

**ADDRESSING THE CARIES EPIDEMIC AMONG CAMBODIAN CHILDREN
THROUGH THE USE OF SILVER DIAMMINE FLUORIDE (SDF)**

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BACKGROUND

Following the Khmer Rouge period, only 34 dentists remained. Dental services have been very slow to re-establish, partly due to more urgent health priorities, and some provinces still have very few dentists. Recent data from the Cambodian Dental Council show that in Kratie, for example, there is one dentist for 372,000 people.

Cambodia also lacks community- and school-based oral health programs, although recently there has been more activity in this area. There are presently no fluoridated water supplies in Cambodia, which has also impacted on population's oral health.

There have been several epidemiological oral health surveys carried out in Cambodia over the past 10 years. A National Oral Health Survey carried out in 2011 found that very few children were caries-free, and very few had previously accessed dental care. The caries experience of the 6-year-olds and the 12-year-olds, as measured by the dmft and DMFT indices, were 9.0 for primary teeth and 3.2 for permanent teeth respectively. That is to say, the average 6 year old had 9 decayed teeth. This is perhaps the highest decay rate in the world, and demands more attention than it presently gets.



The consequences of poor oral health in children have been well described. Apart from frequent episodes of pain and infection, children often have difficulty in eating healthy foods (which can result in under-nutrition). They may have to miss school or be unable to concentrate in class due to toothache. Their dental appearance can be affected resulting in embarrassment and social problems. And if they do manage to get treatment – this can be a significant drain on the family budget. Cambodian children deserve better than this!

Traditional “drill and fill” strategies for tooth decay work well in many countries, but the costs are high. Qualified dentists are usually needed to provide the treatment, and the equipment and materials are expensive. To adopt this approach in the Cambodian setting would mean that only the rich could access care. To provide such care to all Cambodian children with decay would be impossible for two main reasons: there are not nearly enough dentists and dental nurses to provide all the treatment needed – and the entire Ministry of Health budget could be used up just on restoring and extracting children’s decayed teeth.

However, there is another innovative approach to address this major public health problem, which we at the University of Puthisastra been part of, and which will be described in this paper. The innovation involves the use of **Silver Diammine Fluoride (SDF)** to arrest dental caries in the primary teeth in a school setting, allowing the decayed teeth to remain symptom-free and be lost in the normal way as the child grows older. But before proceeding to talk about our innovation, it is necessary to understand more about what SDF is and what it does.

SILVER DIAMMINE FLUORIDE (SDF) - A ‘SILVER BULLET’ FOR MANAGING DENTAL CARIES

Silver Diammine Fluoride (SDF) is a clinically applied treatment that controls active dental caries and aids in preventing further progression of the caries process (Chu et al., 2002). It has been used in a few countries by some dentists since the late 1970s, however recently there has been a resurgence in interest in this unique dental material. The SDF ion acts directly on the caries lesion to inhibit demineralization, promote remineralization, and render the lesion hard and resistant to further advancement (Rosenblatt A et al., 2009).

As well as arresting dental caries, SDF can be used to prevent new lesions in the enamel. This preventive effect has been documented in the pits and fissures of first permanent molars (Lodara et al., 2012), which are the first permanent teeth to decay in most Cambodian children.

There are several different preparations of SDF however the best results appear to be with concentrations of 30-38%SDF.



INTRODUCTION OF SDF IN CAMBODIA

About 3 years ago, a group of dentists (including some from University of Puthisastra) set out to develop a demonstration school-based oral health program which could start to address the mountain of dental decay among Cambodian children in an appropriate and cost-effective manner. Most of the previous approaches had focused only on tooth brushing, which could not really do much for the large number of decayed teeth already present. The new program, which obtained the approval of the Oral Health Office at the Ministry of Health, and the School Health Department at the Ministry of Education, Youth and Sport, was called “Healthy Kids Cambodia” (HKC). This program set out to involve local stakeholders, promote oral health in the school environment, provide holistic health care, focus on prevention and be sustainable. The HKC program has now spread to over 12,000 children in more than 20 primary schools. Students from University of Puthisastra, as well as personnel and volunteers from several NGOs help to support the program in these schools. The HKC program has 3 Levels. Level 1 involves health and oral health check-ups, health education, daily tooth brushing and hand washing (at school), and the application of 30% SDF (imported from Brazil) to decayed primary teeth and the fissures of teeth without decay. Following Level 1, about 50% of children require Level 2 interventions, which include fissure sealants on the permanent molar teeth (to prevent decay), and simple white fluoride-releasing fillings, placed using only simple hand instruments (no injections or drills needed). With Level 1 and 2 interventions, 90% of the dental problems children have can be managed. Level 3 is only

needed by a small percentage of children, and involves more comprehensive care eg dental extractions and fillings which cannot be done in a simple way.



As part of the Healthy Kids project, a research study was carried out by 3 UP dental students, to evaluate the success of the SDF applications. The abstract below was submitted for a conference in 2017, and explains in brief what our research involved, and what the outcomes were.

Objective: To test the effectiveness of silver diammine fluoride (SDF) in arresting primary tooth caries in 6-12 year old Cambodian children. **Methods:** This study was a longitudinal observational study using a convenience sample of 167 children from Api Wat Meanchey primary school. Participants received two applications of SDF (Cariestop 30%) at a six month interval across the course of 1-year. Oral health education was provided to the participants at the beginning of the study and a school tooth brushing program was in place. **Results:** 118 (70.7%) of the participants were followed up after one year of which 56.8% were female. The mean dmft/DMFT at baseline was 10.5 (SD 7.6) / 4.6 (SD 4.9). At follow up **82.5% of open carious lesions were arrested.** **Conclusions:** This study involved children with a very high caries experience and the 30% SDF solution applied two times per year was an effective way to manage caries in this population.

HOW IS THE SDF APPLIED?

The application of SDF is simple: isolate the tooth with cotton rolls, clean and dry the teeth with cotton pellets, apply the SDF with a micro-brush (one drop can treat 6 decayed teeth), and wait for one minute (Monse et al. 2012).



Our team was trained in the method, and found it easy to use in the school setting, with the children lying on a school bench. The children were quite happy to have the solution applied to their teeth.



OBJECTIVES OF THE INNOVATION

The aim of our project was to demonstrate that SDF can be used in a school-based health program to provide significant reductions in active dental caries in a high-risk population, at low cost and using very simple technology.

THE INNOVATIVE NATURE OF THE PROPOSAL

Although SDF has been shown in previous studies (and confirmed by our own study) to be a very effective low-cost way of arresting dental caries, no other countries in South East Asia are employing this strategy to address the high level of dental caries in their own children. The use of SDF in the Healthy Kids Cambodia project, demonstrates how, in a country like Cambodia, which has very limited resources to spend on oral health, this intervention can greatly improve the oral health of thousands of children at a cost the community and country can afford. There are few other countries in the world where this approach is being taken. Cambodia can serve as a demonstration model for neighbouring countries which also have high caries rates among children, on the use of SDF in a public health setting.

FEASIBILITY OF THE PROCESS

Since the introduction of SDF in Cambodia, the University of Puthisastra has been promoting its use among children, both at our UP Dental clinic (where we treat many disadvantaged children) and in the primary schools where we work. SDF has found favour with the School Health Department and the

Oral Health Office at MOH. Our results have been presented at several local and regional conferences. Some dentists are now using SDF in their own clinics, based partly on the results of our study. And the integration of SDF within the Healthy Kids Cambodia project has been a huge success. We believe that our work on demonstrating the appropriateness and cost-effectiveness of SDF has been instrumental in its growing acceptance. Based in part on our results, the Healthy Kids Cambodia project is planning to expand the program to more schools over the coming years, and will be presenting our findings to both the MOH and MOEYS in the future.

COSTS

The SDF which was used for our study cost less than \$10 for a 5ml bottle which can treat approximately 100 children, and arrest caries in over 80% of these children. In contrast, one dental restoration at a good dental clinic in Phnom Penh will cost \$20-\$30. In the future, there are plans to bring in the product into Cambodia through a non-profit micro-enterprise, so that it can continue to be sold to HKC, NGOs, dental clinics and others at low cost.

Presently, the schools which are using SDF as part of the Healthy Kids Cambodia project require outside assistance to implement the program due to their own lack of financial resources. The cost for implementing level 1, which includes daily tooth brushing, daily handwashing, and SDF applications is \$2 per child per year. A number of NGOs are currently supporting some schools to run the program. In addition, dental students from University of Puthisastra are involved in providing Level 1 and 2 interventions on a weekly basis as part of their community dentistry program. There have also been volunteer overseas dental personnel who have helped out in some schools. In the future, if the program is to expand, the parents of the children could be asked to contribute, or government sources of funding could be found. HKC is considering ways to make the project sustainable.

POTENTIAL IMPACT OF THE INNOVATION ON THE TARGET GROUP

The advantages of using SDF include: it is easy to use; there is no need for dental drills or electric power or even a dental clinic; it can be used in school settings with minimal instruments and materials; it is ideally suited to children who are very young or anxious, and who may be unwilling to accept conventional treatment (eg dental injections and drills); and it is very inexpensive. The results of overseas studies show a high rate of dental caries prevention and arrest.

SDF treatment can potentially increase access to care, improve oral health, and reduce the need for emergency treatment. A primary tooth with its caries arrested can act as a space maintainer and sustain chewing function until the tooth is replaced with a permanent successor tooth (Dos Santos et al. 2012).

Although SDF is clinically effective, there is one disadvantage. The most common reported adverse effect of SDF is black staining of carious enamel and dentine (but not the sound tooth tissue)(Yee R et al. 2009, Llodra JC et al. 2005).



WORKING METHODS USED BY THE TEAM

Our team of three senior dental students worked closely with our supervisors from the University of Puthisastra. Ethical consent for evaluation of the Healthy Kids Project interventions was obtained from the National Ethics Committee. Our team underwent training on the diagnosis of caries, the protocol for placement of SDF, and later the measurement of the arrest of dental caries. The team worked together at the school, alternately assisting and placing the SDF on the children. Team members all helped enter the data onto the SPSS program, and carried out the analysis themselves with advice from a UP lecturer. The data from the study is being used as part of their thesis for graduation, with all members contributing. The results have already been presented in a competition at a conference in Jakarta, and in a competition at the Cambodian Dental Association conference (2017). It is intended to present the results at a dental student research competition at Universiti Teknologi Mara in Kuala Lumpur in early April. We believe it is important to show our colleagues in neighboring countries that this innovation is working well in Cambodia, and could probably work well in their countries also.

WHY IS SDF AN IMPORTANT INNOVATION IN CAMBODIA

Although SDF has been used on a small scale in some countries since the 1970s, our work has shown that it has the potential to address the significant issue of child dental caries in low income

communities where access to dental care is very limited. SDF used in school programs such as the HKC project, could be a very effective way of managing dental caries in children in low resource settings in the future.

CONCLUSIONS

Our group of three dental students from the University of Puthisastra has helped to introduce SDF into primary schools in Cambodia, and we have shown through our research that over 80% of the dental caries in the primary teeth can be arrested, and left to exfoliate in the natural way. Applying the conventional “drill and fill” approach to the huge problem of dental caries in Cambodian children is both unrealistic and unaffordable. The use of SDF is not only very cost-effective, but it can be applied in school settings by dental students, dental nurses and even trained nurses. The use of SDF is an important innovation which promises to have a huge impact on the oral health of children, not only in Cambodia, but also in neighbouring countries.

REFERENCES

(see attachment)