Creating an operational framework for digital multi-disciplinary oral health promotion in children - the ODA pilot in Kuopio public oral health care

Anni Palander[1,2,3], Heidi Liukkonen[1], Tuula Miettinen[1], Maija Rajamaa[1], Katariina Savolainen[1]

[1] City of Kuopio Public Health Center, Kuopio, Finland; [2] Kuopio University Hospital Teaching Clinic, Kuopio, Finland; [3] University of Eastern Finland Institute of Dentistry, Kuopio, Finland

Anni Palander, DDS, University of Eastern Finland Institute of Dentistry, P.O. Box 1627, FI-70211 Kuopio, FINLAND. Email: anni.riepponen@uef.fi.

Abstract

Health care professionals are in the front line to identify signals of life issues. In Finnish school healthcare 25% of the children are raising concern from the professional's perspective. In oral health care, ill oral health may be an indicator of issues and vice versa. However, the early inter-professional cross-talk is minimal. The aim of this project was to recognize the patients that would raise concern among oral health care professionals. Holistic interventions of these patients would secondarily improve oral health. Targeting the group with heaviest disease and social burden, the morbidity would cease in the total population.

The staff of Kuopio public oral health care was trained for early patient recognition and referral to an oral health intervention clinic. The clinic focused on speaking out the patient's life situation and individual oral health education. If needed, a multi-professional primary healthcare support team was gathered. With the most complex problems, the family services and child protection services were consulted.

In 2017 and 2018 there were 264 and 344 recognized concerning individuals. Through tailored intervention strategies, the target group was able to increase brushing, lower the plague index and improve self-reported oral health (SOH). Total population indicators (decayed-missing-filled index, DMFT and invasive treatment) showed decreasing trends but have too many background variables for reliable effect assessment.

Oral health can play an integral role in recognizing compromised individuals. The operational changes created during the project will act as platform for future digital tools.

Keywords: prevention, pediatric dentistry, public health, multi-institutional systems

Introduction

Health care professionals are in the front line to identify signals that could indicate difficulties in life or lead to marginalization. In Finland 25% of the youth and children are raising concern from a school nurse's perspec- tive at annual general health check-ups [1]. However, healthcare professionals especially in oral healthcare, are often unaware of the patients' overall life situation and possible sudden collapses. Problems being often multifactorial, they may not come up in full magnitude at the appointment of one specialized professional

because of a narrow field of focus. For example, it is widely recognized that ill oral health may be an indicator of issues in life and vice versa. Issues or marginalization predispose to poor oral hygiene, hence often resulting in poor oral health [2]. Generally, oral health professionals tend to deal with the issues by hygiene advising and invasive treatments. The holistic multi-professional collaboration in oral health care is restricted to the use of child-protection services in cases of severe negligence of a child's oral health. At that point the problems are often already devastating. According to the healthcare law, there should be a strong network among health and social services, and the interventions should be conducted by an intensive multidisciplinary collaboration among different healthcare stakeholders and social services [3]. Our healthcare system does provide regular check-ups for minors at the maternity clinic, at school healthcare, student healthcare and at oral health care, but the early cross-talk between these stakeholders is minimal. Cumulative information from these stakeholders could lead to earlier actions.

Finnish oral healthcare also regularly provides screenings and free treatment for all minors but still oral health inequalities in children are significant [4]. Nationwide, the oral health habits among the Finnish youth and children are alarming; only two thirds of school girls and less than half of school boys brush their teeth twice a day, which is way below the western average [5,6]. National individual prevention programs have proven to yield positive outcomes compared to invasive treatment modality (topical fluorides, fissure sealants) [7,8]. The preventive strategies should be based on individual risk assessments to increase oral health equity. [9]. However, in practice it may be the case that patients with highest risk actually receive less preventive actions [10].

The aim of this project was to holistically recognize and intervene the patients that would raise concern among oral health care professionals. A new multi-professional operational model was built for the service management. The service would fully focus on prevention without operative treatment pressure. Simultaneously it would yield demand for digital solutions. The hypothesis was that oral health could be improved secondarily through holistic life situation support. Also, by targeting the group with the heaviest disease and social burden we would be able to prevent the oral disease morbidity and amount of dental operations in the total population.

Materials and methods

The project target population consisted of under 18-year old patients of public oral health care in Kuopio City region, Eastern Finland. Number of under 18-year old patients listed to oral health services during 2015-2018 is listed in Table 3A. The patients that would raise concern from the oral health professional's perspective were to be screened and holistically intervened according to individual demand. This service model required operational changes listed in Table 1.

During 2017 the oral healthcare staff was trained for early patient recognition during a one afternoon lecture and electronic support material (recognition criteria and referral protocols). The on-field-recognitions occurred in the regular oral health check-ups, emergency appointments, or newly established pop-up oral screenings at school. Recognition criteria included various oral health and social variables listed in Table 2.

Table 1. Operational changes and aims.

Operational change	Aim
Concerning patient recognition criteria and intervention path	Standardize the referral protocols to multidisciplinary and oral health interventions
	Track the number of concerning individuals
Pop-up check-ups at schools	Reach all children at schools and reduce missed appointments
	Bring oral healthcare as a part of everyday life.
Oral health intervention clinic (oral hygienist and dental nurse) focusing on: - speaking out life situation - oral health education - family commitment - multi-professional interventions - fear management - general anesthesia team collaboration	Supporting the concerning individuals' life situation and individual hygiene habits
	To increase brushing frequency, clinical hygiene level and self-reported oral health in the target group
Building a multi-disciplinary collaboration network	Responsible contact persons in maternity clinic, school healthcare, student healthcare, family and social services and child protection services
	Referrals to multi-disciplinary interventions in basic healthcare
	Reduced pressure on child protection services

Table 2. Referral criteria to the oral health intervention clinic.

Referral criteria to the oral health intervention clinic	Stage of concern
Two missed appointments, poor oral hygiene, elevated caries risk, dental fear or general health issues affecting oral health	Stage 1 concern, hygiene advising, motivational interview (only oral health professionals)
Three missed appointments, poor oral hygiene, intermediate caries risk, difficult dental fear, social issues, eating disorders or mild mental disorders	Stage 2 concern, multi-professional consultation (school healthcare, maternity clinic, student healthcare)
Four or more missed appointments, extremely poor oral hygiene, severe caries risk, difficult dental fear, wide social and family issues or severe oral health negligence	Stage 3 concern, child protection need

The staff was to systematically refer the concerning individuals to an oral health intervention clinic, established in March 2017. The oral health intervention clinic was located in the main public health centre in Kuopio. During autumn 2018 it also provided outreach service days in one of the suburban health care centres. The staff of the clinic consisted of one oral hygienist and one dental nurse. There, the patient's oral hygiene and life situation status was holistically and systematically discussed during a 45-minute appointment. The inter-

view consisted of basic general health anamnesis, oral health questionnaire and holistic motivational interview. Self-reported oral health (SOH) was integrated in the oral health questionnaire as a single 5-step question about the patient's oral and dental health from "poor" to "good". The root causes for ill oral health were tracked by open motivational question models i.e. *"tell me about your daily life"* and *"in your opinion, what are the obstacles in your daily life for maintaining proper oral hygiene?"*. Also, the professionals could utilize a speak-out tool (3x10D) supporting the interview [11].

Oral health examination included a rough assessment of caries activity (mild-strong), rough assessment of periodontal inflammation (mild-strong) and registration of plaque index (PI). PI was determined by a combined and simplified Quickley-Hein Index [12] and Simplified Oral Hygiene Index (OHI-S) [13]. Plaque amount was evaluated between 0 to 5, where 0 indicated no presence of plaque and 5 indicated total debris coverage of the tooth´s vertical surface. The highest value found was then registered. The index was simplified because of the new task management, where anyone could quickly register the status independent form profession.

Based on the interview and clinical examination multiprofessional care management and support actions were conducted according to individual demand. The level of concern was categorized from 1 to 3, listed in table 2. The categorization model was not used before. It was a practical decision -making tool for the professional in order to determine the level of support ac-

tions. 1 indicated just local i.e. motivational issues, 2 indicated intermediate multifactorial issues and need for multi-professional consultation, and 3 indicated severe issues and need for child protection and family services. The required support persons were contacted on patient's permission.

During the first appointment individual oral hygiene education was also provided. This included live brushing and flossing demonstrations with a mirror, plaque colouring and pointing out personal problematic sites in the mouth. Personal development goals were set for oral health habits.

After one month a control appointment (30 minutes) was conducted. The oral health questionnaire was repeated, and especially brushing frequency, and SOH were assessed in addition to personal development goals. Brief clinical examination and PI was also repeated as previously described. The intervention was continued until the hygiene and oral health habit situation reached a satisfying level from the professional's perspective.

The previously described operational changes create the platform for digital solutions, that will be designed to the treatment flow and developed after this project. "OMAOLO" -platform is a national patient data register, that consists of patient-yielded data. This register will be a part of the national "KANTA"-personal health register. The integration of the operational and digital architecture is described in Figure 1.
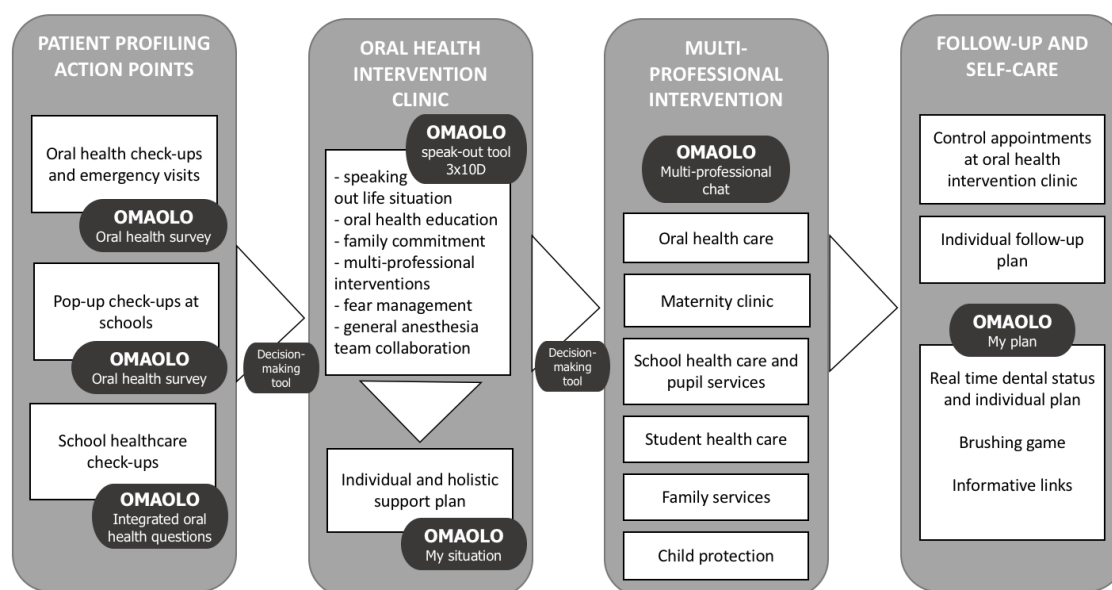
Figure 1. The new intervention path and future integration sites of digital tools.

Results

The success of each operational change can be evaluated through several indicators listed in Table 3A. Concerning patient service path model aimed for recognizing and tracking the number of patients in need for extra support. Earlier the oral health professional felt alone in cases where the patient had psycho-social issues. Hence, in 2017 75% and 2018 85% of the staff found the new guidelines useful or very useful. During the pilot the professional referral habits progressed from theoretical and schematic towards intuitive and routine. Some of the staff would not value the theoretical model itself but, would still find the oral health intervention clinic useful. In 2017 the oral health intervention clinic was found useful by 89% of the staff and by 98% in 2018. Due to the active professional referral system, it was possible to recognize and carry out interventions on 264 concerning children in 2017 and 344 in 2018 respectively. The total patient numbers listed to oral healthcare were 19 895 and 12 034 during those years. There was a fluctuating, but positive trend in total caries morbidity (decayed-missing-filled index, DMFT) and invasive treatment need (restorative, perio-

dontal). However, it is difficult to assess whether the changes were due to interventions or background variables.

Pop-up check-ups aimed at collective outreaches and screenings at schools. Parents were especially pleased about this model because there was no need to discontinue their work day because of an oral health screening. If the child would need further appointments, the parents were strongly recommended to attend. The screening model was able to reduce 10 per each check-up time. Thus, if 816 children were screened in 2017 and 721 in 2018, the saved time was 136 hours in 2017 and 120 hours 12 minutes in 2018. The pop-up model was thought to reach the patients better and hence reduce the overall number of missed appointments. Simultaneously, the organization launched a text message appointment notifications system and commitment strategies in oral health intervention clinic. Despite the efforts, the total share of missed appointments among all under 18-year old children persisted around 5% during 2015 to 2018.

The core unit of the pilot was the oral health intervention clinic that was responsible for the holistic interven-

tions of the concerning children. Effects of the individual interventions were assessed by interview and brief clinical assessment. Almost half of the patients reported brushing their teeth twice a day, but the clinical situation was still poor. After the intervention the number of patients brushing twice a day increased by 100% during 2017 and by 39% during 2018. Plaque index had improved during the intervention in 62% of the patients in 2017 (mean 0,8 degrees) and in 66% of the patients in 2018 (mean 1,1 degrees). Furthermore, the self-reported oral health had improved in 33% of the children in 2017 (mean 0,1 degrees) and in 30% of the patients in 2018 (mean 0,1 degrees), just by supporting their life situation and oral hygiene habits. The results in the intervention group are listed in table 3B.

Multi-professional collaboration aimed to create low threshold consultation paths and more holistic services for the patient. Previously multi-professional collaboration was restricted to the use of child protection services. In the new service model there were 5 multi-professional contacts and 5 child protection reports in 2017. The following year 2018 the contacts had grown to 25 multi-professional contacts and 12 child protection reports. There was a general positive trend in professional cross-talk. However, the patients were still mainly transferred from one professional to another instead of building a team around him/her.

Table 3A. Organization level indicators.

Indicator	2015	2016	2017 operational changes since 3/2017	2018 current level 1-9/2018
Number of patients under 18-year-old in oral health care per year	14 675	15 124	19 895	12 034
Number of recognized concerning patients	Operation not in use	Operation not in use	264	344
Time saving by pop-up check-ups per year	Operation not in use	Operation not in use	816 check-ups, saving 136 hours	721 check-ups, saving 120 hours and 12minutes
Number of multidisciplinary interventions per month (mean)	Operation not in use	Operation not in use	5	25
DMFT index in patients under 18 years old (mean)	0,9	0,7	0,8	0,7
Restorative treatment need (root canal and restorative procedures, mean number per patient)	0,5	0,5	0,4	0,4
Periodontal treatment need (professional procedures, mean number per patient)	0,2	0,2	0,1	0,2
Share (%) of uncancelled appointments of total visits	5%	5%	6%	5%
Professional satisfaction with the recognition model (useful and very useful)	Operation not in use	Operation not in use	75%	85%
Professional satisfaction with the oral health intervention clinic (useful and very useful)	Operation not in use	Operation not in use	89%	98%
Child protection reports	8	6	5	12

Table 3B. Target group indicators.

Indicator	2017 operational changes since 3/2017	2018 current level 1-9/2018
Intervention clinic patients (%) that report brushing twice a day at first visit	36%,	40%
Intervention clinic patients (%) that report brushing twice a day at second visit (one month, change)	71% (+100%)	56% (+39,0%)
Intervention clinic patients (%) with improved plaque index (PI) after the intervention (mean improvement)	62% (+0,8 degrees)	66% (+1,1 degrees)
Intervention clinic patients (%) with improved self-reported oral health (SOH), (mean improvement)	33% (+0,1 degrees)	30% (+0,1 degrees)

Discussion

The building of the concerning individual service path model aimed for standardized patient recognition and service segmentation. It has been recognized that patients with the highest risk of caries actually receive less preventive education [10]. This may be due to the fact that the actual treatment of high risk cases takes more time, which is away from preventive actions. Hence, the preventive service model had to have a full professional focus on prevention without operative pressure. The professional satisfaction with the model was high (75% to 85%) throughout the observation period. The model has provided clear instructions for the clinicians in case of clinical, social or no-show-related concerns. For example, in case of missed appointment a major share of the clinician's time was spent on contact attempts and arranging new appointments. As the treatment need in these patients is generally high, and the next appointment should happen after several months due to long lines, the situation has been found stressful. There was a clear improvement compared to the previous protocol, where every clinician struggled alone with these issues and could only turn to child protection services in the most severe cases. The model has standardized and advanced the support actions and brought the issues numeric as there were 264 and 344 recognized concerning patients during 2017 and 2018. A sophisticated digital application to support this step would be a decision support tool that could recommend the intervention based on a multivariate analysis.

The pop-up check-ups at schools aimed at reaching the children in their everyday environment. The service model was proven to be cost-efficient with a significant reduction in appointment time. If the patients would electronically pre-fill in the anamnesis and oral health questionnaire, the time reduction could increase. Furthermore, the appointment time could be adjusted according to personal risk. It was suggested that pop-up appointments would reduce missed appointments as the service comes to the patient, not the opposite. This, however was not the case despite the committing work by oral health intervention clinic and simultaneous text message notifications. The inefficacy of school oral health screenings on dental attendance is in accordance with the recent systematic review [14]. Missed appointments still continue to be a major waste of resources and raise further concern from a professionals' perspective. One reason for missing appointments in the group of under 18-year-olds may be the absence of monetary penalty that is charged only from adults.

The oral health intervention clinic acted as a core coordinator of the interventions. The complexity of behavioral challenges that families face in maintaining oral health habits for children is wide. Hence, a through mapping of the family's resources and parent commitment is essential [15]. Considering the multifactorial challenges in the target group, the intervention clinic managed to gain relatively good results in the target groups' brushing habits, clinical PI and SOH. The absolute effectivity of the interventions is hard to assess

without a control group. For example, a reliable assessment of the SOH was difficult because of an easily influenced child population. The question was asked before clinical examination on all visits. Many of the children reported relatively good SOH on the first visit. As they then mostly got poor clinical results, they may have reflected the negative feedback during control visit survey and reported poorer SOH. When they then mostly got positive feedback, they reflected that on their third visit answers. The oral health intervention clinic could also benefit from several digital solutions in the future. First, the patient recognition and referral to the clinic could be conducted by an electronic survey without a professional contact, as the treatment lines are very long. Second, the individual support plans could be restored so that patient could refresh their memory about the goals. Digitalization could increase participation through knowledge. If the patient and family would have for example a real time dental status available, they would more easily focus the cleaning on problematic sites. Notifications would also play an important role in committing the patient and the family. In the child target group gamifying could increase motivation (i.e. brushing game).

Building the multi-professional network increased the cross-disciplinary discussion, but the number of interventions were relative low during 2017 (5 primary healthcare interventions, 5 child protection reports). The numbers multiplied during 2018 (25 primary healthcare interventions, 12 child protection reports). This can be considered as a positive trend. The path aimed for building the team around the patient instead of referring the patient from one professional to another. According to the practical experience during the pilot this ideology still did not come true. A decision-making tool could lower the threshold also for multi-disciplinary intervention. Furthermore, the support group gathering, and communication could be brought to a digital environment by a chat service, where the patient and the selected support persons could flexibly discuss.

It is extremely difficult to assess whether the new targeted intervention model was able to positively effect on total oral disease morbidity (DMFT) and treatment need (restorative, periodontal), as these indicators have too many background variables. In the long term the rough effects could be assessed by comparing a city with a similar oral disease profile that would not perform similar prevention strategies. In a retrospect the assessment of these things however is relatively unreliable. Nonetheless, there was a clear positive trend in all variables in 2017, with a slight regression in 2018. Having a larger number of resources in this kind of prevention would probably result in greater significance.

Conclusions

Oral health professionals can play an integral role in recognizing compromised patients. Traditional oral health education is effective but should be planned individually considering the patient's life situation. Multi-professional work can add value to the health education but the effectivity of multi-professional interventions on oral health should be systematically studied. The principle of providing individual services in endorsable in order to reduce oral health inequities.

Digital tools provide multiple solutions to oral healthcare, but the keys to success are the operational changes that yield demand to develop and facilitate them. The launching of the digital "OMAOLO" platform is expected to accelerate the recognition of compromised patients and provide effective, user-friendly tools for patients and professionals.

Acknowledgments

Conflict of interest statement

All the authors have been working part-time in the ODA project during 2017-2018.

References

[1] Poutiainen H. What arouses concern in public health nurses? - Challenges to recognising need of support and acting in child Health clinics and School health care. Helsinki: Helsingin yliopisto; 2016. Available from: https://www.julkari.fi/bitstream/handle/10024/131435/Mikahera.pdf?sequence=1.

[2] Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KMS. Socio-economic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent Oral Epidemiol 2004;32(5):345-353. https://doi.org/10.1111/j.1600-0528.2004.00173.x

[3] Finlex. Finnish healthcare law. 30.12.2010/1326 [Cited 10.3.2018]. Available from: http://www.finlex.fi/fi/laki/ajantasa/2010/20101326#a1326-2010.

[4] Johansson V, Söderfeldt B, Axtelius B. Oral B's Nordic Report on Oral Health. Caries prevalence among children, adolescents and adults, and periodontal conditions among adults in Denmark, Finland, Norway and Sweden. 2007 [Cited 28.10.2018]. Available from: http://muep.mau.se//bitstream/handle/2043/6715/Oral%20B%60s%20Nordic%20Report%20on%20Oral%20Health%20.pdf?sequence=1.

[5] Ahluwalia N, Ojala K, Németh A. Bodyweigh. In: Currie C, Zanotti C, Morgan A, Currie D, de Looze M, Roberts C, Sambal O, Smith ORF, Barnekow V. Social determinant of health and well-being among young people. Copenhagen: WHO Regional Office for Europe; 2012 [Cited 10.03.2018]. p. 89-103. Available from: http://www.euro.who.int/__data/assets/pdf_file/0003/163857/Social-determinants-of-health-and-well-being-among-young-people.pdf?ua=1.

[6] Aromaa A, Koskinen S, ed. Health and fuctional capacity in Finland Baseline results of the Health 2000 health examination survey. Publications of the National Public Health Institute B3/2002. Helsinki 2002 [Cited 10.01.2018]. Available from: http://www.julkari.fi/bitstream/handle/10024/78355/b3.pdf?sequence=1.

[7] Ekstrand KR, Christiansen ME. Outcomes of a non-operative caries treatment programme for children and adolescents. Caries Res 2005;39(6):455-467. https://doi.org/10.1159/000088180

[8] Hausen H, Seppa L, Poutanen R, Niinimaa A, Lahti S, Kärkkäinen S, Pietilä I. Noninvasive control of dental caries in children with active initial lesions. A randomized clinical trial. Caries Res 2007;41(5):384-391. https://doi.org/10.1159/000104797

[9] Pienihäkkinen K, Jokela J. Clinical outcomes of risk-based caries prevention in preschool-aged children. Community Dent Oral Epidemiol 2002;30(2):143-150. https://doi.org/10.1034/j.1600-0528.2002.300208.x

[10] Hänsel Petersson G, Ericson E, Twetman S. Preventive care delivered within Public Dental Service after caries risk assessment of young adults. Int J Dent Hyg 2016;14(3):215-219. https://doi.org/10.1111/idh.12135

[11] Kainulainen S, Juutinen AM. Nuoren elämäntilanteen hahmottaminen 3X10D™ -mittarilla. HAMK Unlimited Scientific 9.2.2017 [Cited 23.10.2018]. Available from: https://unlimited.hamk.fi/hyvinvointi-ja-sote-ala/nuoren-elamantilanteen-hahmottaminen-3x10d-mittarilla/.

[12] Qnigley G, Hein J. Comparative cleansing efficiency of manual and power brushing. JADA 1962;65:26. https://doi.org/10.14219/jada.archive.1962.0184

[13] Greene JC, Vermillion JR. The Simplified Oral Hygienie Index. J Am Dent Assoc 1964;68:7-13. https://doi.org/10.14219/jada.archive.1964.0034

[14] Joury E, Bernabe E, Sabbah W, Nakhleh K, Gurusamy K. Systematic review and meta-analysis of randomised controlled trials on the effectiveness of school-based dental screening versus no screening on improving oral health in children. J Dent 2017;58:1-10. https://doi.org/10.1016/j.jdent.2016.11.008

[15] Gray-Burrows KA, Day PF, Marshman Z, Aliakbari E, Prady SL, McEachan RR. Using intervention mapping to develop a home-based parental-supervised toothbrushing intervention for young children. Implement Sci 2016;11:61. https://doi.org/10.1186/s13012-016-0416-4