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치의학박사 학위논문

**Development of School-based Oral Health Program  
in Emerging Countries**

신흥개발국의 학교구강보건사업 개발

2015년 2월

서울대학교 대학원

치위과학과 예방치학 전공

김 선 국

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## **Abstract**

# **Development of School-based Oral Health Program in Emerging Countries**

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Simplified and Modified Atraumatic Restorative Treatment (SMART) program provides school children the removal of caries lesions with hand instruments and restoration of cavities using encapsulated glass ionomer in communities without access to conventional dental clinics in emerging countries.

The purpose of this study was to investigate the effectiveness of SMART program in children to adopt in emerging countries, and to evaluate patients and dentists responses of the SMART program. The author conducted SMART program with 19 Lao dentists in kindergartens in Vientiane, Lao PDR. A total of 368 kindergarten children were provided SMART restoration and evaluated after one year. A questionnaire survey consisted of 8 items was conducted on SMART program to 118 related parents. 19 Lao dentists who practiced SMART program were questioned about opinions and practices of the program.

The 1-year survival rate of fully and partially retained SMART were 76.2%. There was no significant difference among age groups of children. The results showed a relatively higher success rate in the posterior teeth than anterior teeth. And it clearly demonstrate that the effectiveness of the SMART program depends on the experience of practitioners. ( $p < 0.01$ ) A total of 98% of Lao parents responded that SMART program was useful and showed positive attitude toward the program. Most of the children did not report discomfort. All 19 Lao dentists responded to participate in the sustainable SMART program.

This study showed that it would be recommended that SMART program to prevent and treat dental caries effectively in emerging country.

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**Key Words : emerging country, Lao PDR, prevention of dental caries, , dental atraumatic restorative treatment, glass ionomer cements, school-based oral health program**

**Student Number: 2010-30647**

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# Contents

Abstract

I. Introduction

II. Background

III. Materials and Methods

IV. Results

V. Discussion

VI. Summary

References

Appendix

국문초록

# I. Introduction

Dental caries is the most prevalent chronic disease among children worldwide. While dental caries has decreased in many industrialized countries the contrary is the case in many low-income countries.<sup>1)</sup> More than 70% of the world's population, mostly in low and middle-income countries, are in need of appropriate and affordable oral health care.<sup>2)</sup> In many developing countries, access to and provision of oral health care is limited, and the dental disease is too expensive to manage with conventional invasive treatment procedures. According to WHO, the cost of conventional treatment of dental caries in developing countries would exceed the total health care budget for children, if available.<sup>3)</sup>

The WHO Oral Health Program works from the life-course perspective, currently community programs for improved oral health of the elderly and of children is given high priority.<sup>4)</sup> The main components of the Basic Package of Oral Care (Oral Urgent Treatment, Affordable Fluoride Toothpaste, Atraumatic Restorative Treatment) offer many opportunities for effective, affordable and sustainable activities that aim to improve oral health on the community and population level.<sup>2)</sup> The BPOC developed by the WHO Collaborating Centre, describes a package of basic oral care activities which can be provided within the framework of the existing first line care, the Primary Health Care System.<sup>5)</sup>

Glass-ionomers (GI) based on Atraumatic Restorative Treatment (ART) has been validated in studies from a number of countries around the world.<sup>3, 6)</sup> It is a minimally invasive approach both to prevent dental carious lesions and to stop its further progression. It involved the excavation of caries by hand instruments such as spoon excavators and the restoration of the cavity using a hand-mixed material.<sup>7)</sup> It started with the desire to develop quality and appropriate oral health care which could reach those who rarely have access to care.<sup>8)</sup> It was officially adopted by the WHO in 1994 as a technique that could contribute to the control of dental caries, as part of primary oral health programs in developing countries.

Encapsulated GI restoratives outperform their hand-mixed equivalents used in previous ART. Therefore, if electricity is available, encapsulated high-viscosity GIs are preferable to hand-mixed GIs.<sup>9)</sup> Accordingly,

SMART program has been developed using only hand instruments and restoring cavities with capsule-type GI restorative material. SMART program works for application of evidence-based strategies in oral health promotion, prevention and treatment of oral diseases worldwide, health systems research and development. It, which does not require sophisticated and expensive dental equipment, might be appropriate for management of dental caries in emerging countries. This targeted school-based dental program, in which SMART restorations are placed at the school, is considered to be a successful strategy for preventing caries and for reaching minority and low-income children.

The aim of study was to evaluate the impact of SMART for children in an emerging country, to assess whether SMART restorations could be provided to children in a kindergarten environment, and to assess patient and dentist acceptability of SMART approach. It has been conducted from 2010 in Lao PDR in this study. This will share the experience and know-how for the program with international relevant organizations and other emerging countries to develop and improve strategy of the program as a model and to ultimately develop a project model that can be applied to other developing countries.

## II. Background

### 1. Geographical characteristics of Lao PDR

In Laos, for the population of 6.6 million oral health care is provided by a limited number of dentists mainly operating from dental clinics at central or provincial levels and at certain district hospitals.<sup>4)</sup> Dentistry personnel in Laos is 0.4 per 10,000 population. The average of South-East Asia Region is 1.0 and global average is 2.7. The public's utilization of dental care service is rather low because of shortages of dental manpower, lack of perceived need for dental care and financial constraints.

**Table 1) Population of Laos (WHO, 2012)**

Total population	6.6 Million
Median age (Year)	21
Aged under 15 (%)	36
Aged over 60 (%)	6
Living in urban areas (%)	35
Net primary school enrolment rate (%)	97 (male) 95 (female)
Population living on <\$1 a day (%)	33.9

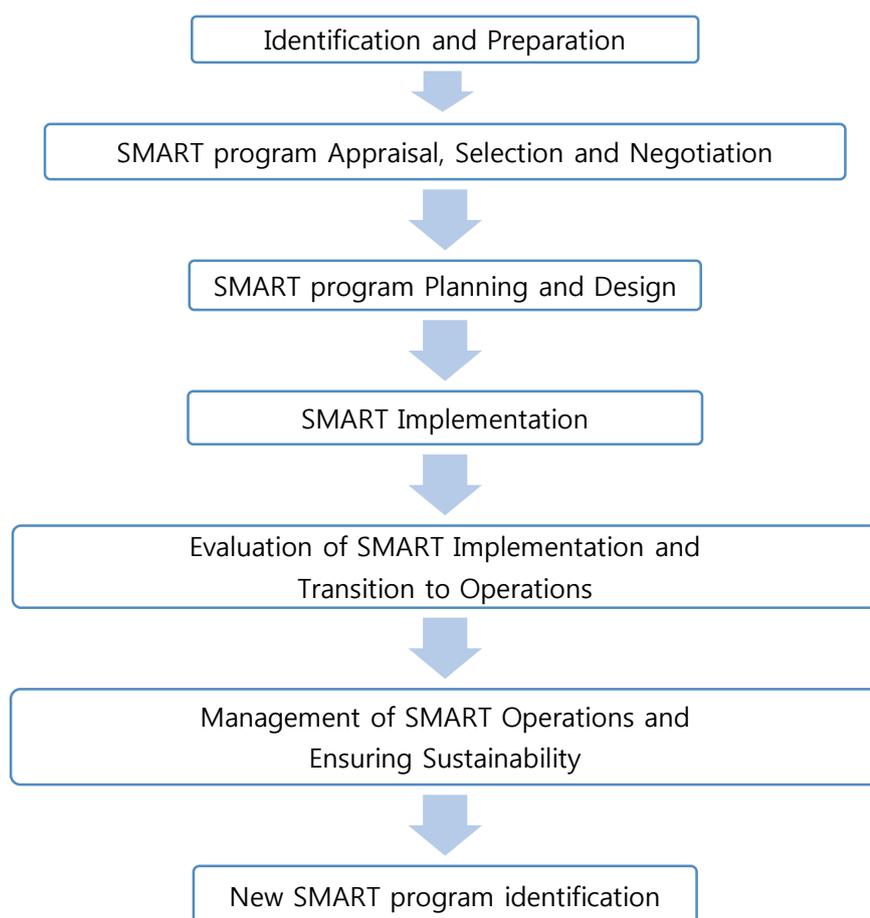
An estimated 36% of the population is under 15 years of age. (Table 1) The overall range of age group tend to be young with a high population of people under 15 while that of elderly is relatively low. The percentage of urban population is low; however, almost all children attend elementary schools. A large amount of people live their lives with under 1 dollar a day.<sup>10)</sup> Based on the facts stated above, an appropriate oral health promotion program can be planned for Laos.

As a means if developing effective interventions, the program can target children since their population is high, and an oral health program targeting school is appropriate since most of the children attend elementary

schools. In Laos, where a large segment of the population has no or limited access to dental services, it is important to establish and implement oral health care that is affordable within school communities. As the possibility of treatment and follow-ups is important, kindergartens and schools provide a unique opportunity for SMART program for young children. It is certainly patient-friendly and makes the provision of oral care much easier to children who are nervous or fearful. Using the WHO data in Laos, a school is an efficient setting for the promotion of oral health. It is obvious that the existing oral health care workforce and delivery system is unable to cope with the oral disease burden of the population. The emphasis should therefore be directed more towards preventive strategies. Early treatment with active preventive programs should be enacted for Laos children.<sup>11)</sup>

## 2. Planning and Design of SMART

The design of the Program is summarized as shown in Fig 1. Projects generally progress through seven main stages.<sup>12)</sup> The feasibility of incorporating a similar SMART program in all of the kindergartens depends on the organization of the program.



**Fig 1. SMART Management Cycle**

### **Stage 1 – Identification and Preparation**

Before the program is identified, relevant authorities – often in consultation with international agencies- define their oral health promotion strategies. These strategies and plans calculate the national and international dental resources required for the program, determine how much is available, and identify sectoral priorities.

### **Stage 2 – SMART program Appraisal, Selection and Negotiation**

This stage is devoted to assessing the economic, financial, and technical feasibility of the program.

### **Stage 3 – SMART program Planning and Design**

Once it has been approved, attention turns to detailed planning and design. First, information is collected to define the target population. Second, the condition to be resolved by the SMART is identified. Third, its goals and objectives are formulated. *Goals* are the promotion of oral health in children. *Objectives* refer to an expected output from the SMART, expressed in quantitative terms. Fourth, decisions are made about the duration and sequencing of each stage. Fifth, additional information is collected for formulating the program model that is expected to produce the promotion of oral health in children.

### **Stage 4 – SMART Implementation**

It includes monitoring of all aspect of the SMART as it proceeds and supervision by external donors. This stage may involve training, designing, and testing educational programs. The financial, material, and human resources required must be procured and mobilized. Facilities and equipment must be installed.

### **Stage 5 – Evaluation of SMART Implementation and Transition to Operations**

Once it has been completed, most donor agencies ask for a program report that will describe and evaluate each component of SMART program identification, appraisal, and implementation.

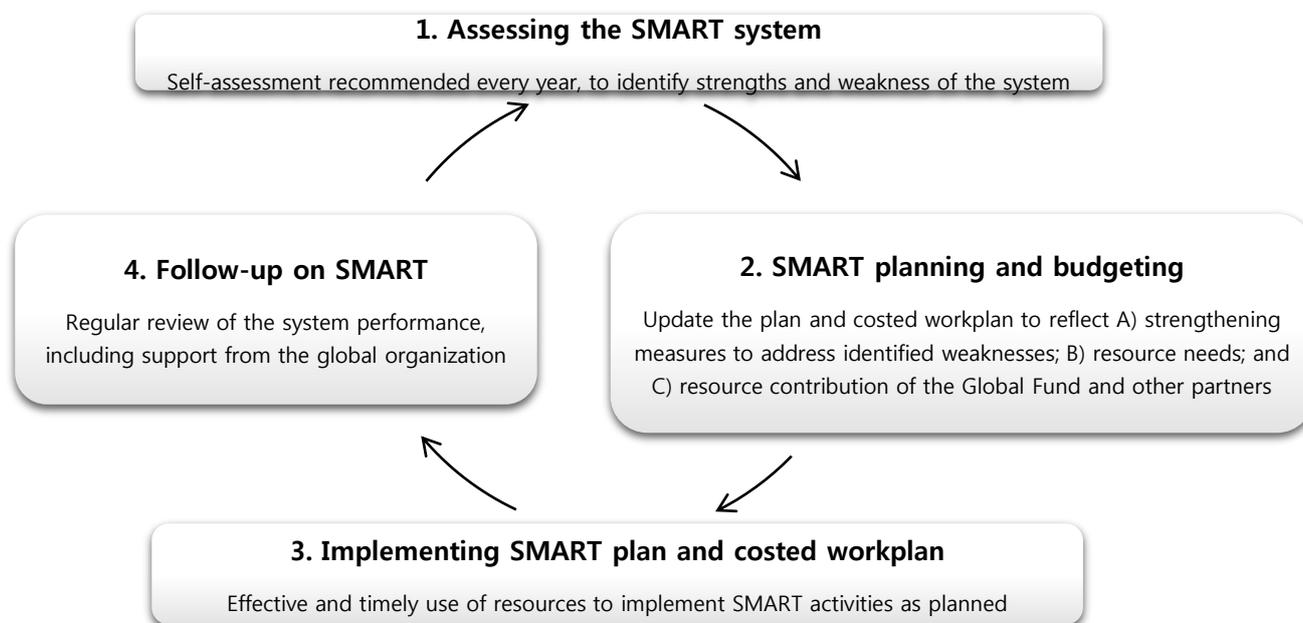
### **Stage 6 – Management of SMART Operations and Ensuring Sustainability**

After implementation, it may continue as a separate activity or it may be absorbed into the local dental hospital. If it is to be successfully sustained, organizational and financial arrangements must be made for managing its delivery; for ensuring that the material and equipment will be maintained; and for assisting the organizations involved with the SMART.

### **Stage 7 – New SMART program identification**

### 3. Monitoring and evaluation of the SMART program

Decisions concerning the design of future programs take advantage of the M/E information from earlier projects.<sup>13)</sup>



**Fig 2. Strengthening country-level Monitoring & Evaluation systems<sup>14)</sup>**

#### 3.1. Individual children records management - CHILDREN RECORD SHEET

Based on the SMART program in Laos, individual records should record data and information about the following aspects of children.

1. School or organization
2. Date of examination and follow-up
3. Children who have been treated - name, age, gender, current grade
4. The dental condition of children and the quantity to be treated
5. Teeth treated – quantity and type of the treatment
6. Follow-up after 6-month or 1-year - it records the scores obtained in examination on these children.

These six essential school records, when systematically kept, updated and used, will not only strengthen

information management within the program, but also enables each school, district, province and monitoring authorities to effectively monitor many aspects of the program. A specially designed form was used for registration and evaluation of SMART. (Appendix E)

**Fig 3. An example of the individual evaluation form in SMART**

Ministry of Public Health's Kingdergaten							
	22-Dec-11						Date :
No.	Name	Age	Sex	Class	DMFT	Treatment	Follow up (0, 1, 2, 3, X )
1	ນ.ສຸຊາດາ	5	F	5A	10	74, 84	
2	ນ. ຕຸກຕາ	5	F	5A	12	64, 65,74,75 ,85	
3	ນ. ແພນຕາ	5	F	5A	6	51,54,61,64	
4	ນ ອາລິຍະພອນ	5	F	5A	11	74, 75	
5	ນ ພິງກີ	5	F	5A	6	74,75	

### 3.2. Gathering school records in the district, province or country- to review and compare them

In this project, the data needs to flow from each practitioner to the monitoring authorities, where it is aggregated with the information from the other practitioners under the supervision. This includes the observations for practitioners who treated with SMART.

If needed, information about characteristics such as gender, age and teeth attributes may also be used so that monitoring authorities can analyze practitioner performance against various individual and local characteristics. This means transferring it into a database suitable for aggregation and analysis.

### 3.3. Practitioner performance summary

Practitioner performance summaries monitor the program in the district. Monitoring authorities use these results to take action to improve SMART processes and give incentives to practitioners. Practitioner performance summaries for consecutive terms or years may be used to monitor how the performance of practitioner changed over time. It can identify appropriate action to assist those practitioners with difficulties.

(Appendix F, G)

Practitioner performance strategy/ goal : Each goal should in some way link to the funding agency’s annual performance plan or budget.

### 3.4. Creation and use

Examinations and assessments are available at 6-month and 1-year term. The progress reports are prepared from the time the SMART starts up to the completion of its implementation. Monitoring authorities summarize by recording each practitioner's score and sort by age, school and teeth. Its performance can be recorded after the first assessment 1-3 months after the beginning of SMART. It is continuously updated and used as reference by monitoring authorities.

It is also used to give funding incentives to practitioners. It is intended to encourage more-rigorous impact evaluations. It may be conditional or staged funding. (Appendix H)

### 3.5. Financial and material summary

Finances and materials used in SMART should be carefully managed according to regulations. Financial and material records must be maintained and regularly updated for management, reporting and auditing purposes. Monthly and yearly summary of income and expenditure can be produced and used by the SMART management. These are also used to report information to funding agencies, local government and communities that have made contributions to it and are entitled to know how their contributions have been used.

It provides information about the flow of financial and material resources of SMART.

### 3.6. Providing feedback to staff and participants

It is to improve the SMART program and to make sustainable. Progress report are discussed in management review meetings. Delays, cost overruns, and related problems are identified and discussed.

# III. Materials and Methods

## 1. Materials

### 1.1. Study population, disposition of subjects and clinical examinations

Three kindergartens in Vientiane, Laos, participated in this research. 2-6 years old children in the kindergartens were selected for evaluating the SMART program because the initiation of dental caries occurs in this age.

Informed consent was obtained from the parents of the participating children and permission for the study was granted by the Ethical Committee of the Ministry of Health of Laos. The children’s parents were informed of the study through the kindergarten and were free to opt for their children not to participate. Of the 389 children whose parents were consulted, 386 (99%) participated in the SMART program. At baseline, the clinical examinations were performed in the kindergarten using a LED headlight for a visual assessment. The participant children were then screened clinically to assess their treatment needs.

One year after the project begins, a dental examination will be conducted to investigate the retention rate of the fillings, and the parents of the participating children and Lao dentists will be surveyed on the program.

### 1.2. Baseline Characteristics

During the first examination, the mean DFT scores were 6.3 (SD  $\pm$ 3.9, age 2), 7.8 (SD  $\pm$ 4.2, age 3), 8.5 (SD  $\pm$ 4.1, age 4), and 9.2 (SD  $\pm$ 3.6, age 5), respectively.

**Table 2. Mean DFT of Baseline in target children**

Age	No. of target children	Mean DFT (SD)
2	28	6.3 ( $\pm$ 3.9)
3	78	7.8 ( $\pm$ 4.2)
4	143	8.5 ( $\pm$ 4.1)
5	119	9.2 ( $\pm$ 3.6)

Baseline characteristics were investigated to assess comparability of the children in kindergartens. The mean DFT of the children increases with the age ( $p < 0.01$ ). The number of teeth to be treated per child increases as the age of the child increases. The mean age of the children at baseline was 4.0 years ( $SD = 0.9$ ). The target children were consisted of 190 girls (DFT :  $8.7 (\pm 4.1)$ ) and 178 boys (DFT:  $8.1 (\pm 3.9)$ ).

### 1.3. Selection criteria

Inclusion criteria for SMART is healthy and cooperative children with dental caries, ICDAS score 5-6, on one of the teeth or early enamel caries and with the child's parental or guardian consent

Exclusion criteria include uncooperative or absent children and those with fever or general disease, obvious pulpal involvement teeth, and unrestorable teeth.

### 1.4. Restorative material and instruments

Standard instruments and procedures for ART were used. Cavity assess was achieved with the use of enamel hatchets and excavators. The restoration material used was a machine-mix, high-strength encapsulated GI, Fuji IX<sup>®</sup> (GC dental, Japan), recommended for use with SMART approach.

### 1.5. SMART program implementation

19 local Lao dentists provided the SMART restorations in 2011-2012 after they had received a training workshop in Vientiane, Laos. (Male 5 (26.3%) Female 14 (73.7%), mean age :  $39.2 \pm 11.0$ , Avg. working year :  $11.1 \pm 10.3$  years)

The treatment was carried out using hand instruments, portable lights, and GI capsule mixing machine. The children were treated in a supine position on tables available in the kindergartens with a chairside assistant assisting the operator. Children who had received SMART restorations were interviewed one or two days after treatment to assess whether they had experienced pain or discomfort during or after treatment.

The process of SMART program workshop is consisted of,

a. Education of practitioners and preparation of material and instruments

- Introduction to SMART program
- Lectures for local oral health status associated dental caries
- Lectures for the progress and arrest of dental caries
- Practice for the material and instruments
- Guide for the case selection of SMART
- Practice of SMART on the extracted teeth

b. Practice of SMART program in a kindergarten

- Participants underwent treatment
- Evaluation of the teeth restored in the previous day : discomfort, pain, swelling, failure

c. Evaluation of SMART program in a kindergarten.

- General discussion and evaluation of the implementation of SMART

This study was conducted in Vientiane, Laos from 22th Dec. 2011. 19 dentists from Laos treated a total of 1385 restorations in 386, 2- to 5-year-old kindergarten children with SMART on the kindergarten compounds.

**Table 3. The number of children and teeth in SMART program**

Kindergartens	Number of Included children	Number of Excluded children due to non-cooperation
Ministry of Public Health's Kindergarten	87 (253 teeth),	2
MOE's Kindergarten	129 (401 teeth)	
Thanakhane's Kindergarten	170 (731 teeth),	1

### 1.6. Evaluation of the program

SMART were evaluated according to the assessment criteria after 1 year, by same evaluator who had not been involved in the placement of the restorations. One dentist from South Korea carried out all follow-up examinations. Most serious issues occur within a short period after the treatment is finished; thus, the first clinical examination will be conducted within 6 months to a year.

The primary outcome was the occurrence of new caries at the 1-year follow-up. The secondary outcome was

the restoration's status, that is, total retention, partially or fully lost also at 1 year of follow-up.

The codes and criteria used to evaluate the restorations were similar to previous ART studies, but were also simplified and modified. (Table 4) Although these criteria might appear somewhat coarse, they were simple and robust and thus appropriate for clinical evaluations carried out in a field setting.

**Table 4. Codes used in the evaluation of the SMART restorations.**

Code*	Criteria
0	Present, good
1	Present, slight marginal defect. No repair is needed.
2	Present, gross marginal defect. Repair is needed.
3	Not present, restoration has (almost) completely disappeared. Treatment is needed.
X	Tooth is missing, exfoliated or extracted.

The goal of the clinical assessment was to assess whether further treatment was required for the tooth surfaces previously restored with the approach. Failed, lost or fractured restoration need to be restored upon confirmation. Such longitudinal observational investigation can be more easily implemented in schools than hospitals, because the students remain at the same school even when the year changes, only in different class, and moving to a different kindergarten is rare in Laos.

## **2. Behaviors and attitude of the parents and practitioners**

The questionnaires were distributed to Lao dentists and Lao parents after SMART program in 2012. (Supplement 1, 2) A survey was performed by questionnaires after this program. Of the total of 118 Lao parents and 19 Lao dentists answered for these questions. (Table 5)

**Table 5. Number of subjects for this survey**

Subjects	No.
Lao parents	118
Lao dentists	19

## 2.1. Questionnaire on SMART program to Lao parents

The survey to Lao parents comprising of eight items was developed to rate their willingness, satisfaction and desire. It was conducted by questionnaires on the program to 118 related Lao parents. Parents whose children had received the SMART were surveyed after treatment to assess patient acceptability of its approach, whether they had experienced pain or discomfort during or after treatment, and whether they were willing to receive the SMART again.

The parents need to ask the children whether they felt fear or pricking during the treatment, confirm their willingness to participate again, inquire how they felt and any recommendations they might have. The investigation needs to include the hardships that the parents feel in terms of their children's oral health care in Laos. (Appendix A)

## 2.2. Questionnaire on SMART program to Lao dentists

19 Lao dentists who practiced this program were inquired about opinion and suggestion. They were questioned for the opinion, attitude and comment of the program as follows.

Investigate whether the equipment and device functioned well, the material was supplied smoothly, and the pre-workshop was helpful. Additionally, investigate into the participants' discomfort or complaints if any, whether they are motivated to participate in future businesses, what improvements can be made, whether the number of children treated in a day was appropriate, and if their cooperation level decreased. (Appendix B)

# IV. Results

## 1. Success rate of 1-year follow-up

Among the 368 children, 146 were followed. 5-year-old children were excluded due to transfer from kindergartens to schools. Children were excluded who left the kindergartens or were absent on the examination day. Therefore, 568 teeth in 146 children remained in the follow-up.

**Table 6. Integrated success rates summary for three kindergartens**

		Score					Success (0, 1)	Fail (3, X)	Total
		0	1	2	3	X			
Kinder- gartens	A	17 (27.9%)	9 (14.8%)	13 (21.3%)	22 (36.1%)	0	26 (42.7%)	22 (36.1%)	61
	B	25 (20.8%)	27 (22.5%)	34 (28.3%)	33 (27.5%)	1 (0.8%)	52 (43.3%)	34 (28.3%)	120
	C	120 (30.6%)	105 (26.8%)	84 (21.4%)	80 (20.4%)	3 (0.8%)	225 (57.4%)	83 (21.2%)	392
Age	<4	98 (30.4%)	85 (26.4%)	71 (22.0%)	68 (21.1%)	0	183 (56.8%)	68 (21.1%)	322
	4<	64 (25.5%)	56 (22.3%)	60 (23.9%)	67 (26.7%)	4 (1.6%)	120 (47.8%)	70 (28.3%)	251
Tooth	Ant.	29 (17.7%)	34 (20.7%)	28 (17.1%)	70 (42.7%)	3 (1.8%)	63 (38.4%)	73 (44.5%)	164
	Post	133 (32.5%)	107 (26.2%)	103 (25.2%)	65 (15.9%)	1 (0.2%)	240 (58.7%)	66 (16.1%)	409
Total		162 (28.3%)	141 (24.6%)	131 (22.9%)	135 (23.6%)	4 (0.7%)	303 (52.9%)	139 (24.3%)	573

A: MPHK : 61 teeth in 18 children    B: MOE : 120 teeth in 41 children

C: Thanakhane's : 392 teeth in 87 children

In consideration of the relatively low in wear and fracture resistance, restorations with codes 0 and 1 were regarded as successful, code 3 and X were regarded as failures and cases with code 2 were excluded from the analysis. A dichotomous classification of success or failure would therefore have sufficed. At the 1-year follow-up, the failure rate was noted in 24.3% (n=139) among the total of treated teeth (n=573). Table 6. presents the estimated score number of teeth with SMART restorations.

After 1 year, 76.2% of the SMART were either partially or completely retained. Overall, about 23.8% of the SMART restoration failed. Failure occurred in 131 restorations overall (23.1 %), and 4 had been lost. Most of the restorations were in a good condition or had some minor defects or wear which did not need further treatment.

**Table 7. The relationship between factors affecting the failure of SMART**

		B	Sig.	Exp (B)	95.0% C.I. for EXP(B)	
					Lower	Upper
Age	2years		.177			
	3years	.088	.825	1.092	.501	2.381
	4years	.484	.220	1.623	.749	3.515
Treatment Area		-1.547***	.000	.213	.135	.335
Kinder(A)			.004			
Kinder(B)		-.672	.088	.511	.236	1.104
Kinder(C)		-1.093***	.001	.335	.171	.656
Constant		.828	.111	2.288		

\*\*\*p<.001, Treatment area (a value of 0 refers anterior teeth. Posterior teeth=1)

Negative values refer to the decrease of failure rate.

IBM SPSS Statistics 22, Logistic Regression Variables

The failure rates were increased gradually from 21.1% (below age 4) to 28.3% (above age 4). The older, the higher odds ratio value: four-year-olds had the highest failure rate (1.62) and two-year-olds had a relatively lower failure rate (1). But it is not statistically significant.

Class III or IV restorations were principal type of anterior restoration reflecting the caries pattern of these younger children. In determining if the success rate would depend on the treatment region—incisors or molars—the latter got a lower failure rate with the odds ratio value of .21 than the former. ( $p < 0.01$ )

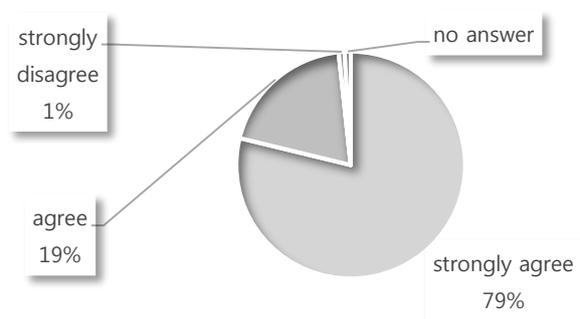
Note that the SMART fail rate in the first kindergarten was significantly higher than that in the next. The local Lao dentist group that participated in SMART is consisted of nearly the same when visiting kindergartens. In terms of the order of visits to kindergartens, the last one, C, got the lowest failure rate (.33), followed by B (.511) and A (1). ( $p < 0.01$ )

## 2. Attitude, opinions and practices on the program

66 of 118 (56%) of Lao parents responded that they had been to the dentists with their children during last one year. The reasons for going to the dentist were pain (44%), oral exam (44%) and discomfort (12%). The reasons not going to the dentist were busy and no time (35%), far distance (15%), giving analgesic (15%), expensive (10%) and others. (24%)

Fig. 4 and 5 showed the result of questionnaires about SMART program of Lao parents. Most Lao parents (97%) wanted more continuing SMART program in school.

**Fig. 4. Percentage of attitude about SMART program among Lao parents**



The reasons of satisfaction were mainly prevention and treatment of dental caries (62%) and its convenience (30%).

**Fig. 5. Percentage of the reasons of satisfaction after SMART program**

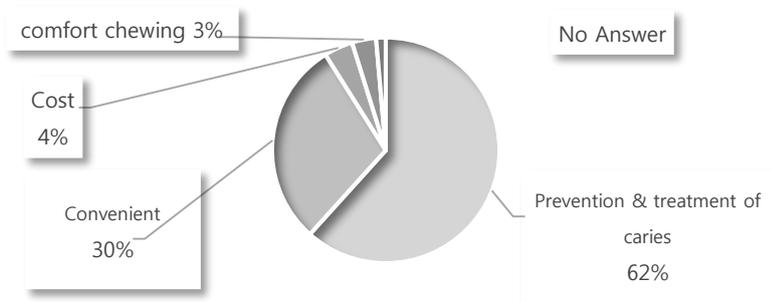


Table 8 shows the reasons to be dissatisfied after SMART program among Lao parents. Most of parents (82%) had no reason but the reasons were terrified or sick child (9%), no trust (5%) and cost (4%).

**Table 8. The reasons not to be satisfied after SMART program among Lao parents**

Reason	No.
My child was terrified or sick.	11 (9.4%)
No trust to SMART	6 (5.1%)
Expensive cost	4 (3.4%)
No answer	96 (82.1%)

97.5% of parents answered that they would participate in the program continuously. And they agreed the program (34%), wanted to continue (29%), and thought it was useful (20%). (Table 3, 4).

**Table 9. Percentage of parents expected to participate in the SMART program continuously**

Answer	No.
Yes	115 (97.5%)
No	1 (0.8%)
No answer	2 (1.7%)

Most parents had positive attitude for SMART (82.9%). They hoped this program would continue. (28.8%).

**Table 10. Opinions of parents about SMART**

Opinion	No.
Agree	49 (33.6%)
Continue this project	42 (28.8%)
Useful project	30 (20.5%)
No answer	25 (17.1%)

Table 11 shows that the opinions and attitude about the program of Lao dentist. It shows the assessment of the program. Very high proportions of Lao dental practitioners (100%) felt that its training workshop was worth but 21% of dentists responded that the supply of material was inappropriate. The main problems for SMART were incentive (33%), excessive amount of treatment work (28%) and staff and assistants (21%).

**Table 11. Questionnaires of Lao dentists about SMART**

Questions	Strongly agree	Agree	Disagree	Strongly disagree
All equipment works well and clean.	12 (63%)	4 (21%)	3 (16%)	0
Proper disinfection of dental instruments.	13 (68%)	4 (21%)	2 (11%)	0
Supply of materials was appropriate.	13 (68%)	2 (11%)	4 (21%)	0
SMART workshop and training was helpful.	9 (47%)	10 (53%)	0	0
Incentive is guaranteed as long as I tried.	5 (26%)	14 (74%)	0	0
I want to participate in SMART again.	12 (63%)	7 (37%)	0	0

Table 12, 13 showed that no inspiration, incentives and patient load were main factors for the practice of SMART program in Lao PDR.

**Table 12. The problem of SMART suggested by Lao dentists**

Problems	No.
Incentive	13 (33.3%)
Excessive amount of treatment work	11 (28.2%)
Staff and assistance	8 (20.5%)
Environment	7 (17.9%)

\* multiple answers for this question

They expressed their opinions about the program. They felt the lack of inspiration (54.5%), assistant (9.1%), funding (9.1%) and materials (4.5%). Nevertheless, they regarded the program as a useful project (18.2%).

**Table 13. Opinions on SMART in school**

Opinions	No.
No inspiration	12
Useful project	4
Lack of assistant	2
Not enough capital	2
More training needed	1
Lack of material	1

\* multiple answers for this question

## V. Discussion

The retention rates in this study were 76.2% similar to previously reported for ART restorations. It can be speculated that the hot and humid weather in Laos was one of the reasons. Due to the weather condition, the mixing of encapsulated GI makes the setting time too fast. Placing such a capsule in a preparation will result in the material crumbling and the eventual loss of the restoration.

The retention rates were related to the size and type of the cavity and the skill of practitioners. The causes can be listed as complete loss, partial loss, fracture, gross wear, marginal discoloration, and re-occurrence of dental caries in the marginal areas. To minimize such failures and obtain the most optimal result, the previously investigated results need to be continuously revised and improved based on the instructions of SMART manual. Since encapsulated GI was a relatively new restorative material at the time of the study, a more precise definition of the reason for failures when they occurred was considered useful. But these results of retention rate did not decrease the benefit in the program because teeth with partially or completely lost SMART restoration were not at a higher risk of developing caries than teeth that had never been treated.

As the age increases, the occurrence of open cavity with bigger cavity rises, and due to such a fact, these cavities are more likely to be a treatment target. The treatment would be more successful among the younger whose teeth have not been severely decayed yet.

The retention rate in the third kindergarten was significantly higher than that in the previous. It is estimated that the failure rate is high among the local dentists who first encountered SMART materials and devices in the first kindergarten they visited. We can speculate that the unskilled Lao dentists led to the lower retention rate. It is thought that, as the technique of the operators improves and they become more familiar with the operational method of SMART and the surrounding circumstances, the retention rate of restoration materials would increase. These results clearly demonstrate that the effectiveness of the program depends on the experience of participants. This could be explained by the difficulties in achieving the best SMART procedure. It indicated that the senior, more experienced dentist performed significantly better. (Table 7)

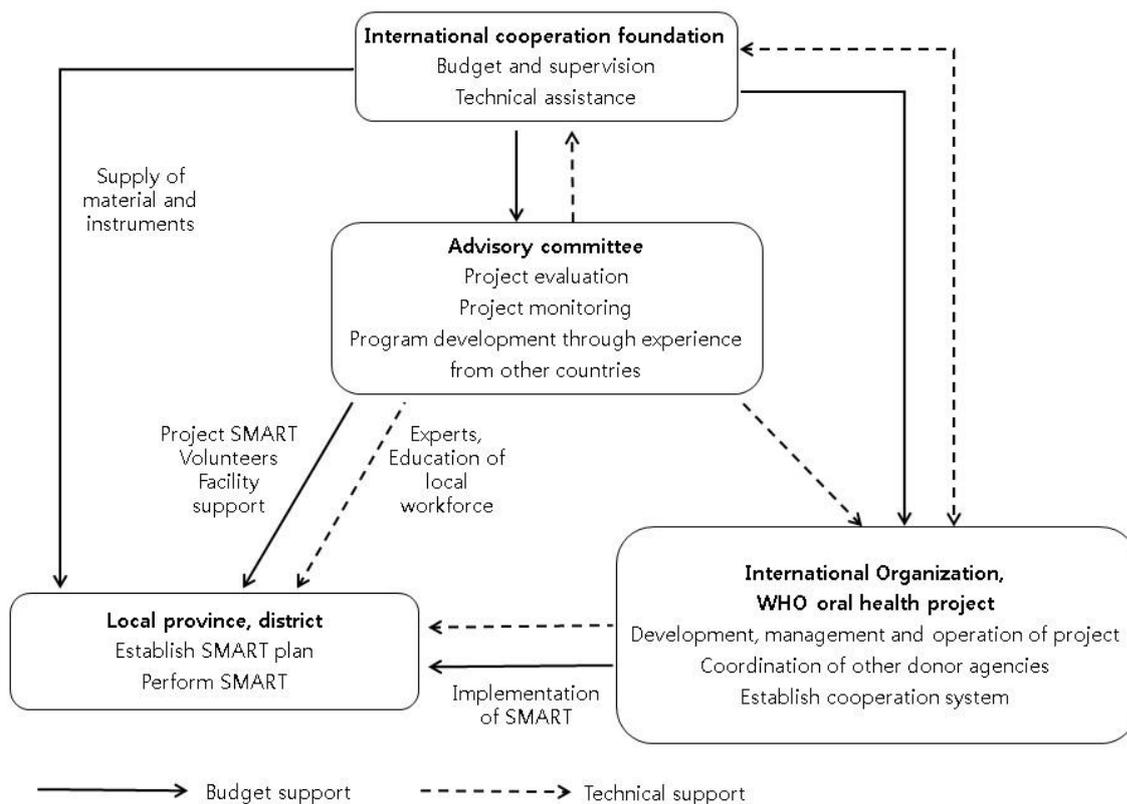
Selection of the appropriate case and the skill level of the operators are important elements of the successful program. It is obvious that these technical deficiencies need to be adequately addressed in training courses on the workshop. Although some operator effect is expected in any dental treatment procedure, the present findings suggest that operators who have received adequate training can produce reliable results.

To seek long-term and sustainable solutions, it is important to provide essential SMART materials and instruments and to educate and train dental workers. Therefore the health authorities in an emerging country should therefore focus on planning and implementation of oral health promotion programs through schools, in collaboration with the international organizations and WHO. This program will have to be provided within the context of what local health care workers are capable of undertaking. It should be continued by local health care workers.

The emphasis for future projects must be on acceptability, affordability and sustainability. The project concept has evolved from the activities of the international aid agencies and their concern that their financial assistance would be used to achieve specific and monitorable objectives within a given time frame. For aid effectiveness, it needs to be considered about value for budget.

- How many restorations with finance provided
- How much money per one tooth
- Compare to other methods with aid-effectiveness.
- Direct participation as a practitioner or support for local practitioners as a researcher who educates, studies and monitors the program.

An assessment of the cost benefit of the program in Lao children (\$US 3,000-4,000 per 1,000 children) shows that it is appropriate for many of other nations. It was determined by the association between some organizations. (Fig. 6)



**Fig 6. Collaborative SMART planning model to fund self-sustaining development**

#### Advisory Committee on Evaluation

- made up of external experts or academics
- provide advice to the committee on SMART evaluation systems and methods
- reviews the results of SMART

It was particularly encouraging to find that over 97% of the parents were willing to receive SMART. It is attributable to the non-use of rotary instruments and anesthetic injections combined with the provision of treatment within a familiar, non- threatening environment. Most of Lao parents had a positive attitude for the program.

In this survey, the on-site questionnaire was distributed to whom attended the program. Parental responses to the questionnaire in this survey carry the limitation of all self-reported information. This method of survey facilitates the willingness of participation to respond their curious questions. But there can be a risk of bias by

excluding non-attendants.

Nevertheless, the intention of Lao dentists to perform the program was strongly influenced by inspiration. Children patient load and no inspiration were two barriers that had the most influence on the implementation of the program in Laos. Possible barriers should in future be identified before introducing the SMART approach into a public oral health service system. Such information would prove useful to address barrier factors and implement after workshop. Therefore, in order to have a successful introduction of the program in Laos, positive attitude is needed. It needs enough incentives for practitioners and inspiration. If this program is insufficiently managed and chair-side assistance is inadequately available, operators are hardly likely to see introducing a change as beneficial.

This program, including the education of Lao dentists, was effective for Lao children from a low-dental access background. Our study demonstrated that the program at kindergarten was effective in children who are less likely to receive oral health care from dentists in a private practice.

There are other potential countries of application of SMART. Future research will show to what extent it will be effective in these countries. It is hoped that this proceedings will stimulate all those who are relevant to take notice of the real need of the program to improve oral health globally. It is suggested that it should be expanded and supported substantially to prevent caries for children in emerging countries.

## VI. Summary

Simply modified atraumatic restorative treatment (SMART) program provides school children with restoration of dental cavities using glass ionomer cement following removal of caries lesions by hand instruments.

The purposes of this study were to investigate the effectiveness of SMART program in children to adopt in emerging countries, and to evaluate patients and dentists responses of the SMART program. The author conducted SMART program with Lao 19 dentists in kindergartens in Vientiane, Laos. A total of 368 kindergarten children were provided SMART restoration and evaluated after one year. Questionnaires consisted of 8 items on SMART program were evaluated to 118 related parents and 19 dentists who practiced the program about opinions and practices of the program respectively.

The 1-year survival rate of fully and partially retained cavities was 76.2%. There was no significant difference among age groups of children. The results showed a relatively higher success rate in the posterior teeth than anterior teeth. And the retained rate of the SMART restoration depended on the experience of practitioners. ( $p < 0.01$ ) A total of 98 % of parents responded that SMART program was useful and showed positive attitude toward the program. Most of the children did not report discomfort. All 19 dentists responded to participate in the sustainable SMART program.

This study showed that it would be recommended that SMART program to prevent and treat dental caries effectively in emerging country.

## Acknowledgement

We would like to express our sincere appreciation to Raphael Clinic International, Daewoo International and SNU- Lao Foundation and the regional office of WHO in Lao PDR for reposing confidence on our ability and the feasibility by funding the study. In that process, it is also our duty to thank the dentists posted in Mahosot Hospital. We also thank to prof. Prathip Phantumvanitt and Yupin Songpaisan in Thammasat University in Thailand.

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## Appendix A. The timing and purpose of the SMART monitoring

Study	Purpose	Timing
Performance monitoring	To track the use of SMART inputs and production of outputs and to identify delays and problems	Reports produced monthly or quarterly throughout the period of SMART implementation
Financial monitoring	To monitor the correct use of funds, disbursements, and internal cash flow and assess cost-effectiveness	Monthly, quarterly and annually
Diagnostic studies	To understand why implementation and sustainability problems have occurred and propose solutions	Follow-up to examine problems identified in performance monitoring; or conducted periodically to assess implementation performance.
Midterm assessment of performance	To assess the overall progress of the SMART in order to identify key issues and required changes	Midpoint of the implementation phase
SMART completion report	To assess SMART implementation performance	Prepared within six months of final disbursement
Monitoring operations, maintenance, and sustainability	To assess the capacity of the SMART to continue delivering services and benefits	Conducted on a periodic basis or at one point in time

## Appendix B. The difficulties during SMART program to examine factors affecting the sustainability

SMART project cycle		Plan and design	Resource mobilization	Implementation	Maintenance and monitoring
Organizational factors		- Labor availability Non-sufficient staff or resources - Poor coordination and communication between organizations - Community response - SMART needs assessment	- Procurement problems Inexperience in procurement - Poor control disbursement delays - Participants do not contribute resources.	- Lack of community support - Poor communication - Not available in some schools - Poor management slows SMART. - Inefficient patients selection	Difficulties to collect follow-up data and questionnaires
External environmental factors	Beneficiary responses		Staffs not willing to provide labor.	Patients not willing to be treated.	No expected changes in patients.
	External events		Resources delayed or broken	Delayed caused by environment	

## Appendix C. Questionnaire to parents after SMART.

1. I have been to the dentist with my child during last one year.

(1) Yes -> go to 2nd question (2) No -> go to 3rd question

2. The reason for going to the dentist.

(1) Pain (2) discomfort (3) Oral exam

3. What is the reason not to go to the dentist?

(1) I don't need to go to the dentist.

(2) The payment for dental service is expensive.

(3) Giving the analgesic to my children when they get pain.

(4) Busy and have no time.

(5) The distance is too far.

(6) Etc. - \_\_\_\_\_

4. I am satisfied with SMART that was performed in schools or kindergartens

(1) strongly agree (2) agree (3) disagree (4) strongly disagree

5. What is the reason to be satisfied with SMART?

(1) Prevention and treatment of dental caries

(2) Dental treatment at kindergartens is convenient.

(3) The cost was reasonable.

(4) My child feels comfortable in chewing.

6. What is the reason not to be satisfied with SMART?

(1) My child was terrified or sick. (2) I do not have trust in the treatment. (3) The cost was expensive. (4) I do not feel the need.

7. I would like to continue to participate in the following SMART program.

(1) Yes, I want to participate in the following.

(2) No, I do not feel the need.

8. What do you feel about the program? What you desired about the program?

### Appendix D. Questionnaire assessing SMART to dentists

\* Personal Information

Gender : Male / Female                      Age :                      Dental career (years) :

\* Questions for procedures of SMART

1. All equipment works well and clean.

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

2. Proper disinfection of dental instruments

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

3. Supply of materials was appropriate.

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

4. SMART workshop and training was helpful.

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

\*\*\* Questions on attitudes about SMART

5. Incentive is guaranteed as long as I tried.

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

6. I want to participate in the following SMART again.

(1) strongly agree    (2) agree    (3) disagree    (4) strongly disagree

7. What do you think of the problem of SMART program?

(1) Incentive                      (2) Environment

(3) Excessive amount of treatment work

(4) Staffs and assistants                      (5) Pediatric patients

(6) etc                      \_\_\_\_\_

8.                      What do you think about SMART in school?

\_\_\_\_\_

### Appendix E. Daily SMART Application Report by Local Dentist

Date: ..... Location (Name of School): ..... Responsible Local Dentist: .....

No.	Child's name	Class	Tooth#/ Surface received SMART	Operator	Remark
1					
2					
3					

**Note:** If a child has received more than one SMART application, please record all the applications. Record only one SMART application per line.

## Appendix F. Monthly SMART Application Report by Local Dentist

Month/Year: ..... Area of Implementation: ..... Responsible Local Dentist: .....

No.	Date	No. of children received SMART	Total No. of SMART application		Remark
			Teeth	Cavities	
1					
2					
3					
	Total				

## Appendix G. Quarterly SMART Application Report by Local Dentist

Period (Month/Year): ..... Area of Implementation: ..... Responsible Local Dentist: .....

1. Total amount of material/supplies used

No.	Type of material/supply	Amount	Cost
1	Glass ionomer material		
2	Disinfectant solution		
3	Cotton & Gauze		
4	Hand Instruments		
5	Instrument tray		
6	Etc.		

2. Total amount of material and equipment needed for the next period

No.	Type of material/supply	Amount	Cost
1	Glass ionomer material		
2	Disinfectant solution		
3	Cotton & Gauze		
4	Hand Instruments		
5	Instrument tray		
6	Etc.		

3. Encountered and solved problem(s) .....

## **Appendix H. Interim/Final SMART Application Report by Lao Dental Association**

Date: ..... Period (Month/Year): ..... Location of practicing area: .....

### Summary

1. Number of children and number of cavities received SMART
2. Total number of operator (dentists) rendering SMART
3. Total number of working days/hours rendering SMART
4. Total amount and cost of materials/supplies used
5. Total number of SMART teeth/cavities retention
6. Etc.

Future plans ..... Comments .....

# 신흥개발국에서의 학교구강보건 사업 개발

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## 1. 목 적

신흥 개발 국가 아동들의 구강건강증진 방안을 마련하기 위하여, SMART 사업을 시행한 후 아동들의 구강건강 상태를 평가, 추적 조사하고, 학부모와 시술에 참여한 치과의사들에게 설문 조사를 실시하여, 아동들의 구강 건강 증진 여부, 사업 만족도, 개선 사항, 치과 치료에 대한 인식 등을 조사 분석하여, 다른 신흥 개발 국가에서 SMART 사업을 시행하는 데에 필요한 기초 자료를 마련하기 위함이다.

## 2. 방 법

라오스 비엔티안 지역에 있는 3개의 유치원을 대상으로, 사업 1년 후에 충전물 유지율을 조사하였고, 사업대상 학부모와 사업에 참여한 라오스 치과의사에 대한 설문조사를 시행하였다. 사업 대상 아동은 3-6세의 아동들 중에서 SMART 시술이 필요한 치아가 1개 이상 있으며, 학부모들에게 동의를 얻은 아동들을 대상으로 하였다.

## 3. 결 과

총 368명의 대상 아동 중 146명, 573개의 치아를 추적 조사하였다. 1년 후의 실패율은 24.3% (n=139)이었고, 76.2%는 완전 유지 혹은 부분 유지되고 있었다. 아동들의 나이가 어릴수록 성공

률이 높은 경향을 보였으나 통계적으로 유의하지는 않았다. 구치부의 성공률이 전치부보다 유의하게 높은 경향을 보였다. ( $p < 0.01$ ) 또한 프로그램을 시행할수록 술자의 기술과 숙련도, 경험도 등이 높아져서 유의하게 실패율이 낮아졌다. ( $p < 0.01$ ) 부모들은 98% 이상 사업에 긍정적 의견을 보였으며, 97%이상의 부모들이 다음 사업에도 참여의사를 보였다. 참여한 현지 라오스 치과 의사 모두가 긍정적인 의견을 보였으며, 인센티브제도, 치료 업무의 양, 보조 인력, 주변 환경 등의 개선이 필요하다고 반응하였다. SMART 프로그램은 지속 가능한 신흥개발국에서 발전시켜야 할 효과적인 구강건강 증진 사업으로 권장되었다.

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키워드 : 신흥개발국, 라오스, 예방, 치아우식증, 비손상 치아수복치료, 글래스아이오노머, 학교 구강보건사업

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