehensive, continuously accessible, coordinated and family-centered way by a dental practitioner in every recall appointment [1–4].

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In spite of the prime importance of these recommendations for daily home preventive measures, only few studies evaluated the compliance of pediatric and adolescent patients with conflicting results [5–10]. In a study conducted in Salford, North-West England, 58–78% of the children brushed their teeth twice a day with fluoridated toothpaste [8] compared to another study in which 37–60% of the children in the same area brushed their teeth twice a day [7]. Improvement in compliance to tooth brushing was found 1 year following dental treatment under intravenous sedation [9]. In contrast, oral health instructions in Danish adolescents did not improve their oral health habits after 1 year, although it did slightly increase their awareness to the importance of preventive dentistry [4]. The reported compliance to dental flossing was found to be even lower [6, 10–12].

Ashkenazi et al. [10] evaluated the rate of compliance to dental home measures by pediatric patients attending regular recall appointments in a specialized pediatric dentist clinic. The patients received oral and written basic instructions in conjunction with the recommendation for specific dental home measures. They found low compliance to daily flossing (5.6%), fluoride rinsing (11.9%), and using a high concentrated fluoride gel (12.6%). Caries experience was negatively correlated with regular consumption of meals, drinking water between meals, and frequency of brushing. The authors concluded that further studies to elucidate the reasons for the low compliance are needed. Thus, the aims of the present study were twofold: (1) To record the self-reported factors for non-compliance to 'dental home'. (2) To clarify whether number or frequency of follow-up appointments, in which preventive measures are discussed, increases the long-term compliance to dental home.

Methods

Children aged 2–18 years, who attended regular or irregular recall appointments at a specialized pediatric dentist's clinic from 2002 to 2008, participated in this prospective study. Only children, who attended at least one consecutive recall after completion of recommended treatment at the previous examination, were included. Patients with special medical needs were excluded from the study. During each recall appointment, participants and/or their parents received instructions regarding the various preventive measures the child needed to practice until the next periodic examination. Instructions for the recommended preventive measures were given by the same certified pediatric dentist (MA) according to a structured form. At the recall appointment, children and their parents were interviewed regarding the present status of the child's compliance with the previous recommended preventive measures. In cases of non-compliance to one or more of the preventive measures, the reason for non-compliance was recorded as well. Interviews were completed before the clinical examinations. Patients' compliance was defined only when the patient complied with the recommended preventive measures at the time of the recall. A structured form was designed to collect demographic data, such as patient's age and gender, compliance with the recommended preventive measures as well as reason for non-compliance. This form was filled out by the treating dentist and data from all forms were collected and analyzed. In addition, the total number of recall appointment as well as their frequency (average time in months between appointments) were recorded.

Preventive measures

Frequency of meals

Patients were instructed not to eat more than six meals a day. The patients and/or their parents were asked whether they usually ate more or less than six meals a day, not including drinking soft drinks.

Drinking between meals

Patients were instructed to drink only water or sugar-less non-carbonated drinks between meals, but allowed to drink sugary carbonated, non-carbonated or milk beverages during meals. Therefore, they were interviewed only about their drinking habits between meals. Patients were categorized into three groups: drinking only water or diet (carbonated or non-carbonated) beverages, drinking sugary non-carbonated beverages (alone or alternately with water) and drinking sugary carbonated beverages (alone or alternately with water).

Brushing twice a day

Children who had the ability to perform correct tooth brushing (usually older than 7 years) were instructed to brush their own teeth. Otherwise parents were instructed to brush their child's teeth. Tooth brushing was recommended to be performed twice a day morning and evening. Children or their parents were asked whether they brush their teeth in the morning and in the evening. If yes, how many days a week did they accomplish their tooth brushing.

Use of fluoridated toothpaste

Parents were instructed to adjust the fluoride-ion concentration in the toothpaste with the child's age according to the recommendation at that time [9]. For children up to

4 years, the recommended fluoride-ion concentration was limited to 500 ppm (parts per million; mg/l) F^-, for children aged 4–7 years, the recommended fluoride-ion concentration was 900–1100 ppm F^-, and over the age of 7 years, parents were instructed to use adult toothpaste (1200–1450 ppm F^-) for their children. Oral instructions were given to parents on how to verify the F^- concentration in toothpaste together with a written list of several toothpastes with their fluoride concentration. To increase compliance, children were given a taste of several merchandized fluoridated toothpastes, and to choose the one they preferred. Children were categorized into three groups: using correct, lower, or higher concentrations of F^- in their toothpaste.

Use of daily fluoride mouth rinse

Children over the age of 6 years, which were diagnosed as medium-to-high risk for caries development, were recommended to rinse their teeth daily with a fluoride mouth rinse. To increase compliance, again, children were given a taste of several merchandized fluoride rinses. Compliance of these children to perform the daily rinses was evaluated and recorded as days per week (zero to seven).

Use of high-concentrated fluoride gel

Children over the age of 8 years, who were diagnosed as medium-to-high risk for caries development, were recommended to brush their teeth once a week with high concentrated fluoride gel, Elmex gel (GABA Ltd, Switzerland), which contains 12500 ppm F^-. Compliance of these children to use Elmex gel was evaluated and recorded as number of weeks per month (0–4).

Flossing

Children over the age of 11 years, without orthodontic fixed appliances, were instructed to floss their teeth once a day. Their compliance was evaluated and recorded as days per week (zero to seven).

The Ethics Committee of Tel Aviv University approved the study.

Statistical analysis

Data were analyzed by SPSS 10.0 (SPSS, Inc., Chicago, IL, USA) using *T* test, Chi-square test, Non-parametric correlations (Spearman's rho coefficient), one-way ANOVA and two-way ANOVA, as appropriate. The level of significance was set at 5%.

Results

Study population

Files of 651 children (47% boys) who attended regular or irregular recall appointments in a private clinic of one certified pediatric dentist were analyzed. Mean age was 9.36 ± 4.38 years. Children attended 3.39 ± 2.53 (mean $\pm$ SD) recall visits on average (range 1–15) every 12.32 ± 5.98 (mean $\pm$ SD) months. Older children were found to visit the clinic more frequently ($p < 0.001$).

Preventive measures (Table 1)

Frequency of meals

Eating less than six times a day was reported by 77.9% of the children, while 22.1% reported eating more than six times a day (snacks between meals). No correlation was found between numbers or frequency of follow-up appointments and compliance to number of meals a day.

Drinks between meals

Drinking only water or diet beverages between meals was reported by 63% children, 29.2% reported drinking sugary non-carbonated drinks, 13.8% reported drinking sugary carbonated beverages. There was a significant increase in consumption of sugary non-carbonated and carbonated beverages with age ($p = 0.031$). A significant negative correlation was found between drinking sugary carbonated or non-carbonated beverages between meals and the numbers and frequency of documented recall appointments ($p < 0.0001$, $p < 0.001$, respectively).

Of the patients, 396 (62.5%) reported drinking tap water. Drinking bottled mineral water without fluoride was reported by 220 (34.7%), while 11 (1.7%) drank alternately tap and bottled mineral water. Tap water after filtration by reverse osmosis was used by 7 (1.1%) of the children. There were missing data for 17 patients.

Frequency of tooth brushing

A high percentage of the children brushed their teeth at least once a day (91.8%). Brushing teeth twice a day was reported by 55.1% of the patients. Tooth brushing 7 days a week in the morning was reported by 74.5% children and 66.6% brushed in the evening. Only seven (1.1%) did not brush at all. No statistical differences were found in the frequency of tooth brushing in the evening among children at different age-groups (2–6, 7–13, 14–18). However, children aged <4 years tend to brush their teeth in the

Table 1 Compliance with preventive measures in the different age groups (percents)

	Age			
	2–6	7–13	14–18	Total
Frequency of meals				
Less than six times a day	79.3	76.8	77.6	77.9
More than 6 times a day	20.7	23.2	22.45	22.1
Drinks between meals				
Water or sugarless beverage*	59.4	61.9	72.9	63.0
Sugary non-carbonated drinks*	35.3	27.4	21.3	29.2
Sugary carbonated beverages	12.0	16.2	13.4	13.8
Frequency of tooth brushing				
Twice a day*	58.2	53.7	63.7	55.1
Mouth rinsing				
Rinsed 2–7 days a week	NR	36.4	24.1	26.8
Did not rinse at all or once a week	NR	63.6	75.9	73.2
Use of high concentrated fluoride gel				
Used at least 2 twice a month	NR	22.7	27.6	23.3
Did not use at all or once a month	NR	77.3	72.4	76.7
Flossing				
2–7 days a week	NR	24.0	31.1	31.7
Did not floss	NR	76.0	68.9	68.3

NR not relevant

* Significant difference between age groups ($p < 0.05$)

morning less frequently than children aged $\geq$13 years ($p = 0.008$).

A significant positive correlation was found between compliance to brushing in the morning, in the evening or twice a day and the number of recall appointments ($p < 0.0001$, $p < 0.002$ and $p < 0.0001$, respectively). However, no correlation was found between compliance with brushing and the frequency of the recall appointments.

Correct fluoride concentration in the toothpaste

Of the children up to the age of 4 years, 53.9% used a higher fluoride concentration in their toothpaste than recommended. Of the children aged above 7 years, 13.3% used a lower fluoride concentration in their toothpaste than recommended. A significant positive correlation was found between using the correct concentration of fluoride in the toothpaste and the number and frequency of recall appointments ($p < 0.0001$ and $p < 0.015$, respectively).

Mouth rinsing

Of the 138 children instructed to use a fluoride rinse, 101 (73.2%) did not rinse at all or rinsed only once a week, 10 (7.2%) rinsed 2–4 days a week, and 27 (19.6%) rinsed 5–7 days a week.

The most common child-related reason for not rinsing (Table 2) was 'I forgot' (33.3%) followed by 'I did not know I have to rinse' (15.9%), 'bad taste' (14.5%). The most common parent-related reasons included: 'I could not find it at home' (11.5%), 'my parents did not purchase it' (8.6%), 'it was finished' (7.2%). In addition, 4.3% reported that they rinsed their teeth immediately after the last recall, but for some reason, they discontinued to rinse after a period of time. 5.4% gave more than one reason for their non-compliance. Of the children aged 6–13, 86% of the reasons were child related and 19% parents related. Of the children aged 14–18, 70% of the reasons were child related and 36% parents related. A significant positive correlation was found between compliance to fluoride rinsing and frequent of recall appointments ($p < 0.011$), but not with number of recall appointments.

Use of high concentrated fluoride gel

Of the 300 children instructed to brush their teeth once a week with high concentrated fluoride gel (Elmex gel—12500 ppm F), 230 (76.7%) did not use Elmex gel at all or used it only once a month; 8 (2.7%) used it twice a month and only 62 (20.7%) used it at least 3 times a month.

The most common child related reasons for non-compliance to Elmex gel (Table 2) were 'I forgot' (51.2%) and 'bad taste' (15.1%). Common parents-related reason included 'it went over' (17.6%), 'my parents did not purchase it' (12.7%), 'I could not find it at home' (10.6%), In addition, 10.6% of the children reported that they used the Elmex gel immediately after the last recall, but they discontinued after a period of time.

Of the children aged 7–13, 86% of the reasons were child related and 43% parents related. Of the children aged

Table 2 Reasons for non-compliance by age groups

	Rinsing (%)		Elmex gel (%)		Flossing (%)	
	6–13	14–18	7–13	14–18	7–13	14–18
Child-related factors						
I forgot	45.7	21.1	47.3	57.7	26.1	31.6
I did not know I have to	8.6	24.2	5.5	7.2	8.7	10.5
Bad taste	25.7	3.0	17.8	11.3	8.7	4.0
Laziness	0	15.2	4.1	5.2	4.4	13.1
I have started but stopped	8.6	0	11.6	9.3	0	5.3
I don't have time	0	6.1	0	1.0	4.4	1.3
Technique difficulties	NR	NR	NR	NR	21.8	28.9
Parent-related factors						
I could not find it at home	8.6	15.2	13.0	11.3	13.0	11.8
My parents did not purchase it	5.7	12.1	11.6	14.4	13.0	10.5
It was finished	5.7	9.1	18.5	16.5	17.4	5.3

Several reasons could be given for each preventive measure

NR not relevant

14–18, 91% of the reasons were child related and 42% parents related.

A significant number of patients gave several reasons at different recall appointments for the same non-compliant behavior. Of the patients that reported non-compliance with brushing their teeth with Elmex gel, 20.9% gave two different reasons, 5.3% gave 3 reasons and 0.8% gave four reasons. A significant positive correlation was found between compliance to use Elmex gel and number and frequent of recall appointments ($p < 0.0001$ and $p < 0.0001$, respectively).

Dental flossing

Of the 132 children instructed to floss their teeth once a day, 102 (77.3%) flossed maximum once a week, 13 (9.8%) flossed 2–4 days a week, and 16 (12.1%) flossed 5–7 days a week. The most common child-related reasons for not flossing (Table 2) were 'I forgot' (30%), 'It is difficult to perform' (27.5%), and 'bad taste' (5.1%). The most common parents-related reasons for not flossing included: 'I could not find the floss at home' (12%), 'my parents did not purchase the floss' (11%), 'it was finished' (8%), In addition, 10% of the children reported that they flossed their teeth immediately after the last recall, but for some reason, they discontinued to floss after a period of time. Again, significant number of patients gave several reasons at different recalls for the same non-compliance measures. Of the children aged 7–13, 88% of the reasons were child related and 42% parents related. Of the children aged 14–18, 92% of the reasons were child related and 27% parents related.

Of the patients that reported non-compliance with flossing their teeth, 15% gave two different reasons, 4% gave three reasons and 1% gave four reasons. A significant positive correlation was found between compliance to flossing the teeth and number and frequent of recall appointments ($p < 0.002$, $p < 0.009$, respectively).

Discussion

Compliance describes the extent of a patient's behavioral adjustment and willingness to comply with medical treatment, maintaining a correct diet, or changing his life style according to the recommendation of any health care provider [13]. Lack of compliance in medicine is estimated to be 50% in chronic diseases [14]. Compliance is reduced with medical improvement of the patient's health. This issue has implications to the reduced compliance to dental preventive measures since these measures are recommended also to healthy patients to prevent *future* dental disease rather than treat existing disease.

The basis for maintaining and improving oral health is long-term compliance to several preventive measures also when there is improvement in dental health to assure positive balanced equilibrium in the oral cavity. Unfortunately, in various fields of medicine including dentistry, achieving long-term compliance to these measures is a difficult challenge [10, 14–16]. Dental literature regarding compliance of pediatric patients with preventive measures is scarce. In the present study, compliance to home preventive measure (such as rinsing, flossing, and use of a high concentration of fluoride gel) was limited, although

patients and/or their parents received explanation regarding the importance of these measures. This was true for regular and irregular attending pediatric patients. These results are in accordance with previous reports who revealed low compliance rates for preventive measures [10–12].

Understanding the factors associated with non-compliance might help us at least partially in finding the solutions for promoting compliance, reducing oral disease and improving general dental health. One of the factors that may have impact on the compliance is the number and/or frequency of recall appointment. The effect of regular attending to periodic appointments on the compliance of pediatric patients with preventive measures was studied recently by Wang et al. [17]. They have shown that the compliance of children, who attend regular recall appointments, with fluoride supplements, daily rinsing or tooth brushing twice a day was 2, 2 and 2.5 times higher, respectively, as compared to children who have history of canceled appointment (at least one appointment in 2 years). These results are partially in accordance with the results of the present study that showed that daily rinsing, using higher concentration of fluoride in the toothpaste, using Elmex gel and flossing was positively correlated with the frequency of recall appointments. However, in the present study, we have found that regular tooth brushing was not correlated with the frequency of recall appointments but with the total numbers of recall appointments. Compliance to most preventive measures was correlated with the number as well as with frequency of recall appointments; however, the level of statistical significance was higher in respect with number of appointments. Accordingly, long-term compliance depends mainly on multiple periodic reinforcements. The reason for this may relate to the fact that during the recall appointments the dentist has the opportunity to discuss, with the children and their parents, the importance of compliance with preventive measures and to reinforce correct behavior by compliments. It should be pointed out that to maximize the effect of periodic recall appointments; the dentist should adopt a friendly approach to improve communication with the patients [10, 18]. When the patients perceive a false sense of superiority by the clinician, effective communication will not be achieved. Instead, the patients would be less likely to ask questions [18, 19]. Moreover, dentists should simplify the instructions to their patients, accommodate them to the patient's needs, and improve the communications by giving positive rather than negative reinforcement [19–21]. Patients should also take an active role in this relationship by expressing their concerns with problems regarding procedures, products, etc. [18–21]. Active listening is also important for achieving compliance [20, 21]. The dentist should give full attention also to the patients' specific reason for non-compliance. Knowing and understanding these reasons might help in finding alternative solutions for promoting their compliance, and improving their oral health.

In the present study the most common reason given for non-compliance with all dental home measures was "I forgot". This reason was given by about half of the patients that reported not using Elmex gel and by a third of the children that did not floss or rinse. In literature search in English, we could not find any study that evaluated the reasons for non-compliance of pediatric patients with "dental home", and only few studies evaluated the reasons for non-compliance of a patient with medical treatment. Nevertheless, the results of the present study are in accordance with other studies in medicine that were performed on patients with multiple sclerosis or with patients who received highly active antiretroviral therapy [22, 23]. These studies found that the most frequent reason for incompliance with the treatment was "I forgot". Treadaway et al. [22] found that the most common reason of participants listed for missing injection therapies for multiple sclerosis was that they simply forgot to administer the medication (58%). Several low-cost educational creative measures taken by the parents and their children may overcome the forgetfulness problem and significantly improve dental health. These include: hanging posters on strategies places to remind them to perform "dental home" (near bed, on the mirror in the bathroom, on the refrigerator door), sending messages by phone, text massages, e-mail, etc.

The second most prevalence reason (27.5%) of children who did not floss their teeth was "I cannot manage, it is difficult to perform". One approach to facilitate flossing is to instruct the children to assist by a floss holder, toothpicks, rubber tips (such as in Butler tooth-brush) or to spend more time to instruct the children how to floss their teeth and to verify their performance at the clinic setting. Regarding flossing, it is important to explain the patients that bleeding during flossing results from inflammation and the more they floss the least they will bleed during flossing.

The second most prevalent reason among children who did not used fluoride gel or fluoride rinsing was "bad taste" and was reported by 15% of the children who did not complied. To increase the compliance for rinsing, the child can be given several products to taste at the dental setting. In addition, the manufactures should be aware to improve the taste of these products although not to a level of "very tasty", to decrease the incident of fluoride toxicity resulted from uncontrolled consumption by young children. Other approaches for improving the taste of Elmex gel may include mixing the gel with the favorite toothpaste in equal quantities and decreasing gradually the quantity of the toothpaste with time.

Other reasons for non-compliance with preventive measures were parent-related such as: "it was finished",

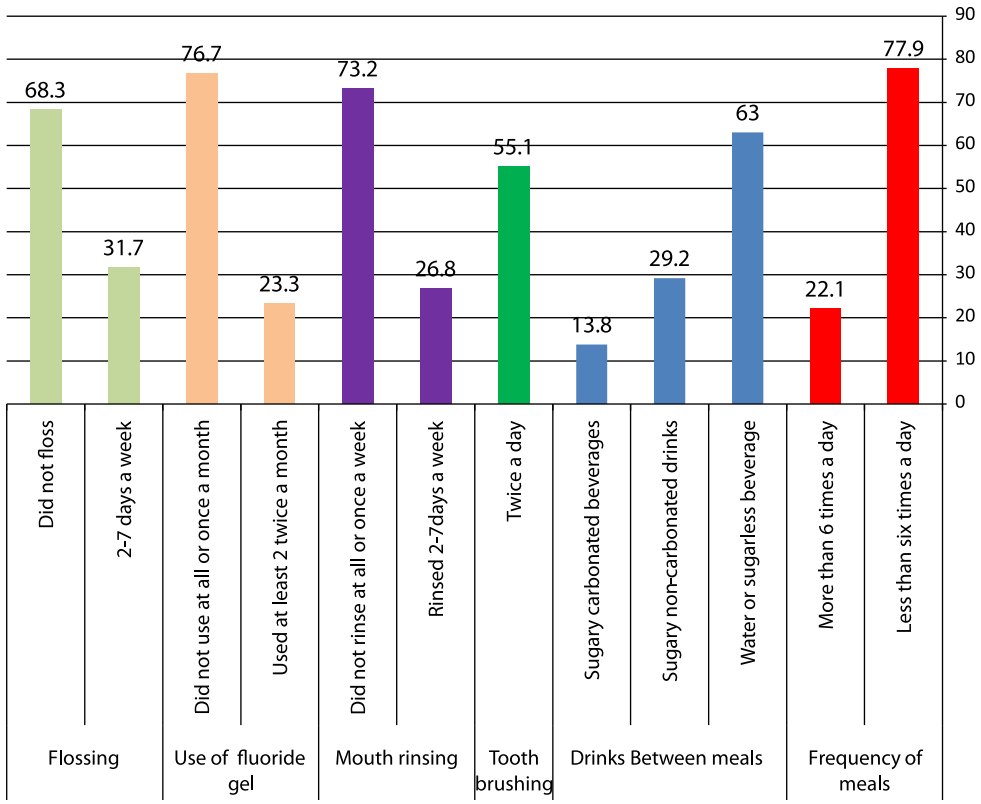


Fig. 1 Compliance with preventive measures (percents)

"my parent did not buy" and "I could not find it at home". These reasons were reported by 31–41% of the children that did not comply with Elmex gel, daily fluoride rinsing or flossing. One approach to increase the compliance related to these reasons is to supply the Elmex gel, the rinsing solutions or the dental-floss to the patient at the dental clinic or to instruct the patient to purchase a bigger packages that will be sufficient for 6 months (time of periodic recall).

It should be pointed out that increasing the compliance with "dental home" can be achieved also by increasing the awareness of the population by macro-environmental factors such as advertisement in the media, which can make the use of the preventive measure a norm similarly to tooth brushing [20].

It should be emphasized that when dealing with compliance among pediatric patients, usually their compliance depends on their parents or guardians as well. The child cannot always understand the importance and consequences of the treatment or the learned habits that can negatively influence compliance [13]. It is advisable that family members or peers provide necessary secondary reinforcement.

One of the major study limitations is the potential bias that may inherent in any self- and face-to-face reported compliance.

Conclusions

Patient compliance to preventive measures is rather difficult to achieve. Frequency and number of recall appointments might improve compliance with dental preventive measures. Reasons for non-compliance included mainly forgetting and inconvenience. Referring to the specific factors for non-compliance may increase compliance to preventive measures (Fig. 1).

Conflict of interest The authors report no conflict of interest.

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