

# Journal

CALIFORNIA DENTAL ASSOCIATION

cda

January 2018

Silver Diamine Fluoride  
History and Use

Chronic Disease Management  
of Caries in Children

Managing Caries With Silver  
Nitrate: Lessons Learned



PART I  
**SILVER DIAMINE  
FLUORIDE ~  
THE NEW OLD**

Paul Reggiardo, DDS,  
and Gregory J. Sabino, DDS, PhD



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# Journal

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## Why We Change: Kirk vs. Spock

Kerry K. Carney, DDS, CDE

It seems simple enough: A new diagnosis and treatment recommendation is published, for example the American Dental Association's guidelines on sealing noncavitated carious lesions. The evidence to support the recommendation is made public. The recommendation comes from an established and respected clinical and research source. The materials are readily available. Then ... nothing happens.

The recommended changes are not incorporated into private practice. Practitioners continue to behave in the same way they did before the recommendation's release. What could be the problem? What keeps us from changing our treatment planning behavior?

There is an interesting examination of dentists' behavior regarding implementation of clinical practice recommendations.<sup>1</sup> The investigation attempted to look at what factors are in play when a dentist in private practice considers changing his or her diagnostic and therapeutic behavior.

The study was investigating the determining factors in treatment planning. It was not a rigorous random controlled trial. The sample was small and qualitative. It was not designed to test what variables determine an outcome. The results can only serve to make us think about how we go about deciding to change. "Participants compared their treatment plans with the ADA's recommendations for sealing noncavitated carious lesions and they described barriers to implementing these recommendations in their practices."<sup>1</sup>



In the card game of private practice, one bad outcome trumps everything. How does that work?

"Personal clinical experience emerged as the determining factor in dentists' treatment decisions ..."<sup>1</sup> This is not hard to understand. Having a bad outcome after trying something new has chastened every dentist out there. Surely, every dentist has heard that tiny internal voice say, "Well THAT did not work. I will never do THAT again." One bad clinical experience seems to exert a powerful brake on innovation. In the card game of private practice, one bad outcome trumps everything. How does that work?

If there is a statistical chance that a bad outcome will happen one in 100 times, why does that one bad outcome weigh so heavily when it happens to us? Probably it has something to do with the emotional aspect of decision-making.

Decision-making requires both emotion and logic or rational thought. The two play off each other sort of like Star Trek's Captain Kirk and Mr. Spock. The emotional part of decision-making (Captain Kirk) gives us the impetus to choose. It is the gut feeling we rely on. It is what makes us "feel" like the decision is right. The logical side (Mr. Spock) can act as a brake on the emotional drive to decide, but more often it is used to bolster or rationalize taking the emotional preference.

This rationalization of an emotional preference is illustrated in an elegant little marketing experiment. In the experiment, subjects were shown a plump chicken and a skinny chicken. The subjects were given the following alternate information about the chickens: either the skinny chicken was the healthier choice or the skinny chicken was the tastier choice. The results showed the subjects liked, or preferred, the plump chicken. They reported they had made their decision because health was more important or, if they had been given the opposite fact, because taste was more important. The subjects used the facts they had been given to rationalize their emotional choice.

This kind of emotion/logic push-pull is part of every decision. Captain Kirk can go charging around the galaxy because Mr. Spock gives him the logical basis to justify his emotional behavior. Maybe the captain and his first officer can illustrate what happens when we choose not to change.

Most of us learned in dental school that carious lesions are the enemy. They should be removed and the tooth restored. To leave infected tooth structure behind is tantamount to setting a time bomb. Someday, the tooth will blow up and you will be the cause of that patient's pain

and extensive restorative need. That is an emotionally charged tenet.

The dentists in the sealant guideline investigation may have found this emotionally compelling tenet too strong for the logical evidence-based challenge. They may have “raised shields” and rationalized their refusal to embrace the new sealant guidelines. They reported that they mistrusted the evidence and did not see a reason to place a sealant over that “dark occlusal groove” when they could “clean it out” first. They found the failure of third-party payers to reimburse for the procedure a barrier and called into question the sealant’s value. Patient lack of awareness and understanding contributed to the dentists’ reluctance to change. Finally, they looked to their peers for practice norms. Is the standard they are applying consistent with their peers or out of step?

This last sentiment clearly underscores how the dentists relied on the emotional connection with their peers to be able to override the emotional sway of the tenets they held. The study concludes by emphasizing that publishing evidence-based guidelines are not enough to make us change immediately. “We are faced with the challenge of overcoming longstanding beliefs based primarily on personal clinical observations that seem to contradict scientific evidence ... we need to look for alternative ways to promote acceptance of EB [evidenced-based] recommendations.”<sup>1</sup>

This study was based on sealant guidelines but the same kinds of barriers to acceptance are in place for other innovations in oral health care. Silver diamine fluoride (SDF) usage faces many of the same challenges. The evidence may not be trusted. Reimbursement may be a problem,

patient awareness and acceptance may be a barrier. The idea of treating carious lesions medically instead of surgically flies in the face of the same long-cherished tenet of our profession.

A colleague recently confessed that she was hesitant to employ SDF in her practice because she was afraid she might be accused of supervised neglect. She is comfortable with the logical facts, the evidence base for the use of SDF in the literature and wants to change her diagnosis and treatment of some carious lesions as a result. However, her emotional fear of losing the respect of her peers or being judged by her patients as providing substandard care keeps her from embracing change.

In a case like this, when Captain Kirk and Mr. Spock are in conflict, it can help to relocate the emotional target. If the emotional priority resides in the patient and the patient’s oral health and welfare, then this conflict can be reduced. The patient can be informed and enlisted as a partner in settling on the innovative treatment decision. Then the patient is prepared to advocate for the procedure and the decision that he or she and the dentist agreed upon. In fact, if the dentist is able to combine the Kirk and Spock elements of decision-making successfully, he or she just might find that an innovative treatment may boldly go where few clinical practice recommendations have gone before: into everyday private practice. (With apologies to the memory of Gene Roddenberry and Trekkers everywhere.) ■

#### REFERENCE

1. O’Donnell JA, Modesto A, Oakley M, Polk DE, Valappil B, Spallek H. Sealants and dental caries: Insight into dentists’ behaviors regarding implementation of clinical practice recommendations. *J Am Dent Assoc* 2013 Apr;144(4):e24-30.

### The Journal welcomes letters

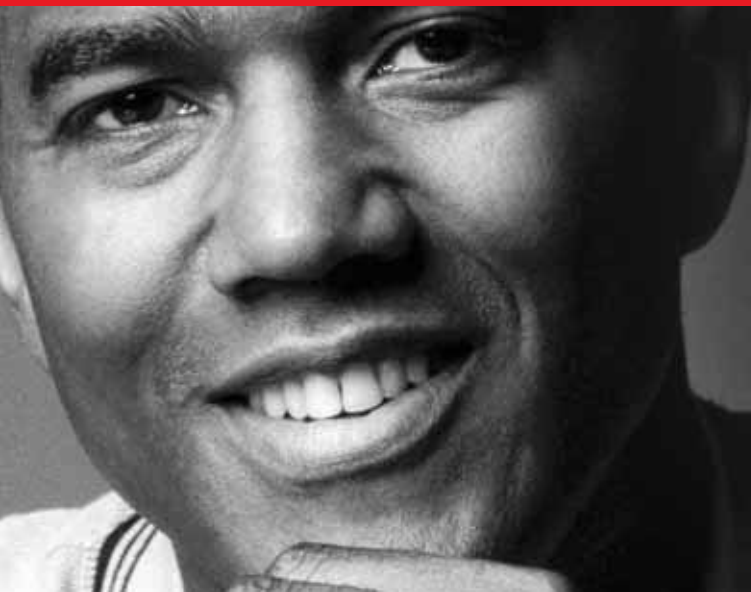
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## For the Love of Amalgam

Dr. Shue's editorial about dental amalgam in the November 2017 issue of the *Journal* was an informative and enjoyable essay. His style of smooth-reading prose was flavored by well-placed bits of humor.

I didn't know there was an amalgam controversy during the birth of the original California State Dental Association. I had to Google Crawcour "brother" to learn when dental amalgam was introduced in the

U.S. (1833), but also to learn that it was used in China in the early part of the Tang Dynasty (AD 618–907), per Wikipedia. Gosh, paper, gunpowder, the compass, printing ... and amalgam, too?

As to the two 40-year-old buccal pit amalgams he still has, I'll one-up him with two of my existing amalgams from 1952 ... placed with a rubber dam.

STEPHEN S. YUEN, DDS  
CDA EDITOR, 1970–75  
San Mateo, Calif.



### More Amalgam Love

I found Associate Editor Brian Shue's editorial "How I Learned to Stop Worrying and Love Dental Amalgam" in the November *Journal* delightful and refreshing.

I love amalgam, too, because I treated and saved many teeth with this durable material during a long professional life. I have also observed the long service life of teeth restored with amalgam by my colleagues.

Despite multiple studies proving that patients are only exposed to a negligible and transient mercury vapor, the neurological safety of amalgam will be debated until the cows come home.

In my private practice, I had a few patients who requested amalgam over composite for health reasons, because they were aware of the estrogen-like component in composites. Let's keep remembering to educate our patients on what we learned in dental school: There is no such thing as a perfect dental material.

DONNA B. HUROWITZ, DDS  
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# Which Is Worse for Dentistry: Markets or Regulation?

David W. Chambers, EdM, MBA, PhD



The nub:

1. Markets are a fair means of exchanging known quantities — price is known by patients, quality of care is not.
2. Regulation primarily benefits organized special interest groups.
3. It is an open question whether professionalism can survive the changing forces of the market and regulation.

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**David W. Chambers, EdM, MBA, PhD**, is a professor of dental education at the University of the Pacific, Arthur A. Dugoni School of Dentistry, San Francisco, and the editor of the American College of Dentists.

During the past decade as dentistry has become more about appearance and cost, dentists' incomes have stagnated and in some cases declined. If dentistry loses its unique status as a regulated professional monopoly, there is no certainty that either the free market or regulation will protect it.

Here is the logic regarding markets. Even in the best of worlds, patients will never know enough about when to seek care or how to choose the best available options. Information asymmetry is part of the arrangement and it is cost-ineffective to attempt to entirely remove that barrier.

Better quality care is necessarily more expensive. Put in negative terms, someone can always do it cheaper and worse. Thus there will always be a quality/price gap where patients are unable to recognize the whole value they receive for higher cost. Such gaps are not evident when buying a car or a meal in a restaurant because the consumer can see pretty much all of the benefit. In oral health, quality is latent. Great skill may be needed in case unanticipated complications arise and the best care reduces or eliminates the signals of quality patients can judge for themselves.

The market is a blunt instrument for reducing the quality/price gap. We cannot count on advertising to correct information asymmetries. Because we cannot adequately evaluate quality, the gap will tend to be closed by offering lower quality at lower prices. We have home bleaching and home orthodontics. Corporate models of delivery emphasize volume and standardized treatment plans.

The market aspect of dentistry is controlled by the Department of Consumer Affairs, not the profession. Licenses are granted to construction firms, cosmetologists, social workers, dentists and others to function as market entities. The standard is low on the grounds that more services are better for the public. A minimal standard is set for safety and customers are allowed to select the level of quality they can discern and afford.

The alternative is regulation — a mixed blessing. It is expensive, sometimes produces unexpected or even paradoxical results and is intended to benefit one group at the expense of another. Dentistry, as a well-organized special interest group, has enjoyed monopoly status and consistently raised the minimal standard of care. Monopolistic regulation focuses on the high end of the quality/price gap, holding up both and denying access to care for many.

Historically, dentistry has balanced the market and regulatory mechanisms quite successfully. This has been possible because dentistry has been organized and the public has not. These conditions are changing. Many in the profession have started selling smiles instead of health, and that in dollar-denominated terms. New, well-organized interest groups are pushing for regulatory adjustments at exactly the time when membership in organized dentistry is dropping. ■



Comparison of dental X-rays from patients with and without vitamin D deficiency. Left image shows a modern tooth with normal pulp horns; right is an archaeological tooth with chair-shaped pulp horns. (Credit: McMaster University)

## Dental X-rays Reveal Hidden Vitamin D Deficiency

Human teeth hold vital information about vitamin D deficiency, a serious but often hidden condition that can now be identified by a simple dental X-ray, according to research conducted by McMaster University anthropologists Lori D'Ortenzio and Megan Brickley and published in the *International Journal of Paleopathology*.

The researchers and their colleagues had previously discovered that human teeth hold a detailed and permanent record of serious vitamin D deficiency, also known as rickets. That record takes the form of microscopic deformities in dentin, the material that makes up the mass of the tooth, and can be extremely valuable for understanding precisely when people, even those who lived centuries ago, were deprived of sunlight, the main source of vitamin D.

The record is preserved by enamel, which protects teeth from breaking down, unlike bones, which are subject to decay.

The problem with looking for such deformities is that a tooth must be cut open to read the patterns that form a lifetime's vitamin D record, and the supply of postmortem teeth available for study is limited. To avoid wasting precious specimens, the researchers looked for a way to isolate teeth for further study. By using X-rays to study the readily observable shapes of the pulp horns, they found a consistent, recognizable pattern that could prove

## Osteocytes Are Major Source of RANKL

A study conducted by a Tokyo Medical and Dental University research team demonstrated that osteocytes play a crucial role in orthodontic tooth movement as the major source of receptor activator of nuclear factor- $\kappa$ B ligand (RANKL), a protein crucial to bone remodeling. The study was published in the journal *Scientific Reports* in November.

During orthodontic tooth movement, osteoclastic bone resorption is essential for alveolar bone remodeling. The differentiation of osteoclasts is regulated by RANKL, however, the source of RANKL in the periodontal tissue during orthodontic tooth movement was not identified.

The research team revealed that osteocytes mainly express RANKL and are the key to remodeling of the bone surrounding teeth during orthodontic tooth movement by first examining an orthodontic tooth movement model in which open coil springs were inserted between teeth of mice to move first molars. Injection of a neutralizing antibody against RANKL reduced tooth movement.

To identify the cellular source of RANKL in periodontal tissue, they established a novel method to fractionate cells in periodontal tissue. Notably, osteocytes were revealed to express much higher levels of RANKL compared with other periodontal tissue cells.

Physiological significance of osteocyte RANKL in vivo was confirmed using osteocyte-specific RANKL deletion mice. Orthodontic tooth movement was significantly suppressed in these mice with a decreased number of osteoclasts on the bone surface around the tooth where mechanical force was applied, thus demonstrating the role osteocytes have as a major source of RANKL during orthodontic tooth movement.

Read more about this study in *Scientific Reports* (2017); doi:10.1038/s41598-017-09326-7.



helpful not only to their studies of archaeological teeth but to living people who may not realize they are suffering from vitamin D deficiency.

The pulp shape in a healthy person's tooth resembles an arch topped by two cat ears, while the pulp shape of a person who has had a severe deficiency of vitamin D is asymmetrical and constricted. The anthropologists' previous research had suggested such a recognizable

pattern, and their examination of both historic and current teeth proved that X-ray images are consistent and reliable indicators of prior deficiency.

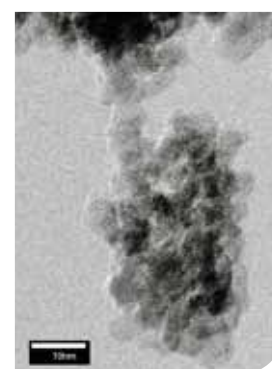
Because the consequences of vitamin D deficiency can be severe, knowing who has had a deficiency can help identify people who may have ongoing issues in time to prevent worse damage. Learn more about this study in the *International Journal of Paleopathology* (2017); doi.org/10.1016/j.ijpp.2017.10.001.

## Nanodiamonds Protect Root Canals, Aid Recovery

People who undergo root canals may soon have a tiny but powerful ally that could prevent infection after treatment. Researchers at the UCLA School of Dentistry and the UCLA Henry Samueli School of Engineering and Applied Science found in a clinical trial that nanodiamonds protected disinfected root canals after the nerve and pulp were removed, thereby improving the likelihood of a full recovery.

The findings are a milestone for the use of nanodiamonds in humans, according to a paper published in *Proceedings of the National Academy of Sciences*.

Nanodiamonds are tiny particles made of carbon and are so small that millions of them could fit on the head of a pin. They resemble soccer balls but have facets like actual diamonds. Those facets enable the nanodiamonds to deliver a wide range



Scanning transmission electron microscope image of detonation nanodiamond.

of drugs and imaging agents. Researchers found that combining nanodiamonds with gutta percha, a material used to fill disinfected root canals, may enhance the gutta percha's protective properties.

"Harnessing the unique properties of nanodiamonds in the clinic may help scientists, doctors and dentists overcome key challenges that confront several areas of health care, including improving lesion healing in oral health," said Dean Ho, MS, PhD, professor of oral biology and medicine in the dental school and co-corresponding author of the study.

The researchers tested nanodiamond-embedded gutta percha (NDGP) in three people who were undergoing root canal procedures. Tests of the implanted material confirmed that the NDGP was more resistant to buckling and breaking than conventional gutta percha. All three patients healed properly, without unusual pain and without infection. Using NDGP for the procedures did not require changes to any of the standard procedures for root canals.

"This trial confirms the immense promise of using nanodiamonds to overcome barriers for a range of procedures, from particularly challenging endodontics cases to orthopedics, tissue engineering and others," said co-corresponding author Mo Kang, MS, DDS, PhD, UCLA Dentistry's Jack Weichman professor of endodontics. "We believe nanodiamonds could ultimately help us sidestep drug resistance in cancer ... and address other clinical challenges."

Learn more about this study in *Proceedings of the National Academy of Sciences* (2017); doi:10.1073/pnas.1711924114.

## Antimicrobial Gel Could Improve Root Canal Results

An antimicrobial gel discovered and developed at the Indiana University School of Dentistry could improve the results of root canal treatments, according to a study published in the *Journal of Endodontics* and the *International Endodontic Journal*.

More than 15 million root canals are done each year, according to the American Association of Endodontists. During the procedure, the tooth's pulp and nerve are removed before the tooth is cleaned and sealed. If bacteria, viruses or yeasts contaminate the tooth, another root canal procedure or surgery must be done.

Ghaeth H. Yassen, BDS, MSD, PhD, a visiting assistant professor at the university, developed the injectable antimicrobial gel, which can disinfect a tooth during a root canal procedure.

"I wanted to create a gel that provides sustained antimicrobial properties even when it is removed. I also wanted it to have minimal toxic effect on stem cells and not cause tooth discoloration," Dr. Yassen said. "Creating an antimicrobial space is especially important during clinical regenerative endodontic procedures."

The gel has advantages over traditional medications such as calcium hydroxide, which is widely used as an antibacterial agent, and offers extended and significantly longer residual antibacterial properties. "It is biocompatible and it contains a low concentration of antimicrobial elements," Dr. Yassen said.

His next steps include optimizing a version of the gel that is opaque to X-rays and other radiation, which will enable dental care professionals to track it within the root canal system.

Learn more about this study in the *Journal of Endodontics* (2017); dx.doi.org/10.1016/j.joen.2016.12.014.

Ghaeth H. Yassen's antimicrobial gel is poured from an injectable syringe onto a glass plate. (Credit: Indiana University)





## Dental Filling Failure Linked to Smoking, Drinking, Genetics

New research shows that people who drink alcohol or men who smoke are more likely to suffer a failed dental filling. The research team also found that a genetic difference in some patients is associated with increased filling failure rates.

The study, published in the journal *Frontiers in Medicine*, also shows no major difference in filling failure rates between traditional amalgam and newer composite resin fillings. The results suggest that genetic analysis might help dentists to personalize treatments for their patients, which could lead to improved outcomes.

Fillings can fail for a variety of reasons, including reemergence of the initial tooth decay or the filling becoming detached. Until now, the jury has been out on whether newer composite resin fillings are as durable as traditional amalgam fillings.

To investigate this, researchers accessed a large repository of dental records from a dental school in Pittsburgh, which contained information on patient fillings and rates of failure up to five years after the filling procedure.

The researchers found no major differences overall between patients receiving amalgam or composite fillings in terms of filling failure rates. This suggests that composite fillings are at least as durable as amalgam fillings and offer a viable alternative with no toxic ingredients.

The repository also contained information about patient lifestyles, including smoking and drinking habits, and a DNA sample from each patient

## Dental Health Can Protect Children From Obesity

Talking about dental health with children and parents can be one way to prevent children from becoming overweight, according to a thesis on children's diet, body mass index (BMI) and well-being from Sahlgrenska Academy in Göteborg Sweden.

"Weight can be a sensitive subject, but if you talk about eating behaviors alongside dental health, you're looking at the issue from a different angle," said Louise Arvidsson, registered dietitian, PhD student at the Institute of Medicine in Sweden and author of the thesis.

In one of her substudies, she reviewed eating behavior, BMI and dental health of 271 preschool and primary school children in Sweden. The children's height, weight and food intake over one day were compared with the prevalence of cariogenic microorganisms in saliva – and the link was clear: The children who had a higher amount of caries bacteria also had significantly higher BMI and worse eating habits. They ate more frequently and consumed more foods rich in sugar.

In addition to better oral health, good food also increases self-esteem, better relationships with friends and fewer emotional problems, according to a substudy conducted by Arvidsson. Children who to a higher extent followed general dietary recommendations reported better mental well-being. The effects were achieved regardless of socioeconomic background and regardless of the children's weight.

Arvidsson's thesis is based on data from a large European study, IDEFICS (with the University of Gothenburg having primary responsibility for Sweden's participation), the aim of which is to document and prevent childhood obesity.

Read more of this thesis at [hdl.handle.net/2077/52844](http://hdl.handle.net/2077/52844).



allowing the team to investigate whether patient lifestyle and genetic factors could affect the failure rate of composite fillings.

The team found that within two years of the procedure fillings failed more often in patients who drank alcohol and the overall filling failure rate was higher in men who smoked. Furthermore, a difference in the gene for matrix metalloproteinase (MMP2), an enzyme found in teeth, was linked to increased filling failure.

The researchers hypothesize that MMP2 might be able to degrade the bond between the filling and the tooth surface, potentially leading to failure. However, researchers have not yet confirmed whether differences in the MMP2 gene are responsible for failed fillings and will need to investigate further.

Read more about this study in *Frontiers in Medicine* (2017); doi.org/10.3389/fmed.2017.00186.

## New Technique Simplifies Dental Bone Graft Procedures

Researchers from the University of Minnesota, Minneapolis, have introduced a technique that aims to maintain the integrity of the bone graft during closure after tooth extractions to avoid additional surgeries and increased treatment costs. The study was published in the *Journal of Oral Implantology* in 2017.

Termed the continuous periosteal strapping suture (CPSS) technique, this method, if implemented correctly, requires a less complex surgical procedure than currently available techniques. This simpler procedure leads to lower overall treatment costs, according to the study.

CPSS relies on resorbable sutures and membrane and does not include



any surgical screws or tacks to help keep the graft in place. Instead, a series of intricate knots made with resorbable sutures surrounding the membrane are used. The knots help to maintain the strength of the sutures, creating a firmer hold on the wound closure area.

With the use of resorbable materials, the need for a separate surgery to remove “tenting” screws or tacks can be eliminated. The researchers also found that using sutures with a higher tension rate, or tensile strength, increased the duration of the suture time from 56–70 days to 91–119 days. This increased tensile strength for a longer period is expected to be a critical part of membrane and graft stabilization, because having longer-lasting sutures will help ensure the sustainability of the procedure, according to the study.

“One of the biggest challenges when osseous grafting the ridge to widen the site with particulate material is containing the graft and avoiding lateral displacement during healing,” researcher Gregori M. Kurtzman, DDS, said. “The CPSS technique predictably helps contain the graft without the need for an increase in material costs or complicated techniques.”

The researchers conclude that although their technique is limited by the tensile strength and resorption rate of the specific suture used, they still found it to have fewer complications and predictable outcomes. The authors also suggest that future studies should be conducted comparing the CPSS technique with other membrane fixation techniques (i.e., “tenting” screw or tack techniques).

Read more about this study in the *Journal of Oral Implantology* (2017); doi.org/10.1563/aaid-joi-D-17-00060.

## Study Shows How EPS Support Survival of Bacteria in Dental Plaque

Extracellular polysaccharides play a central role in the survival capabilities of caries-causing bacteria in dental plaque, according to a report published recently in the journal *PLOS ONE*. Researchers from the University of Basel’s preventative dentistry and oral microbiology clinic and department of biomedical engineering in Switzerland hypothesized that extracellular polysaccharides (EPS) support the bacteria’s survival capabilities. EPS are substances that build extracellular cariogenic bacteria from sugar residue. They create the biofilm’s scaffolding and ensure that bacteria are able to anchor themselves in the dental plaque.

Cariogenic bacteria live in biofilm and attack dental enamel by converting sugar and starch into acids that dissolve out calcium from the enamel. This process can cause caries. The dissolution of calcium increases the concentration of calcium locally, creating an environment that is hostile to bacterial life. In the study, the researchers investigated how bacteria manage to survive in dental plaque despite these conditions.

The study showed that the more calcium cariogenic bacteria dissolve, the greater their calcium tolerance and survival capability in the biofilm becomes. The scientists were able to prove that cariogenic bacteria develop mechanisms to help them survive the high concentrations of calcium.

They demonstrated that extracellular polysaccharides possess a high number of calcium binding sites through which they can integrate the free calcium into the biofilm, which neutralizes the toxic substance and strengthens the biofilm’s EPS structure. The EPS’ integration of calcium doesn’t just help cariogenic bacteria to survive in dental enamel; it also causes caries, according to the study.

Learn more about this research in *PLOS ONE* (2017); doi.org/10.1371/journal.pone.0186256.





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# Silver Diamine Fluoride — The New Old

Paul Reggiardo, DDS

## GUEST EDITORS

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*Conflict of Interest*  
*Disclosure: None reported.*

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*Conflict of Interest*  
*Disclosure: None reported.*

*“Hey, Doc, what’s new?”*

How many times have we heard that tiresome chestnut from patients, relatives or neighbors we run into at the supermarket or ATM and from friends and strangers alike at dinner parties or similar social gatherings? The answer today is something as old as the description of the arrest of carious dental lesions by the application of silver nitrate reported by Stebbins in the 1800s.<sup>1</sup> And at the same time, it’s as new as the recent FDA approval of a commercially available silver diamine fluoride (SDF) product as a Class II medical device to treat dentin hypersensitivity and used “off label” by dentists to treat dental decay in the paradigm shift to the medical management of caries.

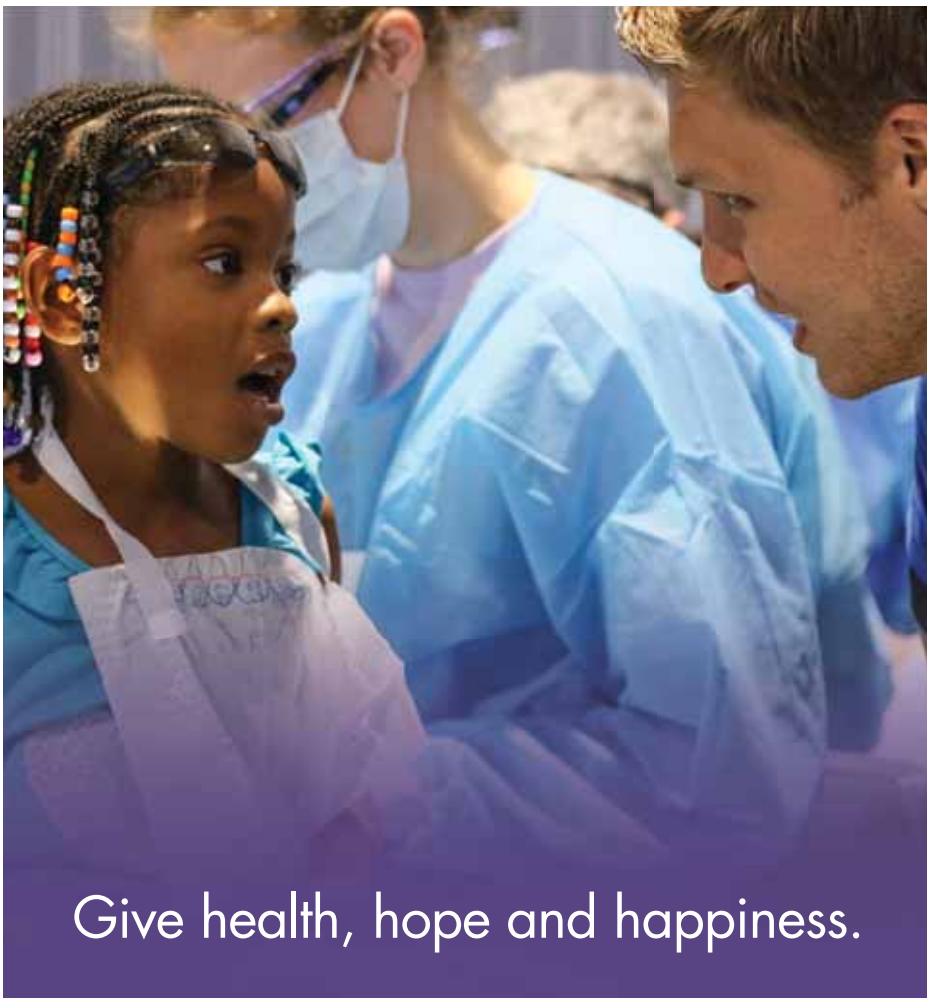
Or maybe our patients are telling us about SDF after reading it is “better, faster, cheaper” than conventional restorative treatment with the added benefit of “no noise, no drilling” and “you don’t need an injection.”<sup>2</sup>

Where does silver diamine fluoride fit in our armamentarium of treatment options? For which conditions, under which situations and for which populations is it indicated? How

is it best applied? Although these questions are slowly being answered by researchers and clinicians, and in spite of a well-developed protocol published in this *Journal* in 2016 by Horst and others at the University of California San Francisco,<sup>3</sup> we have yet to reach professional consensus on these issues or others such as the duration of application or the ideal number and frequency of application for optimum caries control.

This issue and the next of the *Journal* will attempt to move that understanding and dialogue forward with a series of articles that begins with a background and history of the use of silver compounds in dentistry by Elise Sarvas, DDS, MSD, MPH. Dr. Sarvas discusses the mechanism by which SDF arrests the carious process, suggests some of the indications for use and places it in the context of the shift from surgical management of dental caries to a medically managed process.

Man Wai Ng, DDS, MPH, and Rosalyn Sulyanto, DMD, MS, consider in even greater detail the role of SDF in chronic disease management (CDM) of caries, a personalized system of coordinated health care interventions and patient self-management of etiologic



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factors to restore or maintain health. The authors outline a customizable seven-component CDM protocol for effective control of early childhood caries and suggest that SDF not be offered alone but in the context of a CDM program.

Taking the concept into the field, Michael Kanellis, DDS, MS, and co-authors report on the initial lessons learned from the first randomized clinical trial in the United States to examine the effectiveness of silver nitrate in the medical management of childhood caries. The authors highlight challenges in adopting the medical model as the sole intervention strategy for dental caries and suggest clinically relevant recommendations on appropriate case selection.

Finally, to aid clinical decision-making, the first evidence-based guideline on the use of silver diamine fluoride to treat caries in pediatric and special needs patients is included. Developed by the American Academy of Pediatric Dentistry from a systematic literature review and released in October 2017, it contains practical guidance in the application of 38% SDF and an application protocol supported by the best available evidence to date.

In the February issue, authors will present case studies in pediatric and adult (aging and medically complex) populations, findings from clinical studies and some additional recommendations for practitioners. ■

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# The History and Use of Silver Diamine Fluoride in Dentistry: A Review

Elise Sarvas, DDS, MSD, MPH

**ABSTRACT** Silver has a long history of use in medicine, even before its antimicrobial properties were fully understood. Dentistry's recent paradigm shift to medical management of oral disease elevates the use of medicaments. After years of use in the developing world, silver diamine fluoride has emerged as a successful alternative to invasive dental treatment in the United States. This medicinal option to bridge primary prevention and surgical treatment holds exciting promise for future development and research.

## AUTHOR

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*Conflict of Interest*  
*Disclosure: None reported*

Humans have valued silver for thousands of years for its antimicrobial properties. Even before the advent of germ theory, Alexander the Great stored water in silver containers on his campaigns, ancient Romans described placing silver foil in wounds in their first book of medicine and American settlers traveling west to California dropped silver coins in their water barrels to slow the growth of algae and bacteria.<sup>1</sup> As the microbial origin of disease became better understood and antibiotics were developed, silver continued to play an important role in creating successful and safe medical devices such as sutures, catheter parts, cardiac devices and other surgical appliances.<sup>2</sup>

Silver was first used in dentistry as early as the 1840s in the form of "nitrate of silver" (known today as silver nitrate,  $\text{AgNO}_3$ ). This salt is extremely caustic and early American dentists used it to instantaneously cauterize carious lesions

in order to achieve an effect analogous to the hard, dark crust observed on teeth whose untreated decay had fortuitously arrested naturally over time.<sup>3</sup> Silver nitrate continued to be a popular dental medicament through the era of G.V. Black and his modernization of operative dentistry. In 1917, an ammoniacal silver nitrate solution ( $\text{AgNH}_3\text{NO}_3$ ) was developed and marketed as an antimicrobial product that purportedly could penetrate even deeper into dentin. Until the 1950s, this "Howe's solution" was used to sterilize lesions after preparation and was even advocated as a disinfectant in root canal therapy.<sup>4</sup>

In the 1970s, the Western Australia School Dental Service used silver fluoride (AgF) as the initial part of a minimally invasive treatment process for a cohort of disadvantaged young children in New South Wales.<sup>5</sup> In order to systematically decrease the large backlog of dental cases in this rural area, AgF was seen as essential to inhibiting the growth of

existing lesions. This step was followed by an application of stannous fluoride ( $\text{SnF}_2$ ) to act both as a reducing agent for  $\text{AgF}$  and to prevent new lesions from occurring. This two-step “metal fluoride” approach resulted in 74 percent of the existing lesions remaining unchanged and only 35 percent of all lesions requiring additional surgical treatment. Despite this combination’s success in decreasing caries, there were few studies after the 1990s investigating this method.<sup>4</sup>

### A Brief History of Silver Diamine Fluoride in Dentistry

Silver diamine fluoride (SDF) was first investigated as part of Mizuho Nishino, PhD’s thesis at Osaka University in Japan in 1969.<sup>6</sup> She sought to combine the powerful antimicrobial properties of silver with the benefits of a high dose of fluoride. This formulation also resulted in a precipitate that occluded dentinal tubules and reduced hypersensitivity.<sup>7</sup> Soon after, “diammine silver fluoride” was granted approval from the Central Pharmaceutical Council of the Ministry of Health and Welfare of Japan as a cariostatic agent and marketed under the name Saforide (Toyo Seiyaku Kasei Co. Ltd., Osaka, Japan). This compound,  $\text{AgF}(\text{NH}_3)_2$ ,<sup>2</sup> is commonly misspelled or misinterpreted as silver diamine fluoride, when in fact the proper terminology is silver diammine fluoride as it contains two ammine groups ( $\text{NH}_3$ ), not two amine groups ( $\text{NH}_2$ ).<sup>4</sup> The use of the term “diamine” is so ubiquitous, however it has become the accepted form both in the scientific and marketing literature.

In vivo and in vitro studies of SDF as an alternative dental treatment initially emerged from dental public health researchers in the developing world, where access to oral health care is extremely limited. Most of these primary population studies came from teams in Argentina, Brazil, China, Cuba, Japan

and Nepal.<sup>8,9</sup> The results of these studies are challenging to analyze because of their diverse methodology, inconsistent inclusion criteria, lack of standardized controls and dissimilar outcome criteria, but several key themes emerged. First, a concentration of 38% SDF was found to be superior at arresting caries compared to lower concentrations of 10 or 12%.<sup>10</sup> This was true with or without reducing agents such as potassium iodide or tannic acid found in tea.<sup>11,12</sup> Second, SDF was superior at arresting dental caries and preventing new caries compared

In October 2016, the FDA awarded SDF the designation of “breakthrough therapy” based on its arrest of dental decay in children and adults, a first for an oral health therapy.

to fluoride varnish alone, interim therapeutic restorations (ITR) with fluoride-releasing glass ionomer cement (GIC) or other medicaments and low-cost interventions such as chlorhexidine and oral hygiene instruction.<sup>8,13,14</sup> This however did not hold true when SDF was used as a sealant over noncavitated molar grooves. In these studies, it performed worse than or equal to GIC or resin sealants.<sup>11,15,16</sup> Finally, multiple applications of SDF were found to be more successful at arresting dental caries than one-time placement. There was no consistence evidence for what the optimal frequency and time interval between these applications might be or the variables that could influence these protocols, but most recommend an application every six to 12 months.<sup>8,17</sup>

SDF gained clearance from the U.S. Food and Drug Administration (FDA) as a Class II medical device in August 2014. Similar to 5% sodium fluoride varnish, its approval for use to treat dentin hypersensitivity in adults aged 21 and older was grandfathered in because it was in use before 1976. Its physical ability to block dentin tubules allowed it to be classified as a medical device, rather than a drug, paving the way for expedited approval. In October 2016, the FDA awarded SDF the designation of “breakthrough therapy” based on its arrest of dental decay in children and adults, a first for an oral health therapy. This distinction identifies SDF as a drug “to treat a serious or life-threatening disease or condition” and affirms that “preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over existing therapies.”<sup>18</sup> This marked the first time that oral disease had been categorized as a serious medical condition and elevated its importance as a significant public health issue. As of this writing, SDF is manufactured by one company in the U.S.

### Utilization of SDF

#### *Medical Management of Caries*

The resurgence of using silver ion products in dentistry stems from the growing movement to shift the surgical management of dental caries to a medically managed process. In medicine, care exists in three broad levels: primary, secondary and tertiary care. For example, primary care of noninsulin-dependent diabetes mellitus includes preventive measures such as eating a healthy diet, maintaining appropriate body weight and regular exercise. Secondary care for this disease includes intervention with medications such as metformin or sulfonylureas. If the disease continues to

progress, tertiary care in the form of surgery (e.g., bariatric to maintain body weight or limb amputation) may be necessary. From the profession's barber-surgeon origins until the late 20th century, dentistry was concerned primarily with tertiary treatment of oral disease sequelae. As more of the infectious process was understood and with recognition that surgical treatment alone was not a cure, the profession embraced a medical model to manage the disease.

A 2001 consensus statement from the National Institutes of Health affirmed that this paradigm shift involved assessing the caries risk of a patient and providing preventive measures as necessary based on this risk.<sup>19</sup> Primary care, including oral hygiene instruction, dietary counseling and fluoride supplementation was formally included to address specific patient risk factors.<sup>20</sup> Introduction of pharmaceuticals as secondary care was the next logical step in full adoption of this model. Dental chemotherapeutics (e.g., high-concentration fluorides, pellicle-inhibiting drugs such as chlorhexidine and silver ion compounds) act as adjunct options to the surgical treatment of these lesions as caries-inhibiting and caries-arresting medications. Currently, SDF is covered under the Current Dental Terminology code D1354 as set forth by the American Dental Association. This is designated for a caries-arresting medicament to topically treat an existing asymptomatic carious lesion without removal of tooth structure and can be used by all properly trained dental professionals. Future research will hopefully continue to add secondary care adjuncts to the dental arsenal.

#### *Mechanism of SDF*

SDF is a uniquely powerful caries-arresting medicament because of the combined antibacterial properties of silver, the resulting precipitated barrier and the high dose of fluoride delivered.

The two main components, fluoride and silver, are made soluble in water by the addition of ammonia. While metallic silver is inert, silver ions are a broad-spectrum antimicrobial that has high biocompatibility and low toxicity in humans. These ions act as tiny "silver bullets" that damage and degrade bacterial cell walls, disrupt bacterial DNA synthesis and replication and disrupt intracellular metabolic activity, eventually leading to cell death.<sup>21</sup> These killed bacteria further act as a carrier for silver ions and can kill living bacteria nearby in a process known as the "zombie effect."<sup>22</sup>

Once applied, a physical barrier precipitates out of the clear solution onto the carious lesion. Two major products form — silver phosphate ( $\text{Ag}_3\text{PO}_4$ ), which acts a reservoir of phosphate ions, and calcium fluoride ( $\text{CaF}_2$ ), which is a pH-regulated fluoride supply available during cariogenic challenge.<sup>4,6</sup> Minor products such as silver-protein complexes form, but their role is poorly understood. It is hypothesized that silver fills the microtubules, further sealing the tooth from disease.<sup>23</sup> Free silver ions in the lesion or other physical harbors (e.g., demineralized crevices or craze lines) are reduced by environmental oxygen and turn the lesion black, which is the major nonmedical side effect of this medicament (**FIGURE**).<sup>12</sup> A small decrease in discoloration is possible by binding free silver ions with an application of potassium iodide, however the darkened color remains a concern in aesthetic areas. A recent study reported that parent acceptability of the resulting staining was low for anterior teeth (29.7 percent), but acceptance increased if the choice was between SDF application and treatment under general anesthesia (60.3 percent).<sup>24</sup>



**FIGURE.** Black staining characteristic of treatment with SDF on a 3-year-old patient. (Courtesy of Daniel G. Raether, DDS, MS, private practice, Plymouth, Minn. )

To date, this medicament has the highest concentration of fluoride ions available on the market. The 5% SDF solution contains 44,800 fluoride parts per million (ppm), almost twice that of 5% sodium fluoride varnish containing 22,600 ppm. In this concentration, SDF reacts with calcium and phosphate ions to produce fluorohydroxyapatite crystals, which are less susceptible to solubility and crucial to tooth remineralization.<sup>25</sup> Despite the high concentration, the small amount required to be effective suggests that SDF is well within the margin of safety for use.<sup>26</sup>

#### *Indications for Use*

As medicament options for the treatment of dental caries expand, their potential uses will become further defined and perhaps more specialized. SDF is currently only approved in the U.S. to treat dentin hypersensitivity and is a conservative alternative to restorative treatment for individuals who experience sensitivity from gastroesophageal reflux disease (GERD) or severe bruxism. It is also a clinically acceptable treatment alternative for individuals with challenging behavior or whose safe dental treatment is precluded by other medical management complexities. Its ease of application allows it to be applied in office without need for sedation or other invasive measures. This makes it ideal for individuals who are uncooperative, either because of age or special health care disability. When

dental care cannot be completed because of a more urgent medical complexity, such as the need for an organ transplant, SDF can buy time until more definitive treatment can be accomplished.<sup>27</sup>

Contraindications to the use of SDF include use in individuals with a silver allergy, those with open oral sores and teeth that require pulpal therapy (i.e., irreversible pulpitis or necrosis). The exact prevalence of individuals with a silver allergy, most commonly a Type IV reaction, is unknown but believed to be rare. Individuals at risk for developing a silver allergy include those who have been previously sensitized to the metal either from medical (e.g., burn treatment with silver sulphadiazine) or industrial (e.g., metallurgical processing) exposure.<sup>28</sup> SDF can irritate already sensitive open mouth sores (e.g., herpetic gingivostomatitis, ulcerative gingivitis) and should be used with caution until those symptoms subside. Coverage of the irritated mucosa with petroleum jelly to protect it during application is an option.

For teeth with large carious lesions approximating the pulp, adjunctive treatments to SDF should be considered to maximize its effectiveness, as it does not restore form and function. Placement of GIC over an SDF-treated lesion using the silver modified atraumatic restorative technique (SMART) is an option.<sup>29</sup> This placement should be done several hours or days after initial SDF placement, as the ammonia in the wet medicament can be corrosive to glass. SDF placed as an indirect pulp cap in deep lesions approximating the pulp have shown similar remineralizing efficacy as GIC and calcium hydroxide (Ca(OH)<sub>2</sub>) in one in vivo study, but the opposite was seen in an in vitro investigation.<sup>30</sup> Further research into the indications of using SDF is needed and, given its popularity, is anticipated soon.

## Conclusion

Silver diamine fluoride represents the application of a familiar medicine to a modern medical control of dental caries. Its meteoric rise to popularity in the U.S. is reflective of the quick adoption of this “medical model” for the management of oral disease. Future research into it and other potential medicaments is needed to continue to support this shift. ■

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# Chronic Disease Management of Caries in Children and the Role of Silver Diamine Fluoride

Man Wai Ng, DDS, MPH, and Rosalyn Sulyanto, DMD, MS

**ABSTRACT** Chronic disease management (CDM) is a science-based approach that has been demonstrated in early studies to be effective in preventing and controlling dental caries in children. In this article, we describe how CDM can be introduced into contemporary clinical dental practice in which active and engaged dental providers can work as a team to support family behavior changes. We also discuss the role of silver diamine fluoride in the CDM of caries.

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Contemporary management of dental caries calls for assessing and understanding an individual's risk of developing caries, applying effective strategies to manage the disease and supplementing with restorative treatment when indicated.<sup>1,2</sup> Historically, the dental profession has primarily relied on restorative and surgical treatment to address dental caries. Young children with early childhood caries (ECC) who are not cooperative often require sedation or general anesthesia. Despite receiving costly surgical treatment, many children develop new and recurrent caries. It is now known that while restorative treatment repairs damaged tooth structure, it alone does not address the underlying disease process.<sup>3</sup> If the responsible risk factors are not adequately addressed, new and recurrent decay will likely develop.<sup>3</sup>

In 2014, the U.S. Food and Drug Administration granted approval for silver diamine fluoride (SDF) to be used as a desensitizing agent, paving the way

for its introduction to the U.S. dental market. The main advantages of SDF include its ability to kill the cariogenic bacteria, provide caries arrest without requiring the use of local anesthesia or caries excavation and promote remineralization.<sup>4,5</sup> These advantages are particularly appealing in the care of young children and children with special health care needs who are not able to receive traditional restorative treatment. The main concerns of SDF use pertain to possible over-exposure to fluoride and objection by parents (and patients) to the black staining of the carious lesions.<sup>6</sup> Crystal et al. found that parents of young children report greater dissatisfaction to having discolored anterior teeth compared to posterior teeth; however, many parents are apparently more willing to accept the discoloration if sedation or general anesthesia procedures could be avoided.<sup>7</sup>

Studies have reported on the effectiveness of SDF to arrest caries and its efficacy to prevent new caries in primary teeth as well as first permanent

molars.<sup>8</sup> SDF has been found to outperform fluoride varnish in achieving caries arrest.<sup>9</sup> Annual application of SDF in children prevented many more carious lesions than quarterly application of fluoride varnish.<sup>9</sup> Longer-term effectiveness is greater if the SDF treatment is repeated.<sup>10,11</sup> Milgrom et al. found a higher average proportion of arrested carious lesions in an SDF-treated group compared to a placebo group after 14 to 21 days postintervention.<sup>12</sup> Additional and longer studies are needed to establish the frequency of SDF applications to achieve and maintain caries arrest, the types and depths of carious lesions for which SDF treatment can be successful and whether caries arrest and prevention can be maintained over time.

Since becoming available in the U.S., SDF has gained considerable attention among U.S. dental providers for its purported ability to arrest dental caries and as a potentially simple, easy-to-use and inexpensive alternative to restorative treatment.<sup>5,6</sup> However, despite the promising potential of SDF treatment to arrest caries and to defer or obviate the need for restorative treatment, Milgrom et al. found that 51.7 percent (15/29) of children who received SDF treatment had 100 percent of caries lesions arrested 14 to 21 days after treatment.<sup>12</sup> This suggests that SDF treatment on its own may be insufficient to achieve arrest. As in the case after restorative treatment, if the responsible risk factors for caries development are not adequately addressed, the disease may continue, resulting in new and recurrent carious lesions. On the other hand, with effective control of dietary factors and with judicious use of fluorides or other remineralizing agents, reduction in caries activity can occur (manifesting as signs of caries arrest).<sup>13</sup>

TABLE 1

**ECC Chronic Disease Management Protocol\***

Caries risk assessment	<ul style="list-style-type: none"> <li>■ Performed in full or abbreviated format during each visit</li> <li>■ Children who have at least one tooth with demineralization or cavitation lesion is an ECC patient</li> </ul>
Effective communication	<ul style="list-style-type: none"> <li>■ With permission, explain the caries process to parent and use structured communication strategies such as:               <ul style="list-style-type: none"> <li>● Fixing the cavities does not fix the problem</li> <li>● Without a change in diet and home care, new cavities and broken fillings will result</li> <li>● Change is hard and won't happen over night</li> </ul> </li> </ul>
Self-management goal setting	<ul style="list-style-type: none"> <li>■ Engage and coach parent to select one or two goals to work on until the next visit</li> <li>■ Goals may include more frequent toothbrushing, topical fluoride use and specific diet modification strategies</li> </ul>
Caries charting	<ul style="list-style-type: none"> <li>■ Use a charting system, such as ICDAS or ADA Caries Classification System to:               <ul style="list-style-type: none"> <li>● Document caries by tooth, surface and activity</li> <li>● Monitor disease improvement or progression</li> </ul> </li> </ul>
Fluorides and other remineralization strategies	<ul style="list-style-type: none"> <li>■ Topical fluorides, including over-the-counter toothpaste, stannous fluoride, xylitol and/or calcium phosphate products can be offered</li> <li>■ In-office silver diamine fluoride treatment or fluoride varnish applications can be offered</li> </ul>
Restorative treatment	<ul style="list-style-type: none"> <li>■ Full range of treatment options can be presented based on each patient's needs and parent's desires, including:               <ul style="list-style-type: none"> <li>● Conventional treatment (including use of pharmacologic management)</li> <li>● Interim therapeutic restorations for caries control and sealants</li> </ul> </li> </ul>
Risk-based recare intervals	<p>Patients are recommended to return in:</p> <ul style="list-style-type: none"> <li>■ 1-3 months (if high risk)</li> <li>■ 3-6 months (if medium risk)</li> <li>■ 6-12 months (if low risk)</li> </ul> <p>At the recare/disease management visit, perform:</p> <ul style="list-style-type: none"> <li>■ Caries risk assessment</li> <li>■ Self-management goal setting</li> <li>■ Exam and charting</li> <li>■ X-rays if indicated</li> <li>■ Silver diamine fluoride or fluoride varnish</li> </ul>

\*DentaQuest Institute

Chronic disease management (CDM) is a science-based approach tested in clinical practice that can prevent and manage caries and which has been demonstrated in early studies to be effective in improving outcomes in children.<sup>14,15</sup> In this article, we describe how CDM can be introduced into contemporary clinical dental practice with and without the use of SDF, in which active and engaged dental providers can work as a team to support family behavior changes.

**CDM**

CDM has been defined as a system of coordinated health care interventions in which patient self-care efforts are significant. Based on the assumption that patients have the most important role in the care of their chronic health conditions, CDM aims to promote a sense of responsibility on the part of the patient, parent or caregiver for his or her own health. Unlike a traditional approach whereby health care providers tell patients what changes to make, CDM calls for



TABLE 2

## ECC Risk-Based Chronic Disease Management Protocol

Existing Risk Category	New Clinical Findings	Fluoride Varnish Interval <sup>§</sup>	Sample Self-Management Goals	Restorative Treatment	DM Return Interval	Other
Low	No disease indicators* of caries; or Completely remineralized (arrested) carious lesions	6–12 months	Twice-daily brushing with F toothpaste <sup>†</sup> Stannous fluoride <sup>‡</sup> on cavitated lesions		6–12 months	
Medium	No disease indicators,* but has risk factors** and/or inadequate protective factors*** Disease indicators present with some remineralization	3–6 months	Twice or more daily brushing with F toothpaste <sup>†</sup> Stannous fluoride <sup>‡</sup> on cavitated lesions Dietary changes	Sealants ITR Conventional restorative	3–6 months	Xylitol gum or candies or wipes Calcium phosphate paste
High	Active caries (disease indicators present) No remineralization occurring Heavy plaque	1–3 months	Twice or more daily brushing with F toothpaste <sup>†</sup> Stannous fluoride <sup>‡</sup> on cavitated lesions Dietary changes	ITR Sealants Conventional restorative Sedation/GA	1–3 months	Xylitol gum or candies Calcium phosphate paste

\*Examples of disease indicators include demineralization, cavitated lesions, existing restorations, enamel defects, deep pits and fissures.

\*\* Examples of risk factors include patient/maternal/family history of decay, plaque on teeth, frequent snacks of sugars/cooked starch/sugared beverages.

\*\*\*Examples of protective factors include fluoride exposure (topical and/or systemic), xylitol.

§May use silver diamine fluoride instead of fluoride varnish.

†Brush with a smear of 1,000 ppm F toothpaste.

‡Apply a smear of 1,000 ppm stannous fluoride to cavitated lesions.

ITR = Interim therapeutic restoration.

GA=general anesthesia.

a partnership or a close collaboration between an informed and engaged patient and/or parent and a proactive health care provider ideally in a culturally and linguistically appropriate manner.

Because dental caries is a chronic disease that is significantly influenced by social and behavioral factors, effective management requires customized patient self-management of etiologic factors. An important role of the professional team is to provide coaching and support to the patient and family to make the necessary lifestyle changes, such as in oral hygiene practices, dietary habits and fluoride use. This personalized approach to patient care is the essence of CDM.

### ECC Collaborative CDM Protocol

Since 2008, the DentaQuest Institute has supported multiple phases of a learning collaborative modeled after the Institute for Healthcare Improvement's Breakthrough Series.<sup>16</sup> Using quality improvement (QI) methods, the ECC Collaborative has

trained clinical providers and team members in more than 40 dental and oral health care practices across the U.S to test and implement a CDM protocol to address ECC.<sup>17</sup> The authors of this paper have been involved in the ECC Collaborative as care providers, change champions in their own dental practices and faculty in the collaborative.

**TABLES 1 and 2** show the most recent ECC CDM clinical protocol for the ECC Collaborative. The ECC Collaborative CDM protocol includes seven components: 1) caries risk assessment (CRA); 2) effective communication; 3) self-management goal setting; 4) caries charting; 5) fluorides and other remineralizing strategies; 6) restorative treatment as needed and desired by patient/family; and 7) recall interval based on risk. The ECC CDM protocol along with its rationale and promising results from Phases 1 and 2 of the ECC Collaborative will not be described in great detail here as they have been published elsewhere.<sup>14,18,19</sup>

### Components 1-3: Caries Risk Assessment, Effective Communication and Self-Management Goal Setting

Regularly assessing each patient's risk for caries and providing support and coaching to control risk factors are the cornerstones of the ECC CDM protocol. In clinical practice, a full or abbreviated CRA is performed at every visit informally or, preferably, by using a structured tool or form. This tool is used to guide the query about the patient's diet and oral hygiene habits, to assess the patient's changing balance of risk and protective factors and efforts with meeting self-management goals. Structured CRA forms are available from the American Dental Association,<sup>20</sup> the American Academy of Pediatric Dentistry,<sup>2</sup> Caries Management by Risk Assessment (CAMBRA)<sup>21,22</sup> and other groups. **FIGURE 1** shows a CAMBRA CRA form for ages 0–5.

With permission from the patient or caregiver, the etiology of the caries process is explained, followed by

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## Goals for Healthy Teeth (Age 5 and Younger)

Patient Name: \_\_\_\_\_ Date of Visit: \_\_\_\_\_

Your child has been assessed to have the following risk for caries (cavities):

- High       Medium       Low

The pictures checked are the areas you should focus on between today and your next visit.



- Next fluoride visit in \_\_\_\_\_ months



- Healthy snacks such as fruit, carrot sticks, yogurt, low-fat cheese, pretzels, whole grain crackers



- No soda/energy drinks  
 No juice  
 Juice only with meals



- Less or no candy/junk food  
 Chew sugar-free gum (e.g., Trident, Orbit, Extra)



- No sippy cup  
 Only plain milk or water in cup or bottle (if bottle to bed use only water)



- Drink fluoridated water, tap water



- Daily flossing with floss string or pick



- Brush morning and before bed with fluoride toothpaste:  
 Thin smear (<2 years old)  
 Pea-sized amount (2-5 years old)



- Fluoride varnish was applied in clinic today. Wait until tomorrow to brush/floss. Avoid hard, crunchy and sticky foods.

**IMPORTANT**  
 The last thing that touches your child's teeth before bedtime is the toothbrush with fluoride toothpaste.



- Brush morning and before bed with fluoride toothpaste:  
 Use Gel-Kam \_\_\_\_\_ a day. Apply a thin smear to all teeth. Wait 30 minutes before eating, drinking or rinsing.

On a scale of 1-5, how likely do you think you will help your child meet these goals?

- 1  
Not likely
2
3  
Not sure
4
5  
Very likely

Clinician's Comments \_\_\_\_\_

FIGURE 2. Sample self-management goals handout (adapted from J Calif Dent Assoc 2010 Oct; 38(10):759).

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coaching about the risk and protective factors and providing support with self-management goal setting. In the ECC Collaborative, visual flip charts and handouts have been used to help guide the conversations with patients and parents.

Effective self-management support uses a collaborative approach, with providers and patients working together to define problems, set priorities, establish goals and create treatment plans to solve problems. A member of the care team (dental hygienist, dental assistant or dentist) engages with and coaches the patient or parent on self-management goal setting. **FIGURE 2** shows an example of a self-management goals handout used in the ECC Collaborative.<sup>14</sup>

Recognizing that change is hard to initiate and even more difficult to sustain, no more than one or two self-management goals are typically selected to work on until the next visit. Self-management goals may include diet modification, more frequent toothbrushing and using remineralization strategies and topical fluorides at home.

#### Component 4: Caries Charting

Because caries may progress and arrest at the same time in different locations of the dentition, a clinical examination and caries charting are important to monitor caries presence, progression and activity by tooth and surface. Using a system such as the American Dental Association charting system,<sup>23</sup> the International Caries Detection and Assessment System (ICDAS)<sup>24,25</sup> or a modified system (**FIGURE 3**) allows for tracking of information important for determining disease diagnosis, caries risk status and appropriate clinical treatment planning.

In order to properly visualize the surfaces of the teeth, any plaque present on the surface is brushed or wiped away. Demineralized enamel surfaces, which appear as chalky white spots, are

← Clinical Visual Assessment →			Alternative Charting System 1		Alternative Charting System 2		
ICDAS Dental Terms	ICDAS Detection	ICDAS Activity					
Extensive cavity with visible dentin	6	+/-	6	A, B, C	D2A	D2B	D2C
Distinct cavity with visible dentin	5	+/-	5	A, B, C	D2A	D2B	D2C
Underlying dentin shadow	4	+/-	4	—	D2	—	—
Localized enamel breakdown	3	+/-	3	—	D1.5	—	—
Distinct visual change in enamel	2	+/-	2	—	D1	—	—
First visual change in enamel	1	+/-	2	—	D1	—	—
Sound	0	+/-	0	—	—	—	—

The codes D1, D1.5 and D2 describe enamel or dentin changes, breakdown or cavitation:  
 D1 = enamel change  
 D1.5 = enamel breakdown  
 D2 = decay extending into dentin

The codes A, B and C describe caries activity:  
 A = completely arrested (inactive caries; may appear shiny or dark brown/black; feels hard)  
 B = becoming inactive (may feel leathery or harder)  
 C = active caries (feels soft)

**FIGURE 3.** International Caries Detection and Assessment System (ICDAS) and alternative charting systems.

important to document and follow closely over time. Caries activity is determined by visual assessment and also through a tactile examination using a balled explorer or by gently sliding a sharp explorer over the caries lesion (**TABLE 3**).

#### Component 5: Fluorides, Including SDF, and Other Remineralization Strategies

The use of fluoride for caries prevention and management is both safe and effective. All children are recommended to have their teeth brushed with a smear of 1,000 ppm of fluoridated toothpaste two or more times each day by an adult caregiver with the eruption of the first tooth until age 3. Children aged 3 to 6 should brush with a pea-sized amount of fluoride toothpaste. After brushing, spitting out but not rinsing with water is encouraged.<sup>26-28</sup>

A smear of 1,000 ppm fluoride toothpaste or 0.4% stannous fluoride may be applied to cavitated or demineralized tooth surfaces to assist

with remineralization of the carious surfaces with instructions to defer eating, drinking or rinsing for 30 minutes. Xylitol products and casein phosphate products are also available to assist in controlling the caries process at home.<sup>29</sup>

Professional fluoride treatments should be offered based on caries risk status. Children with increased caries risk should receive a professional topical fluoride treatment (fluoride varnish) at least every six months.<sup>26</sup> High-risk children should receive fluoride varnish every three to six months and medium-risk children a minimum of every six months. Low-risk children may not receive additional benefit from topical fluoride treatments in addition to what they receive from fluoridated drinking water and toothpaste.<sup>30</sup> Children with ECC who have demineralized enamel or cavitated carious lesions may benefit from professional topical fluoride applications more frequently than every three months to assist in controlling the caries process.<sup>18</sup>

TABLE 3

### Definitions of Codes in the International Caries Detection and Assessment System (ICDAS) and Alternative Charting Systems and the Characteristics of the Carious Lesions

ICDAS Code	Alternative Codes 1 or 2	Characteristics of Lesion	
		Active Lesion	Inactive Lesion
1, 2 or 3	2 or 3 D1 or D1.5	Surface of enamel is whitish/yellowish opaque with loss of luster Feels rough when tip of probe is moved gently across the surface Lesion is in a plaque stagnation area, i.e., pits and fissures, near gingival and approximal surface below contact point	Surface of enamel is whitish, brownish or black Enamel may be shiny and feel hard and smooth when tip of probe is moved gently across surface For smooth areas, caries lesion is typically located at some distance from gingival margin
4	4 or D2	Probably active	
5 or 6	5A, B or C D2A, B or C	Cavity feels soft or leathery on gently probing the dentin	Cavity may be shiny and feels hard on gently probing the dentin

The use of SDF may be included in the CDM protocol, substituting for fluoride varnish. Following most recently available evidence-based protocols and with informed consent, SDF may be applied to slow down caries progression or to achieve caries arrest. Return visits for additional SDF treatment can be considered recare visits (Component 7), during which a clinical examination and CRA are performed and self-management goals are revisited.

#### *Component 6: Restorative Treatment (Including Sealants, Interim Therapeutic Restorations and Conventional Restorative Treatment as Needed and Desired by Patient/Family)*

In high-caries risk children, tooth surfaces with deep pits or fissures would benefit from sealant with a bonded or glass ionomer material.<sup>2</sup> Typically, sealants are placed on permanent molars, but primary molars may also benefit from sealant placement, especially if there are already incipient lesions present or if decay has already manifested on other primary molars with similar pit and fissure anatomy.<sup>2</sup>

If destruction of tooth structure by the caries process is minimal, achieving arrest of the decay might be possible with remineralization strategies.<sup>14</sup> Restorative treatment may be deferred if the disease can be effectively controlled. If the decay has progressed into dentin or caries arrest has not been achieved, interim

therapeutic restorations (ITR) may be performed. The ITR procedure involves removing the decay using hand or rotary instruments with caution to avoid pulp exposure. After preparation, the tooth is restored with a fluoride-releasing glass ionomer restorative material. It is important for the parent to understand that this approach is caries control rather than permanent restoration.<sup>14</sup>

When significant tooth structure has been destroyed by the caries process, restorative treatment is performed to restore function or improve aesthetics. Due to the high risk of recurrent decay and the significant costs of general anesthesia, long-term success of restorative treatment for ECC depends upon effective management of the disease along with appropriate use of restorative technique and materials for the primary dentition.<sup>31</sup> A child who shows improved caries risk status and caries activity may receive more conservative restorative treatment. However, a child demonstrating no improvement of caries risk status or continuing progression of caries activity may benefit from a more aggressive restorative strategy to reduce new and recurrent decay in susceptible tooth surfaces, such as with use of full-coverage stainless steel crowns.

When caries arrest is achieved, restorative treatment may be deferred, especially in a child who is unable to cooperate for restorative treatment.

However, close follow-up and risk-based preventive care are essential to safeguard from disease relapse. Seeing a child more frequently for preventive care over time has been found to be helpful to reduce a child's fears and build trust between the care provider and the child, allowing for restorative treatment to be completed with greater ease in the clinical setting, at a later time.<sup>18</sup> On the other hand, a cavitated lesion, although arrested, may benefit from receiving a restoration in order to prevent food impaction. If caries arrest has been achieved (such as through use of SDF), caries excavation is not required prior to placement of either glass ionomer or another restorative material. Deferring restorative treatment and avoiding use of local anesthesia are significant benefits of both SDF treatment and the CDM protocol.

#### *Component 7: Recare Visits*

Patients with increased caries risk would benefit from more frequent recare visits than the customary interval of every six months. The recare interval should be based on the patient's caries risk status (one to three months or more often for high risk, three to six months for medium risk and six to 12 months for low risk) and the desires of the parent or parent. During the recare visit, a CRA and clinical examination are performed and self-management goals are revisited. The clinical examination includes

TABLE 4

**ECC Collaborative Phase I: Comparison of Rates of New Cavitation, Pain and Referral to OR Between ECC Patients and Historical Control Patients**

Outcomes	Boston Children's Hospital			Saint Joseph Hospital		
	ECC (N=403) %	Historical Control (N=129) %	Improvement %	ECC (N=234) %	Historical Control (N=80) %	Improvement %
New cavitation	26.1	75.2	▼65.3	41.0	71.3	▼57.5
Pain	13.4	21.7	▼38.2	7.3	31.3	▼23.3
Referral to OR	10.9	20.9	▼47.8	14.9	25.0	▼67.8

a specific assessment of plaque control, new caries, caries progression and caries arrest of existing carious lesions and the need for SDF reapplication. From a conversation with the patient or parent, the effectiveness of meeting the previously agreed upon self-management goals is assessed. Coaching is then provided to the patient and family to help them sustain or adjust their selected self-management goals if required. Fluoride varnish or SDF may be applied during these visits. ITR and restorative treatment can be provided if needed.

Recare visits are excellent opportunities to build trust and provide coaching, role modeling, positive reinforcement and social rewards. Whenever possible, the CDM activities are coordinated with return visit intervals based on the most recent caries risk status in conjunction with the restorative care needed (TABLE 2).

**CASE STUDIES 1**<sup>32</sup> and **2** and **FIGURES 4** and **5** describe examples of successful CDM interactions between the dental health care team and patients with ECC and their parents.

### Evidence Supporting Chronic Disease Management of ECC

Phase 1 of the ECC Collaborative, which took place at two hospital-based dental care practices, found that after 30 months children with ECC in the intervention group experienced lower rates of new cavitated carious lesions, pain and referrals for restorative treatment in the OR compared to baseline historical controls with ECC (TABLE 4). A follow-up Phase 2 of the ECC Collaborative

TABLE 5

**ECC Collaborative Phase II: Comparison of Rates of New Cavitation, Pain and Referral to OR Between ECC Patients and Historical Control Patients**

Outcomes	ECC (N=344) %	Historical Control (N=316) %	Percentage Improvement %	Improvement Range %
New cavitation	33	46	▼28	▲14-▼71
Pain	8	11	▼27	▲80-▼100
Referral to OR	14	22	▼36	0-▼81

continued with five additional sites across the U.S. found that after 18 months, fewer disease management (DM) children experienced new cavitation, pain and referrals to the OR for restorative treatment compared to baseline historical controls (TABLE 5). The five participating sites found that quality improvement methods facilitated adoption of the DM approach and resulted in improved care to patients and better outcomes overall.<sup>14,15</sup>

### Collaborative Team-Based Care

The typical dental health care team includes dentists, dental hygienists and dental assistants. Although any member of the clinical care team may facilitate team-based CDM care, dental hygienists may be ideally suited to lead this care. Dental hygienists are already in position to provide patient education and oral health promotion while facilitating continuity of patient care and fostering relationships and trust building with patients and parents.

**FIGURE 6** shows a flow diagram of the CDM protocol outlining the role that members of the dental team may

assume. In the CDM approach, the dental hygienist or dental assistant can play a pivotal role in providing patient education, support, coaching, self-management goal setting and documentation of findings from CRA. CDM of caries requires all members of the care team to work collaboratively with the patient or family to address specific risk factors and provide education, but really focus on behavioral change (using effective communication techniques such as motivational interviewing), introducing fluorides, including SDF and other remineralizing agents, and recommending patients to return for DM visits and fluoride varnish applications more often based on the patient's caries risk. At the same time, a patient may present for restorative treatment, but the dentist or another staff should revisit caries risk factors and provide continued self-management support.

The collaborative care team approach should extend to the administrative staff, such as front desk/reception and billing staff, who

## CASE STUDY 1

### An Example of a Successful CDM Patient

**Visit 1:** Two-year-old Abby presents with her mother for a new infant oral health visit with Logan, a dental hygienist. Logan performs a CRA and a knee-to-knee examination with Abby's mom. Pertinent findings from the CRA include: history of active caries in her mom, patient sleeps with a nursing bottle containing milk, patient brushes with a training nonfluoride toothpaste, patient drinks apple juice three times per day and no reported pain. Pertinent clinical examination findings include heavy plaque biofilm presence on buccal cervical gingival margins of the maxillary incisors, demineralized enamel on the maxillary incisors and extensive breakdown of the maxillary left lateral incisor and a cavitated carious lesion just into dentin on a mandibular primary first molar.

With parental permission, Logan explains the etiology of the caries process and lets Abby's mom know that cavities can be prevented and stopped. But without a change in the diet and/or oral hygiene, the cavities will get worse. Logan asks Abby's mom what is most important to her, such as avoiding pain and infection, preventing the cavities from getting worse or the appearance of the teeth.

Logan discusses with Abby's mom possible restorative treatment options including restorative treatment with sedation or general anesthesia and interim therapeutic restoration (ITR) treatment of the lower left first molar at an upcoming visit, explaining to Abby's mom that because the decay is just extended into dentin, restorative treatment can be deferred in order to avoid inflicting psychological trauma to Abby.

Logan helps Abby's mom select one or two self-management activities to implement in the next month and asks if she would be willing and able to return with her child in one month for another visit and fluoride varnish application. Abby's mom agrees to return in one month. Her two goals are to begin brushing with a smear of 0.4% stannous fluoride toothpaste (as demonstrated after breakfast and before bed and to wait 30 minutes before eating, drinking or rinsing after) and to switch completely to water in the bottle for bed. Abby's mom is advised to expect a couple of sleepless nights.

**Visit 2:** In one month, Abby and her mom return for a follow-up CDM with Logan. Mom reports brushing with a smear of stannous fluoride toothpaste after breakfast and before bed and has switched to water in the bottle for bed. A knee-to-knee exam performed shows improved plaque control and demineralized surfaces and cavitated lesions manifesting remineralization. Logan congratulates Abby's mom on her efforts and asks what other strategies she could consider implementing next. Abby's mom is willing to try to reduce juice intake to one to two times and will give more water or milk. She agrees to defer restorative treatment and to return in three months. Because Abby has no pain and the caries lesions have not progressed, ITR for the molar is discussed as possible treatment at the next visit and to defer restorative treatment for the maxillary incisors. Fluoride varnish is applied.

**Visit 3:** In three months, Abby and her mom return for a follow-up CDM visit with Logan. A knee-to-knee examination finds good oral hygiene. The carious lesions on the maxillary incisors are arrested. The cavitated lesion on Abby's lower left first molar has become larger and feels soft to the explorer.

Abby's mom reports that she has been brushing Abby's teeth with a smear of stannous fluoride toothpaste before bed and sometimes in the morning. She has stopped the bottle to bed completely and is giving a cup of juice each day with more water and milk. She is giving Abby fruit snacks occasionally.

Abby's mom gives consent to ITR treatment for the lower left first molar. She agrees to defer restorative treatment on the maxillary incisors. Because Abby has been returning for frequent visits, she has become more comfortable with the practice and the providers. Abby has become less anxious and the ITR procedure was completed quickly and easily by the dentist. Glass ionomer restoration is placed on the molar. Fluoride varnish is applied.

Logan coaches Abby's mom to avoid fruit snacks. She agrees to give more fruit and to try to brush Abby's teeth after breakfast and to return in three months for another follow-up visit.

Abby returns every three months for CDM visits. With no additional new caries, she is deemed to be medium risk. At age 4, Abby becomes cooperative to have her maxillary incisors with the arrested decay restored with composite strip crowns. Abby's mom and Logan agree to recare visits every six months.



FIGURE 4A.



FIGURE 4B.



FIGURE 4C.



FIGURE 4D.



FIGURE 4E.

**FIGURE 4A.** Abby at her third visit, with improved oral hygiene and signs of caries arrest.

**FIGURE 4B.** Abby's lower left primary first molar with occlusal decay.

**FIGURE 4C.** Interim therapeutic restorative treatment of mandibular left primary first molar; decay excavated without local anesthesia.

**FIGURE 4D.** Glass ionomer restoration on mandibular left primary first molar.

**FIGURE 4E.** Abby at her fourth visit, three months after restoration was placed, with no new carious lesions.

## CASE STUDY 2

**Example of a Successful CDM Patient Treated With SDF**

**Visit 1:** Three-year-old Dominic presents with his mother for a recall visit. Dominic's medical history is significant for Down syndrome. He has been followed in the clinic since age 2. At the time of his initial visit one year ago, demineralization and cavitations on his maxillary incisors and deep pits and fissures on his molars were noted. An initial CRA was performed with pertinent findings including history of active caries in Dominic's mom, patient breast-feeds throughout the night, patient brushes with a training nonfluoride toothpaste and no reported pain. Since his initial visit, Dominic has discontinued breast-feeding and has been brushing with 0.4% stannous fluoride twice daily, which has allowed remineralization of his maxillary incisors.

On knee-to-knee exam, a new cavitated carious lesion on a maxillary primary first molar (tooth I) is observed. Plaque is noted in the grooves of his molars and along the gingival margin. The carious lesions on Dominic's maxillary incisors are arrested. His mom reports that Dominic has started wanting to brush his teeth more on his own and has started eating fruit snacks at school.

Possible restorative treatment options are presented, including restorative treatment with sedation or general anesthesia, interim therapeutic restoration (ITR) treatment of tooth I or silver diamine fluoride (SDF) treatment of tooth I. Based on Dominic's limited cooperation during dental visits, his mom opts for application of SDF with the understanding that restorative treatment may be needed in the future. The risks and benefits of SDF are discussed with Dominic's mom, and she consents to its application.

SDF is applied to tooth I during the recall visit. Dominic tolerates the procedure well. Dominic's mom agrees to return in three months for another visit. She also sets the goal of brushing Dominic's teeth after he brushes them himself and replacing fruit snacks with nonsticky alternatives.

**Visit 2:** In three months, Dominic and his mom return for a follow-up visit. Mom reports that she has been brushing Dominic's teeth twice daily with a pea-sized amount of stannous fluoride toothpaste and that she has replaced his fruit snacks with fresh fruit.

A knee-to-knee-exam performed shows improved good plaque control, continued remineralization of the maxillary incisors and a dark arrested cavitation with some small areas of unarrested caries on tooth I. SDF is reapplied. Dominic's mom is reassured that the temporary discoloration of the soft tissues will resolve after approximately one week. She agrees to continue to maintain Dominic's good oral hygiene and limit cariogenic snacks and to return in three months for another follow-up visit. At the three-month visit, SDF may be reapplied if needed and an ITR may be placed at the same visit or a subsequent visit.



**FIGURE 5A.** Dominic's maxillary left primary first molar with occlusal decay prior to SDF.



**FIGURE 5B.** Dominic's maxillary left primary first molar with occlusal decay three months after SDF application and immediately after a second SDF reapplication.

can help provide clarification and reinforcement of oral health educational messages and self-management support. In a broader sense, the collaborative care team may also include primary medical care providers or specialty care providers for those patients with special health care needs.<sup>33</sup>

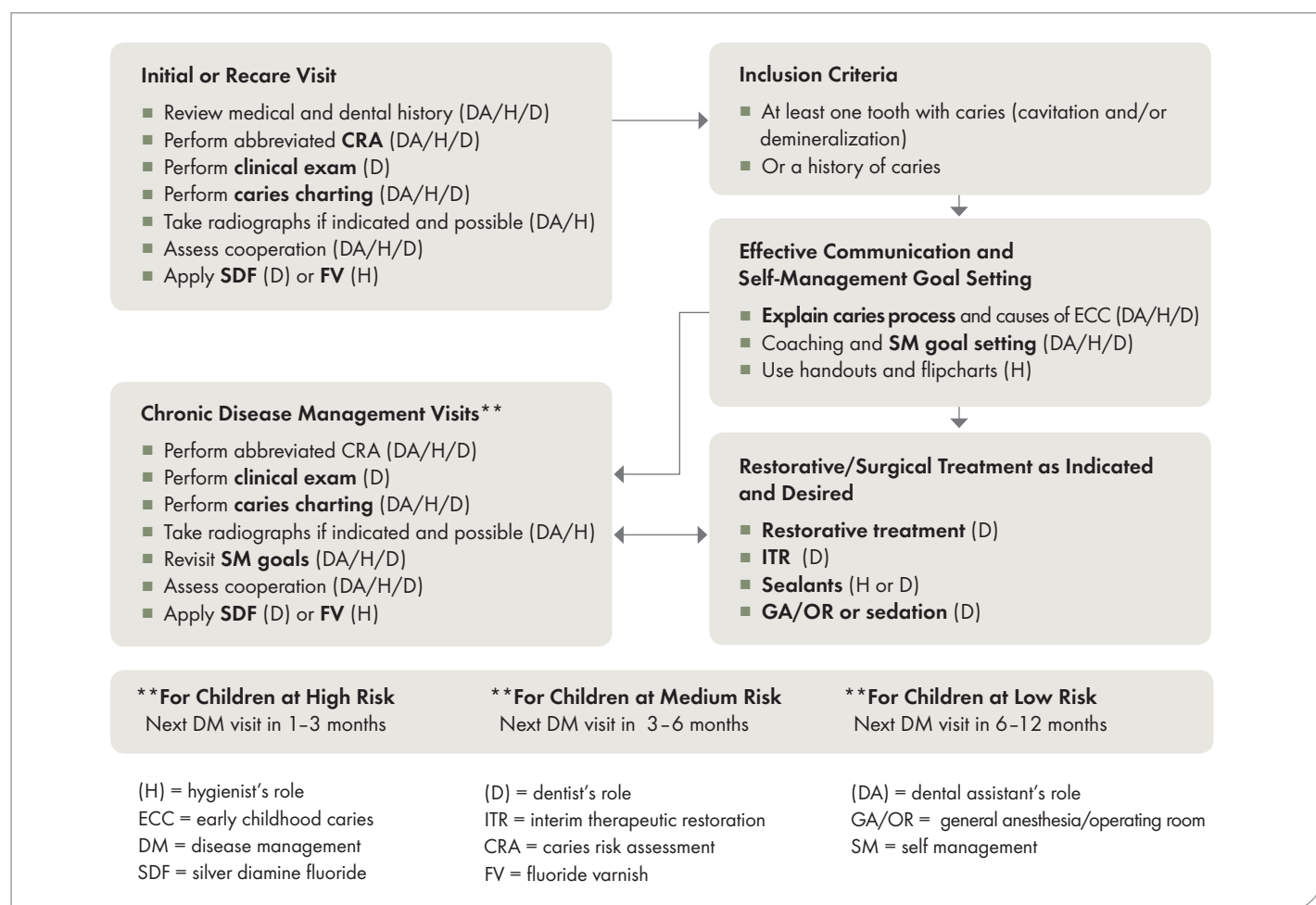
Working in a collaborative partnership with parents and children with ECC, dental professionals and staff are able to increase the motivation to set self-management goals and make seemingly simple but difficult behavioral changes, such as increased brushing frequency, use of fluoride toothpaste, reducing carbohydrate and/or sugar intake and more frequent return recare visits.

**SDF in the Context of CDM**

SDF is gaining interest in dentistry and among the public as an alternative to restorative treatment. Its use is particularly attractive for patients who are unable to tolerate traditional surgical treatment. These patients include young children or individuals with special health care needs who would otherwise require pharmacologic management in order to receive traditional restorative treatment. SDF has the promising potential to arrest caries without drilling and without the need for local anesthesia. However, anecdotal reports and studies<sup>8,12,34</sup> find varying clinical success of SDF to achieving caries arrest.

The use of SDF may help to tip the caries balance in favor of remineralization in some patients. In other patients, SDF use alone may be insufficient to achieve caries arrest without further amelioration of risk factors or the addition of more protective factors. SDF treatment in the context of a CDM protocol can be expected to help facilitate caries arrest or at least slow caries progression. The return recare visits enable monitoring of the clinical effectiveness of the SDF treatment, while at the same time allowing for assessing of caries risk and reviewing and supporting self-management goal setting. If SDF treatment is found to be ineffective for a patient or a particular tooth, restorative treatment would be required to protect the pulp. Patients





**FIGURE 6.** Flow diagram of the ECC chronic disease management protocol and the potential roles of dental team members.

and their families should be educated and coached to understand the potential benefits and limitations of SDF treatment and the importance of dietary and plaque control along with use of home-based fluorides and/or other remineralizing agents.

### Opportunities, Barriers and Limitations of SDF and CDM

Despite its recent introduction to the U.S. market, SDF is actually not new to dentistry. More research is needed to better understand the full potential benefits and limitations of SDF for use in clinical practice. Due to its varying degree of success to arrest dental caries, the authors believe that SDF should be offered in the context of a CDM protocol.

CDM is not a new concept. Featherstone introduced the caries balance in 2000<sup>35</sup> and CRA tools have been available, such as through CAMBRA<sup>21</sup> and the American Academy of Pediatric Dentistry.<sup>2</sup> Barriers to routinely adopting CDM of caries into clinical dental practice include insurance reimbursement that traditionally favors surgical management of dental caries,<sup>36</sup> lack of provider training<sup>36</sup> and lack of knowledge by and incentives for the public to seek risk-based disease prevention and management care strategies.<sup>36</sup> Although providers may be familiar with CRA and CDM approaches, operationalizing them

into day-to-day clinical care with patients can be challenging. In addition, current dental information systems (electronic dental records) do not easily allow population dental health management and tracking of the oral health status of patients.<sup>36</sup>

While dental providers are increasingly incorporating CRA into patient care, many providers are not offering risk-based treatment recommendations in a systematic manner. Testing and implementing a CDM protocol on a small scale among a limited group of clinical providers and clinical and administrative staff may help gain greater long-term acceptance by practitioners and patients/parents.

Payment reform is needed to account for the additional time needed for risk assessment, effective communication and goal setting and professional fluoride treatments. SDF use may help to promote greater acceptance of CDM of caries by providers and patients and families. Some insurance plans have already begun reimbursing for SDF treatment, which can provide some payments to offset costs. With more evidence demonstrating the effectiveness and cost effectiveness of the risk-based CDM approach and SDF treatment, along with movement by payers to reimburse providers via pay for performance payment methods, adoption of CDM may be accelerated to become the future standard of care.

## Conclusions

Chronic disease management of dental caries is grounded in an understanding of caries as a chronic biobehavioral disease. Disease control requires meaningful engagement of patients and parents by the oral health care team in a collaborative partnership in order to provide coaching toward making and sustaining behavioral changes in the unique context of their families and communities. The traditional dental delivery model needs to evolve to focus on systematic risk assessment and risk-based management of the disease itself. SDF should be considered as a tool in the CDM toolbox; SDF can be used as a part of a CDM protocol with or without restorative treatment. ■

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# Managing Caries in the Primary Dentition With Silver Nitrate: Lessons Learned From a Clinical Trial

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**ABSTRACT** “Lessons learned” are reported from a clinical trial comparing conventional restorative treatment to management of caries in the primary dentition using silver nitrate. Key findings include: Silver nitrate provides an effective means for arresting caries in the primary dentition; some lesions progress and new lesions appear despite silver nitrate application; radiographs are important; there can be collateral benefit with silver nitrate application; and interproximal application of silver nitrate can be a challenge.

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Silver nitrate’s ability to arrest the caries process and simultaneously prevent the formation of new carious lesions has long been reported in the dental literature.<sup>1-6</sup> This ability is thought to derive from the combined effects of silver-salt-stimulated sclerotic or calcified dentin formation and silver nitrate’s potent germicidal effect.<sup>2,5,7</sup> As early as 1906, G.V. Black, the father of modern dentistry, developed a protocol using multiple applications of silver nitrate directly to carious lesions until they became hard and totally arrested.<sup>1</sup> The clinical use of silver nitrate in dentistry fell out of favor by the early 1960s.<sup>8</sup> Recently however, there has been renewed interest, especially as a means for managing caries in high-risk populations.<sup>9</sup>

While multiple publications exist touting the efficacy of silver nitrate in arresting and preventing dental caries,<sup>3,4,10,11</sup> to date no randomized clinical trials comparing silver nitrate to conventional treatment have been reported in the literature.

This manuscript reports on lessons learned from a randomized clinical trial comparing the medical management of carious lesions in the primary dentition using silver nitrate to conventional restorative treatment. Designed as a two-year clinical trial, at the time of this manuscript preparation data collection was near completion but not finalized. Final data analysis will take place and be reported following completion of the trial. This manuscript focuses on clinically relevant lessons learned to date from this clinical trial that the authors believe will be immediately helpful to clinicians and researchers alike. The authors hope to highlight some challenges in adopting a medical model as the sole model for managing dental caries and suggest some clinically relevant recommendations on appropriate case selection for this model and the expectations from implementing such interventions in children.

### Study Design

This randomized clinical trial was carried out by faculty and staff from the University of Iowa College of Dentistry and Dental Clinics in a privately owned dental clinic in Kalona, Iowa. The University of Iowa's Human Subjects Committee gave study approval (IRB # 201406792) and the study was registered at [clinicaltrials.gov](http://clinicaltrials.gov) (identifier #: NCT02604134). Subjects in this study were Amish children living in the vicinity of Kalona, Iowa. Inclusion criteria were: between the ages of 2 and 11, no significant health problems (ASA I or II) and caries into dentin in one or more primary teeth. Teeth close to exfoliation or with caries encroaching on the pulp

(no clear band of dentin on radiograph between decay and pulp) were excluded from the study. Subject recruitment began in November 2014 and ended in December 2016. Recruitment was largely dependent on “word-of-mouth” contact between families in the Kalona area. Most families contacted the study investigators by phone and appointment times were offered. Parents gave written consent for children to participate. Eligible subjects were randomly assigned (computer-generated random-number list) to one of two treatment groups: conventional

To date no randomized clinical trials comparing silver nitrate to conventional treatment have been reported in the literature.

restorative treatment (CON) including composites, glass ionomers and stainless steel crowns or treatment with silver nitrate and fluoride varnish (SN). The ratio of random assignment was two SN for every one CON based on the presumption that more is known and understood about conventional treatment. Subject recruitment and follow-up are shown in the consolidated standards of reporting trials (CONSORT) diagram (**FIGURE 1**).

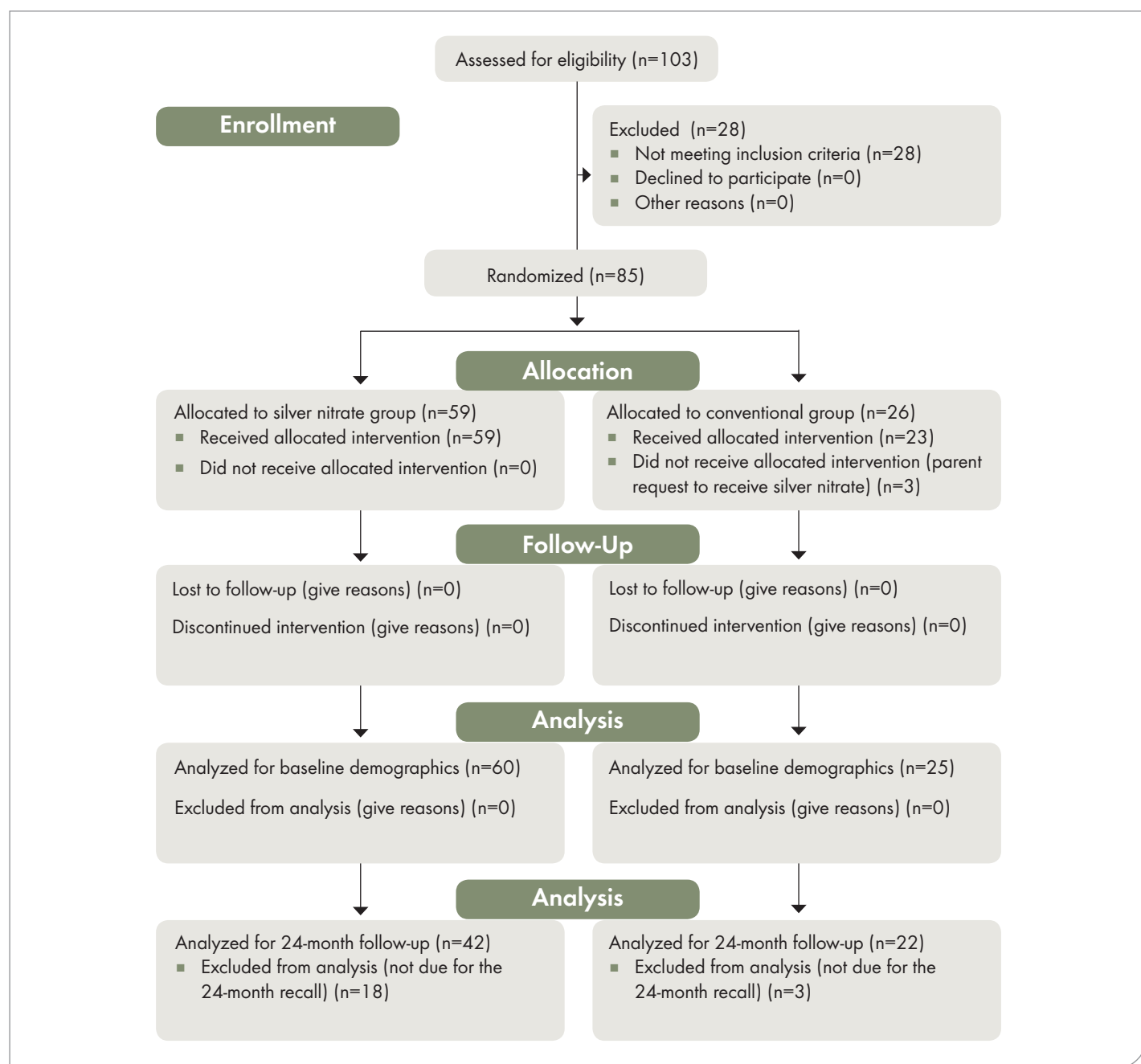
### Study Population

The study population consisted of Amish children from Kalona, Iowa. Kalona is a small rural community 20 miles south of the University of Iowa. The Amish settlement in Kalona began in the 1840s and today there are approximately 1,200 Amish living

in the Kalona vicinity. The majority of Amish living near Kalona are “old order,” with no electricity, no telephones and relying on horse and buggies for transportation. When they need to travel further distances (e.g., for medical or dental care), they typically hire a driver from the community. Family size is typically large, with an average of approximately eight children per family.

This population was selected for the current study for several reasons. Study investigators were looking for a population of children with high caries rates who would also be dependable for follow-up care and visits throughout the duration of the study. Based on previous experiences working with this population at the University of Iowa College of Dentistry and Dental Clinics, the investigators believed the Kalona Amish would provide ideal study subjects. The Kalona Amish's high caries rates can be attributed to lack of fluoride (no fluoridated drinking water, relatively low use of fluoridated toothpaste, infrequent dental visits), infrequent oral hygiene and frequent consumption of carbohydrates.<sup>12,13</sup> The College of Dentistry and Dental Clinics' experience with Amish patients has been that they are reliable patients and family life is typically stable with families remaining at the same address over time.

The Amish community was approached about this study through a letter to one of their church district's bishops (Kalona has nine church districts). This bishop shared the investigators' written invitation to participate in this study at a meeting of the other bishops and responded in a handwritten letter stating “... we were agreed to announce the suggestion that you made, but how the people will respond, we do not know, as it seems



**FIGURE 1.** CONSORT 2010 flow diagram of Kalona silver nitrate study.

if our children do not complain of a toothache, we rarely see a dentist.” To incentivize study participation, all dental care was provided at a private local dental office in Kalona (so patients could travel to appointments by horse and buggy) and all treatment was provided free of charge.

### Study Significance

In 2014, study investigators proposed the first randomized clinical trial in the U.S. to examine the feasibility and the effectiveness of silver nitrate in the medical management of dental caries in children. Through this pilot, randomized

control trial investigators proposed to compare the effectiveness of medical management of caries using silver nitrate and fluoride varnish to the conventional restorative treatment in caries management among a cohort of Amish children. One of the primary outcomes of

TABLE 1

**Outcome Criteria for Procedures: Clinical Assessment in the Two Treatment Arms**

Conventional Restorative Group	Silver Nitrate Group
<b>Primary Outcome: Successful</b>	
<ul style="list-style-type: none"> <li>■ Restoration appears satisfactory (intact tooth surface adjacent to restoration, stained margins consistent with noncarious lesions),</li> <li>■ No clinical signs or symptoms of pulpal pathology or</li> <li>■ Tooth exfoliated without minor or major failure</li> </ul>	<ul style="list-style-type: none"> <li>■ Caries arrested (hardness/softness; lesion feels hard on gently probing the dentin),</li> <li>■ No clinical signs or symptoms of pulpal pathology or</li> <li>■ Tooth exfoliated without minor or major failure</li> </ul>
<b>Primary Outcome: Minor Failure</b>	
<ul style="list-style-type: none"> <li>■ Secondary caries (visible dentin in the interfacial space with signs of caries requiring intervention)</li> <li>■ Restoration fracture or wear requiring intervention</li> <li>■ Restoration loss</li> <li>■ Signs or symptoms of reversible pulpitis treated without requiring pulpotomy or extraction</li> </ul>	<ul style="list-style-type: none"> <li>■ Caries progression that required abandonment of SN protocol and placement of a restoration</li> <li>■ Signs or symptoms of reversible pulpitis treated without requiring pulpotomy or extraction</li> </ul>
<b>Secondary Outcome: Major Failure</b>	
<ul style="list-style-type: none"> <li>■ Signs or symptoms of reversible pulpitis (no spontaneous pain) requiring pulpotomy</li> <li>■ Signs or symptoms of irreversible pulpitis (history of spontaneous pain or precipitated pain caused by thermal or other stimuli) or dental abscess</li> <li>■ Restoration loss and tooth is unrestorable</li> </ul>	<ul style="list-style-type: none"> <li>■ Irreversible pulpitis (history of spontaneous pain or precipitated pain caused by thermal or other stimuli) or dental abscess requiring pulpotomy or extraction</li> </ul>

interest was the major and minor failures in both groups reported over the two-year study period. In other words, “will primary teeth with carious lesions that are treated with silver nitrate remain functional and asymptomatic throughout the study period compared to conventionally treated teeth?” **TABLE 1** summarizes the major/minor failure outcome criteria for both study groups. Other outcomes of interest included incidence of caries, patient quality of life, cost effectiveness and acceptability of treatment strategies.

### Treatment Procedures

#### Treatment Providers

Treatment providers for this study consisted of three board-certified pediatric dentistry faculty members who were calibrated.

At baseline examination, prior to group assignment, all children received a conventional dental exam and appropriate radiographs (bitewings and/or occlusal radiographs). Teeth with

carious lesions encroaching on the pulp or where a pulpotomy, pulpectomy or extraction were deemed necessary were excluded from the study and treated accordingly. Following determination of patient eligibility for the study, informed consent was obtained from the patient’s parent(s) and random assignment was made to either the CON or the SN group. Study participants then received a calibrated dental examination using criteria developed for the NIH-funded Early Childhood Caries Collaborating Centers.<sup>14</sup>

#### Conventional Group

Children in the CON group received restorative dental care in alignment with guidelines from the American Academy of Pediatric Dentistry and local practice within the department of pediatric dentistry at the University of Iowa. This treatment typically included local anesthesia, caries removal using rotary instruments (dental handpieces) or hand excavation (using hand instruments)

and placement of a restoration. Due to generalized preferences of this population, amalgam restorations were not utilized during the study. Restorative materials that were utilized included composite resins, resin-modified glass ionomers and stainless steel crowns.

#### Silver Nitrate Group

The protocol promoted and used by Duffin et al. (2012) was modified for use in this management arm and included the following: 1) Teeth to be treated were isolated with cotton rolls or Iso-shield isolation; 2) teeth were dried with compressed air; 3) 25% silver nitrate solution (Silver Nitrate Solution 25%, Gordon Laboratories, Upper Darby, Pa.) was placed directly on the carious lesion using a microbrush applicator with a dabbing motion — five seconds per lesion; and 4) 5% sodium fluoride (NaF) varnish was immediately placed over the carious lesion to prevent the silver nitrate from being washed away by saliva.



TABLE 2

## Major and Minor Failures at 24 Months\*

Silver Nitrate Group		Conventional Group		Total	
Major Failure	Minor Failure	Major Failure	Minor Failure	Major Failure	Minor Failure
17 / 237	5 / 237	3 / 93	0 / 93	20 / 330	5 / 330
7.2%	2.1%	3.2%	0%	6.1%	1.5%

\*Reported at the tooth level.

Each carious lesion was treated in this way at monthly intervals for a total of three applications. At each six-month recall, all study teeth received a single additional application of silver nitrate. Any new carious lesions diagnosed at subsequent six-month recalls were treated with the baseline protocol, three applications of silver nitrate and fluoride varnish one month apart.

### Prevention (Both Groups)

Preventive procedures were provided to both treatment groups at six-month intervals in accordance with AAPD guidelines including recall examination, prophylaxis, oral hygiene instruction, dietary counseling, fissure sealant placement on permanent teeth and fluoride varnish application. All subjects were given a toothbrush.

### Recall Examination

Both groups were recalled at six-month intervals. At each six-month interval, new radiographs were obtained (bitewings and/or occlusal radiographs as appropriate), calibrated examination took place and preventive procedures were applied.

### Results

The study enrolled 85 children (mean age  $7.16 \pm 2.13$  years) including 51 males (mean age  $7.29 \pm 2.28$  years) and 34 females (mean age  $6.98 \pm 1.19$  years). Twenty-five children were assigned to the CON group (18 males, 7 females) and 60 children to the SN group (33 males and 27 females). Following group assignment, four children assigned to the CON group were immediately withdrawn from the study. In all four cases, their

parents expressed disappointment because they were hoping for the silver nitrate treatment. These subjects were then offered the silver nitrate protocol and all four accepted and remained in the study and received the silver nitrate treatment protocol. The results of these four subjects are included with CON group results due to “intention to treat analysis.”<sup>15,16</sup>

At the time of this manuscript preparation, all 85 subjects remained in the study and 75 percent (64/85) of study subjects had completed their 24-month recall examination.

### Major and Minor Failures

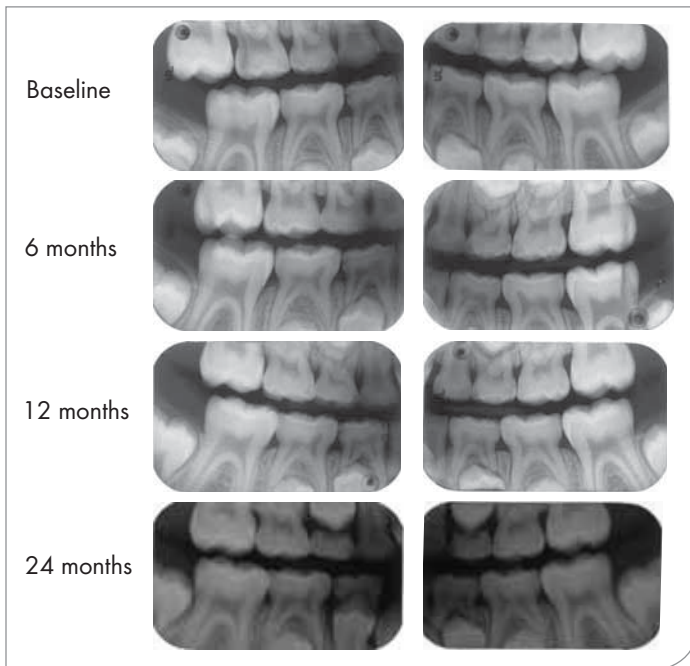
Major and minor failures are reported by tooth in TABLE 2. In every case, major failures were study teeth that required extraction. Minor failures in the conventional group included lost fillings or crowns, broken fillings and recurrent caries that required replacement. Minor failures in the silver nitrate group included caries progression encroaching on the pulp where silver nitrate was no longer considered appropriate treatment. These teeth received excavation of caries and placement of a restoration.

### Lessons Learned

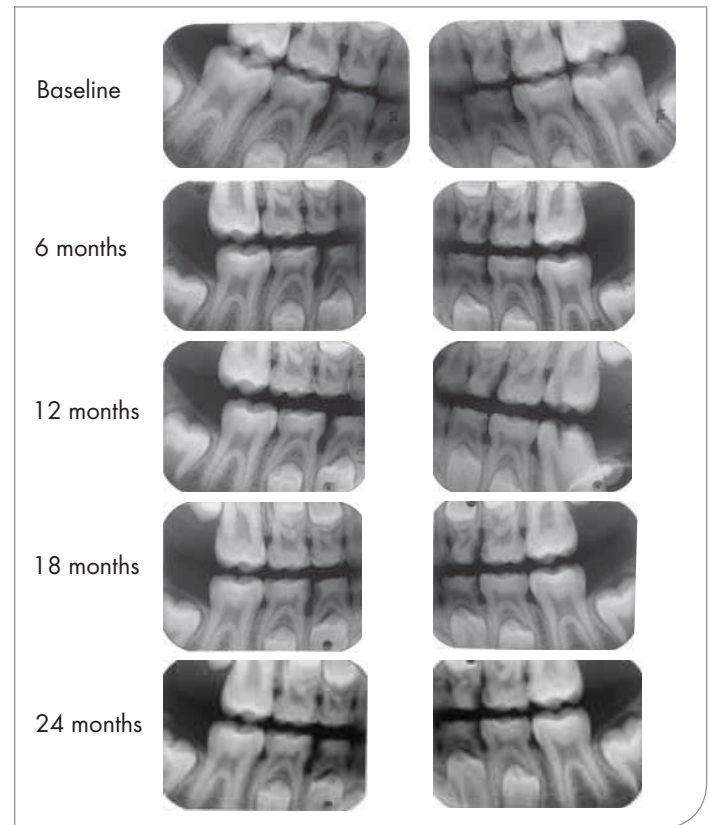
*Community engagement in planning and implementing research constitutes a cornerstone in the success of recruitment and retention of a study population.* The Amish population is a unique one; a culturally appropriate approach was crucial to the successful recruitment and retention of study patients in this pilot clinical trial. This is due primarily to the conservative lifestyle of the Amish and their hesitation

to interact with modern society. The unit of an Amish society is the church district ruled by bishops.<sup>17</sup> The current study was able to successfully recruit children and their families because of support received from the bishops of Kalona's nine church districts. Further, in appreciation of limited access to transportation, the study was conducted in a private dental office in Kalona that was readily accessible to this population by horse and buggy.

*Silver nitrate and fluoride varnish provide an effective means for medically managing dental caries in the primary dentition.* At this preliminary stage, it seems that silver nitrate works to arrest caries. After two years of follow-up, the majority of study lesions treated with SN were arrested. Caries activity (active versus arrested) was determined by visual and tactile sensation using a periodontal probe following criteria described by Nyvad et al.<sup>18</sup> Despite a small number of failures, most teeth are doing well (TABLE 2). At the time of this manuscript preparation, 90.7 percent of the SN group carious teeth are satisfactory (maintained in the mouth and symptomatic) compared to 96.8 percent of the CON group's carious teeth. FIGURE 2 provides a case example of a 6-year-7-month-old (at baseline) female subject from the SN group with radiographic caries into dentine diagnosed on the distal of tooth I, the mesial of tooth J and the distal of tooth S. Following adherence to the silver nitrate protocol, these carious lesions did not progress throughout the study period, and teeth I and J actually appear to have reversed in progression. A second case example of lack of caries progression following adherence to the SN protocol is found in FIGURE 3. This 9-year-4-month-old (at baseline) male subject is of special interest because the carious lesions were deep and capable of “packing food” at baseline and throughout the study. Despite the extent of the decay,



**FIGURE 2.** Lack of caries progression over 24 months following SN treatment.



**FIGURE 3.** Deep carious lesions at baseline. Lack of caries progression over 24 months following SN treatment.

this subject showed no signs or symptoms of caries progression or irreversible pulpitis throughout the course of the study.

*Silver nitrate doesn't always arrest all caries progression.* Despite evidence that silver nitrate was successful in managing approximately 90 percent of the lesions in the SN group, some lesions progressed rapidly during the study period. **FIGURE 4** provides a case example of a 4-year-8-month-old (at baseline) male subject with interproximal caries that progressed rapidly during the first 12 months of the study period, despite adherence to the silver nitrate protocol. It is unclear at this time why some patients reacted differently than others. The authors are optimistic that some of the variability can be explained following statistical analysis of all variables following the conclusion of the study. Key variables that may be explanatory could include diet and oral hygiene practices.

*Silver nitrate doesn't always prevent new caries.* Contrary to what has previously been reported in the literature, silver nitrate did not prevent new caries development in our study subjects. New carious lesions were found in 47.5 percent of the SN subjects throughout the 24-month study period (**TABLE 3**). This is similar to the percent of the CON group (52.0 percent) who also experienced new carious lesions.

*Radiographs are important.* The majority of new carious lesions detected in this study were interproximal and diagnosed by radiographs (**TABLE 4**). In the SN group, 70.5 percent of the new carious lesions were interproximal. The percent was even higher for the CON group (90.9 percent). Of note is the previously discussed case (**FIGURE 2**) where all of the carious lesions were interproximal and none were detectable without radiographs.

*Location and size of lesion matters.* It is worth noting that all major failures in this study thus far have occurred in posterior teeth. It could be that anterior teeth fare better than posterior teeth because they are more readily cleansable and do not typically pack food. Posterior teeth on the other hand can pack food in either occlusal or interproximal open lesions and this creates an additional challenge for caries arrest and prevention. An example of interproximal lesions packing food in a subject assigned to the silver nitrate group is found in **FIGURE 5**. Food packing can also be uncomfortable and irritating to patients.

*Collateral benefit is present with the silver nitrate intervention.* When silver nitrate is applied to carious lesions, adjacent teeth can benefit. **FIGURE 6** provides a case example where tooth K had received the SN protocol for distal caries and upon exfoliation it was noted that the mesial surface of tooth

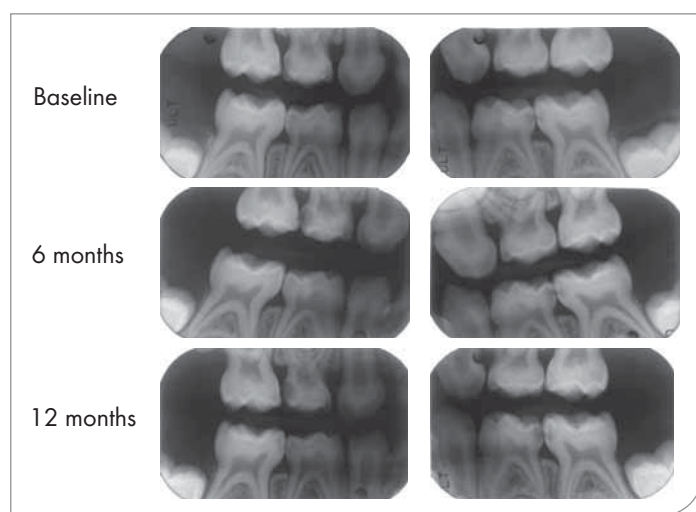


FIGURE 4. Rapid caries progression over 12 months following SN treatment.

TABLE 3

**New Carious Lesions Detected by 24 Months\***

Silver Nitrate Group N=59		Conventional Group N=25		Total N=84	
Subjects w/ new lesions	Subjects no new lesions	Subjects w/ new lesions	Subjects no new lesions	Subjects w/ new lesions	Subjects no new lesions
N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
23 (47.5)	31 (52.5)	13 (52.0)	12 (48.0)	41 (48.8)	43 (51.2)

\*Reported at the child level

TABLE 4

**Location of New Carious Lesions by 24 months**

	Interproximal (M,D)	NOT Interproximal (O,F,B,L)	Total
Silver Nitrate Group	43 (70.5%)	18 (29.5%)	61 (100%)
Conventional Group	20 (90.9%)	2 (9.1%)	22 (100%)
Total	63 (75.9%)	20 (24.1%)	83 (100%)

No. 19 had hard black staining with no radiographic evidence of caries. The application of SN to the carious primary molar K had arrested an undetected white spot lesion on the mesial surface of the adjacent permanent first molar.

Silver nitrate “leaches” and stains decalcified lesions. Caution must be taken when applying silver nitrate on primary teeth adjacent to permanent

anterior teeth that may have visible or preclinical white spot lesions. Silver nitrate is a clear liquid that easily leaches onto other surfaces and can unintentionally discolor teeth. An example can be found in FIGURE 7 where a decalcified permanent tooth was inadvertently stained black when silver nitrate was applied to the carious interproximal (mesial) surface of tooth H.

Interproximal application of SN can be a challenge. When this study was initiated, a decision was made to use a microfiber brush to apply SN directly to accessible carious lesions. However, for interproximal carious lesions without direct access, SN was applied using either unwaxed dental floss or interproximal picks. Both of these interproximal applications methods can be problematic. With both of these delivery methods, a microfiber brush saturated with SN was applied to either the unwaxed floss or picks as the devices were moved interproximally. Unwaxed floss can be unwieldy to use and therefore the risk of contamination of the floss with saliva is high, as is the inadvertent application of SN to unintended surfaces (lip, cheek, etc.). It is difficult to keep the carious lesion free from saliva contamination during application. To minimize this risk, a separate string of unwaxed floss was used for each interproximal lesion. With the picks, the risk of gingival bleeding is high, which contaminates the SN solution. Because SN needs to remain in contact with a carious lesion for an extended period of time to be effective,<sup>1</sup> and because SN is a water soluble solution that can be easily washed away,<sup>19</sup> it is important that the carious lesions being treated are dry and remain dry throughout SN application.

### Study Limitations

In considering findings to date, bear in mind this was a small pilot study in a unique population, which impacts the generalizability of our findings. Moreover, the study is not yet complete and the follow-up period was relatively brief. Nevertheless, the study has provided valuable insight into the medical management of caries using silver nitrate. While



**FIGURE 5.** Interproximal lesions packing food.



**FIGURE 6.** Collateral benefit of SN on mesial surface of permanent molar.



**FIGURE 7.** Example of SN “leaching” onto DF surface of permanent lateral incisor.

patients in this study were assigned to an “either/or” treatment approach, this would not necessarily be the recommended treatment approach in clinical dentistry. Depending on the age and cooperation of the patient, the size and location of the lesions and patient/parent preferences, it is likely that a combined approach (SN and CON) may be more appropriate.

Finally, it is important to understand that at the time this study was initiated, silver diamine fluoride was not yet available for use in the U.S. While there are many similarities between silver nitrate followed by fluoride varnish and silver diamine fluoride, there are also differences that could affect treatment outcomes.

## Conclusion

The authors plan to publish final results from this pilot clinical trial following study completion. Final reporting will include statistical analysis of differences between treatment groups, more in-depth analysis of effect of tooth and surface on treatment outcomes, more in-depth analysis on radiographic progression of carious lesions, reporting on outcome measures including patient/parent satisfaction and comparison of time and cost by treatment group. ■

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# Use of Silver Diamine Fluoride for Dental Caries Management in Children and Adolescents, Including Those With Special Health Care Needs

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## Abstract

### Background

This manuscript presents evidence-based guidance on the use of 38% silver diamine fluoride (SDF) for dental caries management in children and adolescents, including those with special health care needs. A guideline workgroup formed by the American Academy of Pediatric Dentistry developed guidance and an evidence-based recommendation regarding the application of 38% SDF to arrest cavitated caries lesions in primary teeth.

### Types of studies reviewed

The basis of the guideline's recommendation is evidence from an existing systematic review "Clinical trials of silver diamine fluoride in arresting caries among children: A systematic review." (*JDR Clin Transl Res* 2016;1[3]:201–10). A systematic search was conducted in PubMed/MEDLINE, Embase, Cochrane Central Register of Controlled Trials and gray literature databases to identify

randomized controlled trials and systematic reviews reporting on the effect of silver diamine fluoride and address peripheral issues such as adverse effects and cost. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used to assess the quality of the evidence and the evidence-to-decision framework was employed to formulate a recommendation.

### Results

The panel made a conditional recommendation regarding the use of 38% SDF for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program. After taking into consideration the low cost of the treatment and the disease burden of caries, panel members were confident that the benefits of SDF application in the target populations outweigh its possible undesirable effects. Per GRADE, this is a conditional recommendation based on low-quality evidence.

### Conclusions and practical implications

The guideline intends to inform the clinical practices involving the application of 38% SDF to enhance dental caries management outcomes in children and adolescents, including those with special health care needs. These recommended practices are based upon the best available evidence to-date. A 38% SDF protocol is included in Appendix II (*Pediatr Dent* 2017;39(5):E135–E145).

### Scope and Purpose

The guideline intends to inform the clinical practices involving the application of silver diamine fluoride (SDF) to enhance dental caries management outcomes in children and adolescents, including those

with special health care needs. Silver diamine fluoride in this guideline's recommendation refers to 38% SDF, the only formula available in the United States. These recommended practices are based upon the best available evidence to date. However, the ultimate decisions regarding disease management and specific treatment modalities are to be made by the dental professional and the patient or his/her representative, acknowledging individuals' differences in disease propensity, lifestyle and environment.

The panel made a conditional recommendation regarding the use of 38% SDF for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program.

The guideline provides practitioners with easy to understand evidence-based recommendations. The American Academy of Pediatric Dentistry's (AAPD) evidence-based guidelines are being produced in accordance with standards created by the National Academy of Medicine (formerly known as the Institute of Medicine) and mandated by the National Guideline Clearinghouse (NGC), a database of evidence-based clinical practice guidelines and related documents maintained as a public resource by the Agency for Healthcare Research and Quality (AHRQ) of the U.S. Department of Health and Human Services (USDHHS).

### Health intents and expected benefits or outcomes.

The guideline is based on analysis of data included in a recent systematic review and meta-analysis<sup>1</sup> and summarizes evidence of the benefits and safety of SDF application in the context of dental caries management, mainly its effectiveness in arresting cavitated caries lesions<sup>2</sup> in the primary dentition. Its intent is to provide the best available information for practitioners and patients or their representatives to determine the risks, benefits and alternatives of SDF application as part of a caries management program. Prevention of new caries lesion development and outcomes in permanent teeth, such as root caries lesion arrest, were not the focus of this guideline; however, because they are of interest and relevant to caries management within the scope of pediatric dentistry, they are mentioned and will be included in future iterations of the guideline as the supporting evidence base increases.

### Clinical questions addressed.

The panel members used the Population, Intervention, Control and Outcome (PICO)<sup>3</sup> formulation to develop the clinical questions that will aid practitioners in the use of SDF in primary teeth with caries lesions. *Does the application of SDF arrest cavitated caries lesions as effectively as other treatment modalities in primary teeth?*

### Methods

This guideline adheres to the National Academy of Medicine's guideline standards<sup>4</sup> and the recommendations of the Appraisal of Guidelines Research and Evaluation (AGREE) instrument.<sup>5</sup> The guidance presented is based on an evaluation of the evidence presented in a 2016 systematic review published by Gao and colleagues.<sup>1</sup>

<sup>†</sup> A caries lesion is a detectable change in the tooth structure that results from the biofilm-tooth interactions occurring due to the disease caries. It is the clinical manifestation (sign) of the caries process.

TABLE 1

Quality of Evidence Grades<sup>†</sup>

Grade	Definition
High	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very Low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

<sup>†</sup> Quality of evidence is a continuum; any discrete categorization involves some degree of arbitrariness. Nevertheless, advantages of simplicity, transparency and vividness outweigh these limitations.

Reprinted with permission. Quality of evidence and strength of recommendations. GRADE Handbook: Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach. Update October 2013. Available at: <http://gdt.guidelinedevelopment.org/app/handbook/handbook.html>.

### Search strategy.

Literature searches were used to identify systematic reviews that would serve as the basis of the guideline. Secondly, the results of the searches served as sources of evidence or information on issues related to, but outside the context of, the PICO, such as cost, adverse effects and patient preferences.

Literature searches were conducted in PubMed/MEDLINE, Embase, Cochrane Central Register of Controlled Trials, gray literature and trial databases to identify systematic reviews and randomized controlled trials of SDF. Search results were reviewed in duplicate at both the title and abstract and the full-text level when warranted. Disagreements were resolved by consensus; if agreement could not be reached, the AAPD Evidence-Based Dentistry Committee (EBDC) overseeing the workgroup was consulted to settle the question. A detailed description of the search strategies is presented in Appendix I.

### Inclusion and exclusion criteria.

The criteria used to identify publications for use in the guideline were determined by the clinical PICO question. See Appendix I for search strategies. Publications which addressed the use of SDF to arrest caries lesions in primary teeth, regardless of language, merited full-text review; in vitro studies and studies of the use of SDF outside of the guideline's stated outcomes were excluded. No new randomized controlled trials were identified that warranted updating the meta-analysis found in the systematic review<sup>1</sup> selected as the basis for this guideline.

### Assessment of the evidence.

The main strength of this guideline is that it is based on a systematic review of prospective randomized and controlled trials of SDF.<sup>1</sup> Evidence was assessed

via the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach,<sup>6</sup> a widely adopted and peer reviewed system of evaluating study quality (TABLE 1). The guideline recommendation is based on the meta-analysis of four controlled trials (three randomized), extracted in duplicate, from a systematic review of SDF.<sup>1</sup> Randomized (RCTs) and controlled clinical trials (CCTs) offer the highest level of clinical evidence; therefore, a recommendation based on a systematic review and meta-analysis of graded RCTs/CCTs provides more reliable and accurate conclusions that can be applied toward patient care.

This guideline is limited by the small number of RCTs evaluating SDF, the heterogeneity of the included trials and selection bias that may have been introduced by possibly poor sequence generation<sup>7,8</sup> and selective reporting by one study.<sup>7</sup> Weaknesses of this guideline are inherent to the limitations found in the systematic review<sup>1</sup> upon which this guideline is based. Major limitations of the supporting literature include lack of calibration and/or evidence of agreement for examiners assessing clinical outcomes and unclear definitions or inconsistent criteria for caries lesion activity.<sup>9,10</sup> Arguably, without a valid and reliable method to determine lesion activity at baseline and follow-up, misclassification

bias is possible, especially because clinicians cannot be blinded with regard to SDF application (due to the dark staining).<sup>9,10</sup> The absence of rigorous caries detection and activity measurement criteria in the reviewed literature can decrease the validity of the reported results.<sup>9,10</sup> Other reviewers of the systematic review<sup>1</sup> noted similar and additional limitations.<sup>9,10</sup>

### Formulation of the recommendations.

The panel formulated this guideline collectively via surveys, teleconferences and electronic communications from January 2017–August 2017. The panel used the evidence-to-decision framework in an iterative manner to formulate the recommendations. Specifically, the main methods used were discussion, debate and consensus seeking.<sup>11</sup> To reach consensus, the panel voted anonymously on all contentious issues and on the final recommendation. GRADE was used to determine the strength of the evidence.<sup>12</sup>

### Understanding the recommendations.

GRADE rates the strength of a recommendation as either strong or conditional. A strong recommendation “is one for which guideline panel is confident that the desirable effects of an intervention outweigh its undesirable effects (strong recommendation for an intervention) or that the undesirable effects of an

TABLE 2

## Implications of Strong and Conditional Recommendations for Different Users of Guidelines

	Strong recommendation	Conditional recommendation
For patients	Most individuals in this situation would want the recommended course of action and only a small proportion would not.	The majority of individuals in this situation would want the suggested course of action, but many would not.
For clinicians	Most individuals should receive the recommended course of action. Adherence to this recommendation according to the guideline could be used as a quality criterion or performance indicator. Formal decision aids are not likely to be needed to help individuals make decisions consistent with their values and preferences.	Recognize that different choices will be appropriate for different patients, and that you must help each patient arrive at a management decision consistent with her or his values and preferences. Decision aids may well be useful helping individuals making decisions consistent with their values and preferences. Clinicians should expect to spend more time with patients when working toward a decision.
For policymakers	The recommendation can be adapted as policy in most situations including for the use as performance indicators.	Policymaking will require substantial debates and involvement of many stakeholders. Policies are also more likely to vary between regions. Performance indicators would have to focus on the fact that adequate deliberation about the management options has taken place.

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intervention outweigh its desirable effects (strong recommendation against an intervention).<sup>66</sup> A strong recommendation implies most patients would benefit from the suggested course of action (i.e., either for or against the intervention). A conditional recommendation “is one for which the desirable effects probably outweigh the undesirable effects (conditional recommendation for an intervention) or undesirable effects probably outweigh the desirable effects (conditional recommendation against an intervention), but appreciable uncertainty exists.”<sup>66</sup> A conditional recommendation implies that not all patients would benefit from the intervention. The individual patient’s circumstances, preferences and values need to be assessed more than usual. Practitioners need to allocate more time for consultation along with explanation of the potential benefits and harms to the patients and their caregivers when recommendations are rated as conditional. Practitioners’ expertise and judgment as well as patients’ and their caregivers’ needs and preferences establish the

suitability of the recommendation to individual patients. The strength of a recommendation presents different implications for patients, clinicians and policymakers (TABLE 2).

### Recommendations

The SDF panel supports the use of 38% SDF for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program. (*Conditional recommendation, low-quality evidence*)

### Summary of Findings

The recommendation is based on data from a meta-analysis of data extracted from RCTs and CCTs of SDF efficacy with various follow-up times and controls (TABLE 3). Based on the pooled estimates of SDF group, approximately 68 percent (95 percent confidence interval [95% CI] = 9.7 to 97.7) of cavitated caries lesions in primary teeth would be expected to be arrested two years after SDF application (with once or twice a year application). Using data with longest follow-up time (at least 30 months follow-up; n = 2,567 surfaces from one RCT<sup>7</sup> and one CCT<sup>8</sup>), SDF had 48 percent higher

(95% CI = 32 to 66) success rate in caries lesion arrest compared to the controls (76 percent versus 51 percent arrested lesions, in absolute terms). In other words, 248 more cavitated caries lesions would be expected to arrest by treatment with SDF compared to control treatments, per 1,000 surfaces after at least 30 months follow-up. Considering the stratum with most data (n = 3,313 surfaces from three RCTs and one CCT, with follow-up of 24 months or more), similar estimates of relative and absolute efficacy were produced (i.e., RR 1.42 [95% CI = 1.17 to 1.72]) and 72 percent versus 50 percent arrested lesions, in absolute terms. Other follow-up and application frequency strata are listed in the summary of findings (TABLE 3). The range of estimates of SDF efficacy between the included trials was categorically wide. Rates of arrest on untreated groups may seem unusually high, and this may be due to background fluoride exposure. In one of the trials,<sup>7</sup> all participants (i.e., both the SDF-treated and control children) received 0.2% sodium fluoride (NaF) rinse every other week in school, while in other trials, children were either given fluoride



TABLE 3

### Summary of Findings: Evidence for the Relative and Absolute Efficacy of SDF Application Compared to No SDF for the Arrest of Cavitated Caries Lesions on Primary Teeth\*

Patient or population: Children and adolescents with cavitated caries lesions on primary teeth				
Intervention: SDF (various periodicities)				
Comparison: No SDF (various controls, including active agents and treatment)				
Outcome: Caries arrest in primary teeth				
Follow-up time; N surfaces (studies)	Relative efficacy, RR (95% CI)	Absolute estimates, % arrested lesions (95% CI) <sup>a</sup>		Quality assessment
		No SDF (other active controls or no treatment)	SDF	
24 months; 746 surfaces (2 RCTs: Yee et al., 2009 & Zhi et al., 2012) <sup>v</sup>	RR 1.45 (0.79 to 2.66)	47.9% (3.8 to 95.6) <sup>A</sup>	68.0% (9.7 to 97.7)	⊕○○○ VERY LOW <sup>a,b,c</sup>
≥ 24 months; 3313 surfaces (3 RCTs: Llodra et al., 2005, Yee et al., 2009 & Zhi et al., 2012., 1 CCT: Chu et al., 2002) <sup>§</sup>	RR 1.42 (1.17 to 1.72)	49.6% (28.8 to 70.5) <sup>C</sup>	72.4% (48.0 to 88.1)	⊕○○○ VERY LOW <sup>a,d,e</sup>
≥ 30 months; 2567 surfaces (1 CCT: Chu et al., 2002 & 1 RCT: Llodra et al., 2005.) <sup>Ξ</sup>	RR 1.48 (1.32 to 1.66)	50.8% (32.5 to 69.0) <sup>B</sup>	76.4% (52.1 to 90.6)	⊕⊕○○ LOW <sup>a,b</sup>
semi-annual application ≥ 24 months; 1784 surfaces (2 RCTs: Llodra et al., 2005 & Zhi et al., 2012)	RR 1.25 (0.99 to 1.58)	72.4% (47.2 to 88.5) <sup>A</sup>	87.7% (80.9 to 92.4)	⊕○○○ VERY LOW <sup>a,d,e</sup>

CCT= Controlled clinical trials; CI= Confidence interval; RCTs= Randomized control trials; RR= Relative risks.

\* Rates of arrest on untreated groups may seem unusually high, and this may be due to background fluoride exposure. In one of the trials<sup>7</sup>, all participants (i.e., both the SDF-treated and control children) received 0.2 percent NaF rinse every other week in school, while in other trials, children were either given fluoride toothpaste<sup>13</sup> or reported use of fluoride toothpaste.<sup>8</sup>

<sup>v</sup> Yee is once a year application of SDF, and Zhi is once a year versus twice a year.

<sup>§</sup> Chu is once a year application of SDF, Llodra is twice a year, Yee is once a year, and Zhi is once a year versus twice a year.

<sup>Ξ</sup> Chu is once a year application of SDF, Llodra is twice a year.

<sup>Ω</sup> The pooled effect estimates and confidence intervals for the relative risk and absolute percentages were derived from random effect modeling.

<sup>A</sup> Comparisons included glass ionomer and no treatment.

<sup>B</sup> Comparisons included no treatment.

<sup>C</sup> Comparisons included both A and B.

<sup>a</sup> At least one domain had 'unclear' risk of bias assessment.

<sup>b</sup> High heterogeneity.

<sup>c</sup> Wide confidence interval of the relative risk.

<sup>d</sup> Very high heterogeneity.

<sup>e</sup> Wide confidence interval.

toothpaste<sup>13</sup> or reported use of fluoride toothpaste.<sup>8</sup> The panel determined the overall quality of the evidence for this comparison was low or very low, owing to serious issues of risk of bias (unclear method for randomization, selective reporting and high heterogeneity) in the included studies. No studies were identified regarding the arresting effect of SDF on cavitated caries lesions in adult patients. The panel suggests that similar treatment effects may be expected for other age groups, but the lack of evidence informing this recommendation restrained the panel from providing an evidence-based recommendation.

The panel made a conditional recommendation regarding the use of SDF for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program. After

taking in consideration the low cost of the treatment and the disease burden of caries, panel members were confident that the benefits of SDF application in the target populations outweigh its possible undesirable effects. Specifically:

1. Untreated decay in young children remains a challenge, from clinical and public health standpoints, in the U.S. and worldwide.<sup>14</sup> It confers significant health and quality of life impacts to children and their families, and it is marked by pronounced disparities.<sup>15</sup>
2. Surgical-restorative work in young children and those with special management considerations (e.g., individuals with special health care needs) often requires advanced pharmacologic behavior guidance modalities (e.g.,

sedation, general anesthesia).

These pathways of care have additional health risks and limitations (e.g., possible effects on brain development in young children, mortality risks<sup>16</sup>), and often are not accessible, at all or in a timely manner.<sup>17-19</sup> The U.S. Food and Drug Administration has issued a warning "that repeated or lengthy use of general anesthetic and sedation drugs during surgeries or procedures in children younger than three may affect the development of children's brains."<sup>20</sup>

3. The cost of managing severe early childhood caries is disproportionately high, especially when hospitalization is necessary. The need to treat children in a hospital setting with

general anesthesia is a common scenario in the U.S. and other countries.<sup>21</sup> Studies report that children from the less-affluent regions have higher dental surgery rates than those from more affluent communities (25.7 versus 6.9 per 1,000),<sup>17</sup> which results in an economic burden for communities already impacted by the effects of poverty-related health problems.<sup>19,22</sup>

4. With caries lesion arrest rates upwards of 70 percent (i.e., higher than other comparable interventions), SDF presents as an advantageous modality. Besides its efficacy, SDF is favored by its less invasive (clinically and in terms of behavior guidance requirements) nature and its inexpensiveness.
5. The undesirable effects of SDF (mainly aesthetic concerns due to dark discoloration of carious SDF-treated dentin) are outweighed by its desirable properties in most cases, while no toxicity or adverse events associated with its use have been reported.

In sum, the panel felt confident that a conditional recommendation was merited because, although a majority of patients would benefit from the intervention, individual circumstances, preferences and values need to be assessed by the practitioner after explanation and consultation with the caregiver.

#### *Research considerations.*

Research is needed on the use of SDF to arrest caries lesions in both primary and permanent teeth. The panel urges researchers to conduct well-designed randomized clinical trials comparing the outcomes of SDF to other treatments for the arrest of caries lesions in primary and permanent teeth.

#### *Potential adverse effects.*

Silver diamine fluoride contains approximately 24–28% (weight/volume) silver and 5–6% fluoride (weight/volume).<sup>23</sup> Exposure to one drop of SDF orally would result in less fluoride ion content than is present in a 0.25 mL topical treatment of fluoride varnish. The exact amount of silver and fluoride present in one drop of SDF is determined by the specific gravity of the liquid and the dropper used. More studies are required to determine that amount, given the stability of the product manufactured and packaged in the U.S.

The main disadvantage of SDF is its aesthetic result (i.e., permanently blackens enamel and dentinal caries lesions and creates a temporary henna-appearing tattoo if allowed to come in contact with skin).

In published clinical trials encompassing more than 4,000 young children worldwide, exposure to manufacturer's recommended amounts of SDF has not resulted in any reported deaths or systemic adverse effects.

Oral absorption can include absorption in mucous membranes in the mouth and the nasal cavity. The short-term health effects in humans as a result of exposure to water or food containing specific levels of silver are unknown. The Environmental Protection Agency (EPA) suggests levels of silver in drinking water not to exceed 1.142 mg/L (1.42 ppm). Silver diamine fluoride should not be used in patients with an allergy to silver compounds.<sup>24</sup>

The main disadvantage of SDF is its aesthetic result (i.e., permanently blackens enamel and dentinal caries lesions and

creates a temporary henna-appearing tattoo if allowed to come in contact with skin). Skin pigmentation is temporary because the silver does not penetrate the dermis. Desquamation of the skin with pigmentation occurs when keratinocytes are shed over a period of 14 days.<sup>25</sup> Silver diamine fluoride also permanently stains most surfaces (e.g., counters, clothing) with which it comes into contact.

#### *Guideline implementation.*

This guideline will be published in the AAPD's Reference Manual and the journal, *Pediatric Dentistry*. Social media, news items and presentations will be used to notify AAPD members about the new guideline.

This guideline will be available as an open access publication on the AAPD's website. Patient education materials are being developed and will be offered in the AAPD's online bookstore. See Appendix II for practical SDF guidance and the Resource Section of the AAPD Reference Manual for a SDF chairside guide.<sup>26</sup>

#### *Cost considerations.*

Silver diamine fluoride is an effective and inexpensive means of arresting cavitated caries lesions in primary teeth.<sup>27</sup> It is inexpensive due to the low cost of materials and supplies and relatively short chair time required for application. Nevertheless, an empirical cost analysis discussion for SDF would need to address the several additional considerations and parameters. First, given the wide array of surgical and nonsurgical management approaches for cavitated caries lesions in the primary dentition, agreement on consensus endpoints and, therefore, total cost is challenging and controversial. Second, cost should include patient/family and practitioner time, health care services utilized and cost of nonhealth impacts,

if any. Third, SDF economic analyses are likely best approached via a cost-utility framework, wherein expenditures are juxtaposed to quality-adjusted or disease-free years. To illustrate the importance of defining a consensus treatment endpoint, in this scenario disease-free years can be interpreted as caries inactive, no surgical intervention needed or pain-free years. Finally, the economic benefits of SDF application must be considered in the context of pathways of clinical care (i.e., disease management) and account, among other factors, for the risks and costs associated with advanced behavior management techniques (e.g., indicated surgical-restorative work may require sedation or general anesthesia in some cases), families' preferences and opportunity costs (e.g., time investment beyond the direct costs).

### Recommendation Adherence Criteria

Guidelines are used by insurers, patients and health care practitioners to determine quality of care. In principle, following best practices and guidelines is believed to improve outcomes and reduce inappropriate care.<sup>28</sup> Therefore, measuring adherence to oral health-related guidelines is key and can serve as manifestation of the dental community's role as a "responsible steward of oral health."<sup>29</sup> Though measurement of oral health outcomes is in its early days at both system and practice levels, system-level performance measures for some oral health areas have been developed by the Dental Quality Alliance of the American Dental Association in partnership with the AAPD and other dental organizations. The goals of professional accountability, transparency and oral health care quality can be furthered through these measures.

### Workgroup.

In December 2016, the AAPD's Board of Trustees approved a panel nominated by the EBDC to develop a new evidence-based clinical practice guideline on SDF. The panel consisted of general and pediatric dentists in public and private practice involved in research and education; the stakeholders consisted of representatives from general dentistry, dental hygiene, governmental and nongovernmental agencies and international and specialty dental organizations.

### Stakeholders and external review.

This guideline was reviewed by external and internal stakeholders continuously from the beginning of the process until the formulation of the guideline. Stakeholders were invited to take part in anonymous surveys to determine the scope and outcomes of the guideline, bringing in points of view from different geographical regions, dental specialties and patient advocates. Comments also were sought on the draft of the guideline. All stakeholder comments were taken into consideration, addressed and acted upon as appropriate per group deliberation. Additional feedback from stakeholders is expected after publication and dissemination of the guideline.

### Intended users.

The target audience for this guideline is general dentists, pediatric dentists, pediatricians and family practice physicians. Public and private payers will benefit from reviewing the evidence for coverage decisions regarding SDF use, and patients and patient advocates may find it useful as a reference for current available treatments for caries management. The target populations include children and adolescents, including those with special health care needs.

### Guideline updating process.

The AAPD's EBDC will monitor the biomedical literature to identify new evidence that may impact the current recommendations. These recommendations will be updated five years from the time the last systematic search, unless the EBDC determines that an earlier revision or update is warranted.

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### AUTHOR CONTRIBUTIONS

All authors contributed to the formation and drafting of the guideline recommendations and the manuscript. Dr. Crystal served as chair of the workgroup and provided expert oversight. Dr. Marghalani provided statistical support and created the GRADE tables. Ms. Graham provided methodical support for the development of the guideline, including search strategy development. All authors contributed to the critical revision of the manuscript and approved the guideline.

### DECLARATION OF INTEREST

Dr. Crystal is a member of the AAPD Editorial Board. Dr. Divaris is a member of the AAPD Editorial Board. Dr. Marghalani is an ad hoc reviewer for *Pediatric Dentistry*. Dr. Sulyanto is an ad hoc reviewer for *Pediatric Dentistry*. Dr. Wright is a member of the AAPD Editorial Board. No other conflicts of interest were reported.

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### TRANSLATION AND CLINICAL REVIEW SERVICE

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## APPENDICES

### Appendix I—Search strategies

PubMed (MEDLINE) – no date limit

#### Search 1. 145 results

cariestop OR “silver diamine fluoride”[Supplementary Concept] OR “silver diamine” OR “silver diammine” OR “diamine fluoride” OR “diammine fluoride” OR saforide OR “Riva star”

#### Search 2. 6,589,771 results

(randomized controlled trial[pt] OR controlled clinical trial [pt] OR randomi\*[tiab] OR randomization[tiab] OR randomisation[tiab] OR placebo[tiab] OR drug therapy[sh] OR randomly[tiab] OR trial[tiab] OR groups[tiab] OR Clinical trial[pt] OR “clinical trial”[tw] OR “clinical trials”[tw] OR “evaluation studies”[Publication Type] OR “evaluation studies as topic”[MeSH Terms] OR “evaluation study”[tw] OR evaluation studies[tw] OR “intervention studies”[MeSH Terms] OR “intervention study”[tw] OR “intervention studies”[tw] OR “cohort studies”[MeSH Terms] OR cohort[tw] OR “longitudinal studies”[MeSH Terms] OR “longitudinal”[tw] OR longitudinally[tw] OR “prospective”[tw] OR prospectively[tw] OR “follow up”[tw] OR “comparative study”[Publication Type] OR “comparative study”[tw] OR systematic[subset] OR “meta-analysis”[Publication Type] OR “meta-analysis as topic” [MeSH Terms] OR “meta-analysis”[tw] OR “meta-analyses” [tw]) NOT (animals [mh] NOT humans [mh])

#### Search 3. 14 results

1 and 2

#### Search 4. 410,530 results

(systematic[sh] OR meta-analysis[pt] OR meta-analysis as topic[mh] OR meta-analysis[mh] OR meta-

analy\*[tw] OR metanaly\*[tw] OR metaanaly\*[tw] OR met analy\*[tw] OR research overview\*[tiab] OR collaborative review\*[tiab] OR collaborative overview\*[tiab] OR systematic review\*[tiab] OR comparative efficacy[tiab] OR comparative effectiveness[tiab] OR outcomes research[tiab] OR systematic overview\*[tiab] OR methodological overview\*[tiab] OR methodologic overview\* [tiab] OR methodological review\*[tiab] OR methodologic review\*[tiab] OR quantitative overview\*[tiab] OR quantitative synthes\*[tiab] OR pooled analy\*[tiab] OR Cochrane[tiab] OR Medline[tiab] OR Pubmed [tiab] OR Medlars[tiab] OR handsearch\*[tiab] OR hand search\*[tiab] OR meta-regression\*[tiab] OR metaregression\*[tiab] OR data synthes\*[tiab] OR data extraction[tiab] OR data abstraction\*[tiab] OR mantel haenszel[tiab] OR peto[tiab] OR dersimonian[tiab] OR dersimonian[tiab] OR fixed effect\* [tiab] OR “Cochrane Database Syst Rev”[Journal])

#### Search 5. 14 results

1 and 4\*

#### Search 6. 890,576 results

(“Economics”[Mesh] OR “Cost of Illness”[Mesh] OR “Cost Savings”[Mesh] OR “Cost Control”[Mesh] OR “Cost-Benefit Analysis”[Mesh] OR “Health Care Costs”[Mesh] OR “Direct Service Costs”[Mesh] OR “economics”[Subheading] OR cost))

#### Search 7. Eight results

1 AND 6

\* Search results vetted in duplicate using an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses checklist.

### Appendix II – Practical Guidance\*

\* Silver diamine fluoride in this guideline’s recommendation refers to 38% SDF, the only formula available in the United States.

#### Setting

Practitioners must first consider the current standard of care of the setting where SDF therapy is intended for use. Silver diamine fluoride is optimally utilized in the context of a chronic disease management protocol, one that allows for the monitoring of the clinical effectiveness of SDF treatment, disease control and risk assessment.

*Practical recommendation:* Know the setting where SDF is to be used to be consistent with goals of patient-centered care.

#### Indications and usage

The following scenarios may be well-suited for the use of SDF:

- High caries-risk patients with anterior or posterior active cavitated lesions.
- Cavitated caries lesions in individuals presenting with behavioral or medical management challenges.
- Patients with multiple cavitated caries lesions that may not all be treated in one visit.
- Difficult to treat cavitated dental caries lesions.
- Patients without access to or with difficulty accessing dental care.
- Active cavitated caries lesions with no clinical signs of pulp involvement.

*Practical recommendation:* SDF is a valuable caries lesion-arresting tool that can be used in the context of caries management. Evaluate carefully which patients/teeth will benefit from SDF application.

### *Preparation of patients and practitioners*

Informed consent, particularly highlighting expected staining of treated lesions, potential staining of skin and clothes and need for reapplication for disease control, is recommended.

The following practices are presented to support patient safety and effectively use SDF:

- Universal precautions.
- No operative intervention (e.g., affected or infected dentin removal) is necessary to achieve caries arrest.<sup>8</sup>
- Protect patient with plastic-lined bib and glasses.
- Cotton roll or other isolation as appropriate.
- Use a plastic dappen dish as SDF corrodes glass and metal.
- Carefully dispose of gloves, cotton rolls and micro brush into plastic waste bag.

### *Application*

Carious dentin excavation prior to SDF application is not necessary.<sup>8</sup> Caries dentin excavation may reduce proportion of arrested caries lesions that become black, and may be considered for aesthetic purposes.<sup>30</sup> Functional indicator of effectiveness (i.e., caries arrest) is when staining on dentinal carious surfaces is visible.

The following steps may vary depending on differing practices, settings and patients:

- Remove gross debris from cavitation to allow better SDF contact with denatured dentin.
- Minimize contact with gingiva and mucous membranes to avoid potential pigmentation or irritation; consider applying cocoa butter or use cotton rolls to protect surrounding gingival tissues, with care to not inadvertently coat the surfaces of the carious lesion.

- Dry with a gentle flow of compressed air (or use cotton rolls/gauze to dry affected tooth surfaces.)
- Bend micro sponge brush, dip and dab on the side of the dappen dish to remove excess liquid before application;<sup>24</sup> apply SDF directly to only the affected tooth surface.
- Dry with a gentle flow of compressed air for at least one minute.
- Remove excess SDF with gauze, cotton roll or cotton pellet to minimize systemic absorption.<sup>4</sup> Continue to isolate site for up to three minutes when possible.

*Practical recommendation:* No need for surgical intervention (e.g., dentin excavation). SDF application is minimally invasive and easy for the patient and the practitioner. It may be desirable for the caries lesion to be free of gross debris for SDF to have maximum contact with the affected dentin surface.

### *Application time*

An application time of one minute, drying with a gentle flow of compressed air, is recommended. Clinical studies report application times range from 10 seconds to three minutes. A current review states that application time in clinical studies does not correlate to outcome.<sup>24</sup> More studies are needed to confirm an ideal protocol.

*Practical recommendation:* Ideal time of application should be one minute, using a gentle flow of compressed air until liquid is dry. When using shorter application periods, monitor carefully at postop and recare to evaluate arrest and consider reapplication.

### *Postoperative instructions*

No postoperative limitations are listed by the manufacturer. Eating and drinking immediately following application is acceptable. Patients may brush with fluoridated toothpaste as per regular routine following SDF application.

Several SDF clinical trials recommended no eating or drinking for 30 minutes to one hour.<sup>13,31,32</sup> As patients are used to these recommendations for in-office topical fluoride applications, the recommendation may not be unreasonable to patients and it may allow for better arrest results. More clinical studies are needed to establish best practices.

### *Application frequency*

The effectiveness of one-time SDF application in arresting dental caries lesions ranges from 47 percent to 90 percent, depending on the lesion size and the location of the tooth and the lesion. One study showed that anterior teeth had higher rates of caries lesion arrest than posterior teeth.<sup>33</sup> The effectiveness of caries lesion arrest, however, decreases over time. After a single application of 38% SDF, 50 percent of the arrested surfaces at six months had reverted to active lesions at 24 months.<sup>13</sup>

Reapplication may be necessary to sustain arrest.<sup>8,31-33</sup> Annual application of SDF is more effective in arresting caries lesions than application of 5% sodium fluoride varnish four times per year.<sup>30</sup> Increasing frequency of application can increase caries arrest rate. Biannual application of SDF increased the rate of caries lesion arrest compared to annual application.<sup>33</sup> Studies that had three times per year applications showed higher arrest rates.<sup>7,31,33,34</sup> Frequency of application after baseline has been suggested at three-month follow up and then

semiannual recall visits over two years.<sup>24</sup> One option is to place SDF on active lesions in conjunction with fluoride varnish (FV) on the rest of the dentition or alternate SDF on caries lesions and FV on the rest of the dentition at three months interval to achieve arrest and prevention in high-risk individuals.<sup>35</sup> Another study recommends one-month postoperative evaluation of treated lesions with optional reapplication as required to achieve arrest of all targeted lesions.<sup>35</sup> Individuals with high plaque index and lesions with plaque present display lower rates of arrest. Addressing other risk factors like presence of plaque may increase the rate of successful treatment outcomes.<sup>33</sup>

*Practical recommendation:* If the setting allows, monitor caries lesion arrest after two to four week period and consider reapplication as necessary to achieve arrest of all targeted lesions. Provide recare monitoring based on patient's disease activity and caries risk level (every three, four or six months). Careful monitoring and behavioral intervention to reduce individual risk factors should be part of a comprehensive caries management program that aims not only to sustain arrest of existing caries lesions, but also to prevent new caries lesion development.

#### Adverse reactions

No severe pulpal damage or reaction to SDF has been reported.<sup>7,36-38</sup> However, SDF should not be placed on exposed pulps. Teeth with deep caries lesions should be closely monitored clinically and radiographically.

Serum concentration of fluoride following SDF application per manufacturer recommendations posed little toxicity risk and was below EPA oral reference dose in adults.<sup>39</sup>

The following adverse effects have been noted in the literature:

- Metallic/bitter taste.<sup>24</sup>
- Temporary staining to skin, which resolves in two to 14 days.<sup>24</sup>
- Mucosal irritation/lesions resulting from inadvertent contact with SDF, resolved within 48 hours.<sup>7</sup>

#### Aesthetics

The hallmark of SDF is a visible dark staining that is a sign of caries arrest on treated dentin lesions. This dark discoloration is permanent unless restored. A recent study that assessed parental perceptions and acceptance of SDF based on the staining found that staining on posterior teeth was more acceptable than on anterior teeth.<sup>40</sup> Although staining on anterior teeth was perceived as undesirable, most parents preferred this option to avoid the use of advanced behavioral guidance techniques such as sedation or general anesthesia to deliver traditional restorative care. It was also found that about one-third of parents found SDF treatment unacceptable under any circumstance due to aesthetic concerns. To identify those patients, a thorough in-formed consent, preferably with photographs that show typical staining, is imperative.<sup>40</sup> To improve aesthetics, once the disease is controlled and patient's circumstances allow, treated and now-arrested cavitated caries lesions can be restored.<sup>35</sup>

#### Other considerations

- Coding — D1354. Reimbursement for this procedure varies among states and carriers. Third-party payers' coverage is not consistent on the use of this code per tooth or per visit. Practitioners are cautioned to check insurance coverage for this code as it is transitioning in most areas.

- Caries arrest is more likely on the maxillary anterior teeth<sup>8,31</sup> and buccal/lingual smooth surfaces.<sup>31</sup>
- Pretreatment of dentin with SDF does not adversely affect bond strength of resin composite to dentin.<sup>41,42</sup> ■

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# ARE YOU THROWING AWAY MONEY ON DENTAL SENSORS?

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THE CORRESPONDING AUTHOR, Laurel Graham, MLS, can be reached at [lgraham@aapd.org](mailto:lgraham@aapd.org).

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### LOS ANGELES COUNTY

**CARSON**— Long established GP in a small shopping center. **Grossed \$234K in 2016.** Has 5 eq ops. Retiring seller work 3 days/wk. **Property ID #5181.**

**LA MIRADA** - GP established circa 1963 located in a 2 story med prof bldg. Consists of 5 eq ops. Grossed approx. \$408K in 2016. **Property #5119.**

**LA VERNE**— Est. in 1980 w/ 4 eq op in a 1, 250 sq ft. **Grossing approx. \$64K/mo. Net of \$195K. PPO & Cash Only! Property ID #5196.**

**LOS ANGELES - Price Adjustment!** GP w/ 40 years of goodwill. In a 10 story medical/dental bldg. Has 4 eq ops with views to the mountains. PPO/Cash/Medical/CAP. Grossed \$670K in 2016. Net of \$166K. **Property ID #5107.**

**LOS ANGELES** - GP established in 1968 in a 6 story bldg. NO HMO. Has 4 eq ops in a 1,211 sq ft suite. Grossed approx. \$531K in 2016. **Property ID #5163.**

**MONTEREY PARK**— COMING SOON!

**MOTEBELLO**—Grossed approx. **\$1.1M in 2016**, located in a free standing bldg w/ 5 eq ops. Established in 2002. **Property ID #5168**

**PASADENA** - Located in the heart of Pasadena w/ 60 years of goodwill. Grossed approx. \$616K in 2016. Has 3 eqs ops in a 1,150 sq ft suite. **Property ID #5147.**

**VALENCIA** — GP + Spec. office with 9 eq ops in a busy single shopping center. **Grossed \$1.6M in 2016.** **Property ID #5171.**

**WALNUT PARK** - Established in 1968 GP in free standing bldg. **Option to buy bldg.** Grossed \$531K in 2016. Net \$166K. Has 4 eq ops. **Property ID #5176.**

### KERN, VENTURA, & SAN LUIS OBISPO COUNTIES

**CAMARILLO**—GP + Real Estate. Well established practice w/3 eq ops / 1 plmbd not eq. **NET OF \$179K. Property ID #5150.**

**SIMI VALLEY**— GP + Bldgs. Well established practice 4 eq ops & 2 plmbd not eq ops. **Net of \$92K.** Extra income generating from rent. **Property ID #5185.**

### ORANGE COUNTY

**ANAHEIM**— Established in 1960's this practice is on a single story bldg w/ 4 eq ops. **Grossed \$735K in 2016. Net \$308K. Property ID #5187.**

**BREA**— Beautiful well established practice located on a corner location. Has 8 equipped ops and 3 chairs in open bay. **Grossed \$1.5M.** On a busy major street of the city. **Property ID #5190.**

**BREA**— GP + Bldg. Well established practice w/4 eq ops & 2 plmbd not eq. PPO & Cash Only. **Grossed \$683K in 2016. Property ID #5197.**

**COSTA MESA** - COMING SOON!!

**FOUNTAIN VALLEY**—GP in busy strip mall. Has approx. 27 years of goodwill. Grossed \$344K in 2016. Net of \$136K. **Property ID #5165.**

**LAGUNA HILLS**— With over 30 yrs of goodwill this GP is located in a 2 story med bldg. Has 5 eq ops in a 1,600 sq ft suite. Grossed approx. \$304K for 2016. **Property ID #5127.**

**MISSION VIEJO (TURN-KEY)** Modern designed GP located in a 2 story med/dent bldg. Has 3 eq / 3 plmbd for expansion. **Property ID #5138.**

**TUSTIN**— Beautiful GP NET OF **\$159K. Prop. #5199.**

**WESTMINSTER**— GP established in 1983 in a 2 story building. Has 3 eq ops in 1,300 sq ft suite. Next to residential area on a busy street. **Grossed \$183K IN 2016. Net \$61K. Property ID # 5194.**

### SAN DIEGO COUNTY

**CARLSBAD**—Well established GP w/ 3 eq ops and 2 plmbd not eq near residential are. **Buyer's net of \$121K. Property ID #5191.**

**ESCONDIDO**—Perio practice w/ 40 yrs of gdwill in a single story bldg. Has 4 eq ops. **Grossed \$683K in 2016. Property ID #5173.**

**SAN DIEGO** —COMING SOON!

### RIVERSIDE & SAN BERNARDINO COUNTIES

**BEAUMONT**—GP + Real Estate. Modern GP w/ 6 eq ops in 2,400 sq ft office. Could be two suites. **Grossed \$960K in 2016. Property ID #5182.**

**CHINO**—Real Estate Only! This a rare opportunity to purchase a condo located in a single story strip mall. Has been a dental practice for 40 years. **Property ID 5076.**

**DESERT HOT SPRINGS**— GP + Real Estate! Two partners one office. Consists of 4 eq ops / 1 plmbd not eq. Est. in 1986. **Proj. approx. \$802K for 2017. Property ID #5198.**

**FONTANA**— GP + Real Estate!! Premier office with 50 years of goodwill. In a 3,000 sq ft bldg with 8 eq ops. Has the latest technology. Grossed approx. \$2.3M in 2016. Net of \$968K. **Property ID #5140.**

**HEMET** GP + Condo Suite Has over 40 years of goodwill to officer. Icon in the community. Located in a single story tri-plex condo bldg. Has 4 eq ops. No Denti-cal. **Net of \$143K. Property ID #5152.**

**PALM SPRINGS** — General practice with 3 equipped ops located in a free standing bldg. Established in 2005. Suite is approx. 1,200. Seller work 5 days/wk. **BUYER'S NET OF \$153K. Property ID #4487.**

**RANCHO CUCAMONGA**— GP established in 2004 in busy shopping center. Consists of 3 eq ops in a 1,200 sq ft suite. **Grossed \$747K in 2016. Net \$251K. Property ID #5169.**

**RIVERSIDE**—GP + Real Estate!! Established in 1975 in free standing historic bldg. Has 4 eq ops in a 2,000 sq ft office. Projecting approx. \$284K for 2016. **Property ID #5146.**

**TEMECULA**—Modern designed practice w/ 3 eq ops. Projecting approx. \$1.2M. **Net of \$444K. Property ID #5155.**

**UPLAND**—Pediatric dental practice located in a medical bldg with 40 years of goodwill. Consists of 4 chairs in open with Alpha Dent software. **Grossed \$271K in 2016. Property ID #5188.**

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## Re-treating Patients When an Associate Leaves

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Hiring an associate brings the opportunity to lighten workloads and potentially drive in new business. But as with any relationship, both parties may eventually agree to part ways. In worst-case scenarios, the split may not be amicable and your patients and practice as a whole may suffer unwelcome consequences.

As a practice owner, dealing with re-treatment can be one of the most difficult issues and may be especially challenging when the dentist who originally treated the patient is no longer with the practice.

The Dentists Insurance Company reports a case in which a practice owner heard from multiple patients who were unhappy with the treatment they received from an associate who was no longer with the practice. The owner referred the patients to the former associate to resolve their issues, while the associate referred the patients back to the owner.

Frustrated by a lack of resolution, some of the patients called the practice and demanded refunds. They threatened to take legal action and file a report with the dental board if their money was not refunded.

While the practice owner believed it was the associate's responsibility to address the situation, the patients actually belonged to the practice and not to the treating dentist. Therefore, it was the owner's responsibility to respond to the patients' concerns and ensure continuity of care, either by completing the treatment himself, having or hiring another associate within the practice to treat them or referring them to another dentist or specialist for treatment completion.

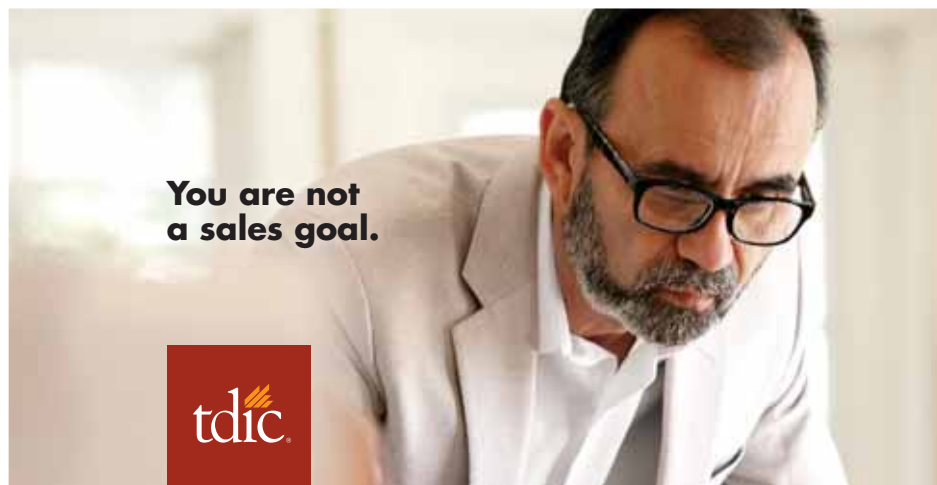
As demonstrated by the case above, patients may become disgruntled

with both dentists if they believe they are getting the runaround or perceive there are arguments in regards to who pays for re-treatment.

One way to prevent this from happening is to have a Business Associate Agreement in place with a re-treatment clause when bringing on an associate. Re-treatment clauses usually address how re-treatment issues will be handled for a specific period of time. These clauses set the terms for objectively validating the need for patient re-

treatment (i.e., through a neutral third-party dentist) and establish a financial agreement if re-treatment is required.

One associate dentist involved in a re-treatment dispute reported that he did not have a contract agreement with his former employer and was only paid a percentage of the total patient payments the practice received. When another dentist found an open margin on a restoration the associate had performed while still with the practice, the patient demanded a full refund from the owner to cover re-treatment. The



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owner provided the patient with the associate's contact information and advised her to reach out to him directly to resolve her concern. However, the associate dentist felt it unfair to have to absorb the entire cost of re-treatment as he only received a percentage of the profit. When handling re-treatment disputes, practice owners are encouraged to take into account the percentage an associate received to more easily reach a resolution.

If you do find yourself caught in a re-treatment dispute, remember that the patient always comes first. Treat the patient without delay and work out the

details with the former associate separately on the side. Remember, a few hundred dollars upfront in patient care is cheaper in the long run than the cost of a damaged reputation. By putting the patient first, you demonstrate the quality of care others can expect when visiting your practice.

Keep the following tips in mind to minimize your practice's risk when dealing with re-treatment:

- Patients belong to the practice; therefore, it is the practice owner's responsibility to ensure continuity of care.
- Before hiring an associate, manage

your risk by mutually agreeing on a clear-cut, well-drafted associate agreement. The agreement should include a re-treatment clause to provide seamless continuity of care for patients.

- Consult with a professional attorney for assistance drafting your contract and for review prior to signing it.
- At the beginning of the business relationship, clearly establish who is responsible for re-treating patients if the associate leaves.
- If a patient is in midtreatment and the treating dentist leaves the practice, complete the treatment in progress yourself or refer the patient to another dentist or specialist for completion to ensure patient care is not compromised.
- Avoid criticizing the original treating dentist's work. Simply state your observations based upon clinical findings. If the patient questions the quality of the previous work, state that you cannot speak for the other dentist or the direction he or she took.

Adhering to these guidelines can help safeguard compliance with contractual obligations and state dental boards. For more information on how to protect your practice when hiring an associate or how to protect yourself when separating from a practice, visit [tdicinsurance.com/reference-guides](http://tdicinsurance.com/reference-guides). ■

*TDIC's Risk Management Advice Line at 800.733.0633 is staffed with trained analysts who can provide guidance on re-treatment protocols and other questions related to a dental practice.*

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### 4101 SAN FRANCISCO GP

Vibrant downtown location in historic high-rise bldg. Retiring doctor offering 30+ years of goodwill. 4.5 days of hygiene, 1,500+ active patients, 20-25 new patients/mo. Gorgeous, spacious facility in approx. 2,500 sq. ft. 2017 annualized GR \$885K. Adjusted net income \$295K+ Seller will assist for smooth transition. Asking \$599K

### 4151 MARIN COUNTY GP

Well established and respected, quality general practice located in desirable Marin County location. Office has convenient ample parking, overlooking a beautiful park like setting adjacent to a peaceful creek. Office contains 5 ops in ~1,300 sq. ft. Gross receipts average \$1.2M annually with 3 doctor days/week.

### 4178 SONOMA COUNTY PERIO

Seller retiring from 21 year practice with trained, seasoned staff and great location. Exceptional 2,100 sq. ft. ample office with 6 fully equipped ops. Majority of equipment purchased in 2002. 4 doctor-days & 3 hygiene days per week. Average gross receipts \$1M+. Asking \$677K.

### 4198 NORTH BAY PERIO

Established Periodontic practice with loyal referral sources in 1,564 square foot office with 5 fully-equipped operatories conveniently located close to Petaluma Valley Hospital. Average Gross Receipts \$480K. Seller is offering the condominiumized office for sale or lease to the buyer of the practice. Asking price for practice \$284K.

### 4191 SONOMA COUNTY ENDO

Seller retiring from 38 year endodontic practice located in attractive ground floor office (remodeled in 2011) with updated modern equipment and cabinetry. Close to several regular referral sources. Doctor sees an average of 7-8 patients per day. 5 year average Gross Receipts \$700K+. Asking \$447K.

### 4202 SANTA CRUZ COUNTY GP

Retiring seller offering 40+ years of goodwill with emphasis on restorative care. Located on major thoroughfare within walking distance to the ocean. 1,600 square foot office with 4 fully equipped operatories. Average annual gross receipts approx. \$500K with adj net of \$170K+. Owner/doctor works on average 3 days per week with average of 5 hygiene days/week. Asking \$300K.

### 4193 SAN BRUNO GP

Well established practice in prime, high-traffic location. 670 sq. ft. office with (3) fully-equipped operatories set up for rear delivery. Approx. 650-700 active patients with an average of 5 new patients per month. Approx. 3.5 doctor days per week. 2016 Gross receipts \$516K+. Average adjusted overhead 56%. Seller transitioning into retirement. Asking \$378K.

### 4133 NAPA GP

Napa County GP in newly furnished, fully equipped 2 op facility with digital x-ray. 4 doctor day/week with 3 hygiene days. Average annual Gross Receipts \$420K+. Seller willing to help for a smooth transition. Asking \$331K.

### 4190 SAN JOSE GP

Excellent location on west side of SJ in the Blossom Hill area. Easy access to Hwy 85 & 87 and light rail. Offering 17+ years of goodwill. Beautifully appointed 3 op office in 950 sq. ft. Plentiful on-site parking. 730 active patients with 1.5 days of hygiene. Average two years gross receipts \$389K with adjusted net of \$154K.

### 4150 SANTA CRUZ COUNTY GP

Seller retiring from successful 33 year general practice. Fee-for-service only practice. Fully-equipped 4 op facility in beautiful, remodeled seller owned building. Located in desirable residential and commercial neighborhood. Building also for sale.

### 4123 CAMPBELL GP

Seller transitioning 32 year general practice with an emphasis on Restorative and Preventative care. Well-trained and loyal staff. Approximately 37% hygiene production. 3.5 doctor days per week & 3 hygiene days per week. Average gross receipts \$625K+ with average adjusted overhead of 62%. Asking \$464K.

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**NORTHERN CALIFORNIA**

**CHICO:** 7 Ops, Digital, Dentrax, Pano. Practice est. 60+ yrs w/ 2 long-term owners. 6 days Hyg/wk. GR \$757K. #CA402

**CLEARLAKE:** 4 Ops in 1,600 sq. ft. with Dentrax, Dexis, Laser, Microscope, Pano, \$650K in GR. Est. in 2001, retiring. #CA457

**EASTERN CONTRA COSTA:** 3 Ops, 1300 sq. ft., w/room to expand. Intraoral Camera, Laser, Dexis Digital X-ray, Softdent PMS. 2016 GR \$274K w/52% adj. net. #CA454

**EL DORADO COUNTY:** 1,200 sq. ft., 3 Ops, with Pano, EZ 2000 software. 2015 GR \$342K on 3 day week. #CA390

**ELK GROVE -FACILITY ONLY:** Fully furnished 5 ops total (4 furnishing). Signage on Elk Grove Bl., fast growing area, ready to move in, separate pano #CA411

**GREATER EL DORADO HILLS:** 1,500 + sf office, 4 ops, Dentrax microscope, 2 Schick digital x-ray sensors, new server & CPUs. Bldg avail. Seller Retiring. #CA407

**GREATER SACRAMENTO:** Oral Surgery office w 5 Ops. 2,282 sq. ft. suite. Digital X-rays and Pano. 2016 GR of \$798K. Doctor is retiring. #CA438

**GREATER SACRAMENTO:** Approx. 2,000 sf, 6 ops, Intraoral Camera, Digital X-ray, Laser, CEREC, & Eaglesoft. 2016 GR \$934,829. #CA455

**GREATER SACRAMENTO:** 1,200 sf w/4 Ops, Intraoral Camera, Dexis Digital X-ray, Dentrax. 2016 GR \$435K, 3 day work week #CA456

**GREATER SACRAMENTO:** Ortho. 2,140 sf, w/4 bays. Equip. w/intra-oral camera, non-digital Pan/Ceph, Laser, and OrthoTrac software. 2016 GR \$640,000. #CA458

**SACRAMENTO:** 1,150 sf office w/4 Ops, Intra-Oral, Dexis digi x-ray, Carestream. Est. 30+ yrs, 2016 GR \$535K. #CA424

**SACRAMENTO:** 1,000 sq. ft. office w/2 Equip. Ops, 2 add'l Plumbed. DentalMate software. 2015 GR \$110,427 #CA332

**SACRAMENTO:** 1,200 sq. ft. w/ 3 Ops, Intra-Oral camera & Patient Base software. Practice est. 40+ years, retiring. #CA408

**SACRAMENTO:** 1,567 sq. ft. w/4 equipped Ops. 1 add'l plumbed. 5 day week. Intra-Oral Camera, Digi Pano, Carestream software. 2016 GR \$680K #CA441

**SAN FRANCISCO:** Financial District office, 5 Ops, room for 6th, 1760 sq. ft. 2015 GR \$1.2 mil, Adj. Net. \$480,000. #CA357

**SAN FRANCISCO:** P dental Practice & Condo Unit. 1600 sq. ft. 4 Op, 2014 GR \$714K w/\$36K Adj. Net. #CA274

**SAN RAMON-FACILITY:** 4 Op facility w/high-end Pelton & Crane Equipment, Digital X-Ray, Digital Pan, I.O. Cameras, 1654 sq. ft. corner suite. #CA370

**SAN RAMON:** General Dentistry, emphasis on Children, 5 treatment rooms, 1700 sq. ft. 2016 GR \$440K w/52% adj. net. 5 day week due to illness. Dentrax PMS, Paperless Charts, Digital Sensor, Digital Pan. #CA439

**SONOMA COUNTY:** 2016 GR \$680K, 3 days/wk. 3 Ops, 960 sf. Condo for sale/lease. Pano X-ray, Intra-Oral Camera, Soft Tissue Laser, Datacon PMS. Retiring. #CA463

**SONOMA COUNTY: New Listing!** Multi-Specialist, est 16 yrs, 2016 GR \$1.6M + on 3.5 days/ wk. 6 fully equipped Ops; LANAP, Digital Pano, Dexis & Dentrax. Retiring periodontist selling practice and 2000 sq. ft. Condo. #CA470

**WALNUT CREEK: New Listing!** 1260 sq. ft. office w/Dexis Digital sensor, EZ Dental, 4 ops. 2016 GR \$633,000, 4 days/week, Adj. Net 45%. Owners retiring. #CA473

**WINE COUNTRY:** Perio, 2016 GR \$1,997,000 w/\$978,000 adj. net in 3,000 sq. ft. office space. Building for sale. #CA418

**VALLEJO: New Listing!** 4 Ops, 1650 sq. ft., Digital X-Ray, Digital Pano. 2016 GR \$567,000 with 40% adjusted net income. Eaglesoft PMS with Paperless Patient Charts. #CA469

**CENTRAL CALIFORNIA**

**FRESNO:** GP. GR past 3 years avg. \$1.5M. 4 days/hygiene. Retiring. Priced for expedient sale. Delta PPO, no HMOs. #CA445

**MODESTO:** 1,110 sq. ft., 3 Ops, Dentrax software, Dexis Digital X-Ray, Fiber Optics, Laser. 2016 GR of \$706K 4 day/wk. #CA451

**MODESTO: New Listing!** ENDO Practice & Building. 6 Ops, stand-alone building, Microscopes, CBCT and Endovision software. 2016 GR \$1.2M, 32% overhead. Owner will stay for transition. #CA475

**SOUTHERN CALIFORNIA**

**BAKERSFIELD:** 6 Ops, 5 Equipped, located in duplex building with signage. 2016 GR \$509K with room to grow. Most specialty work is referred out. PPO/Denti-Cal. #CA459

**BURBANK: New Listing!** Beautiful practice for quick sale. Long-term staff, over 28 years of goodwill. 3 Ops with 3 days of hygiene, digital X-rays. Great Burbank building close to downtown. 2016 GR \$477K. #CA464

**CENTRAL ORANGE COUNTY:** 4 Ops, Intra-Oral Camera, Pano, 3 days Hygiene/week. 50+ years of goodwill with retiring seller plus previous owner. #CA442

**FULLERTON:** 5 Ops, 3 Equipped in shopping center, PracticeWorks, CEREC, Digital, 4 days Hyg/wk. GR \$663K w/ \$235K Adj. Net. #CA453

**LOS ANGELES: Price Reduced!** Perio. 5 Ops, 34 Yrs. Goodwill. Dentrax, Digital, Laser, great referral base, 2016 GR \$712K, Adj. Net \$304K. #CA173

**LA QUINTA:** 8 Ops in busy shopping center, 25 yrs Goodwill. Last year's GR \$1.64M. State-of-the-art, Digital. Seller Retiring. #CA425

**LAGUNA BEACH:** 4 Ops, 3 Equipped, beautiful location. Dentrax G4, Dexis Digital X-rays, paperless. 2016 GR of \$344K and 2017 on track to increase. #CA443

**LANCASTER:** 9 Ops in free-standing bldg. EagleSoft, Digital, Microscope, CBCT machine, and Digital Pano. 2016 GR of \$593K and \$166K Adj. Net. #CA437

**MANHATTAN BEACH FACILITY ONLY: New Listing!** 4 Op office w/ modern design. Incl. computers, furnished Ops, Lab equip., Zoom light, curing lights, 2 X-ray heads. Move-in ready #CA467

**ORANGE COUNTY: New Listing!** Endo, great city w/ 3 Ops, 2 Equipped, Cone Beam CT, Microscope, Digi, & paperless TDO system. 28 yrs goodwill, strong referral base. 2016 GR \$603K, 309K Adj. Net. #CA466

**ORANGE COUNTY:** 4 Ops, 40+ years goodwill, OpenDental, Digital X-rays. 2016 GR \$533K with \$179K Adj. Net. #CA440

**PALM DESERT:** 8 Ops, 3200 sq. ft., 2016 GR \$1.1M, Digital x-rays, nice location, bldg has signage. Owner + 3 Associates work in the practice. #CA426

**PALM SPRINGS FACILITY ONLY:** 4 Ops, 3 Equipped. Seller is here only 12 hrs./wk. Some patients included in the asking price. PracticeWeb, digital x-rays. #CA429

**PALM SPRINGS:** 4 Ops, 30 yrs goodwill. Good loc, Doctor to remain and work part time if possible, 2015 GR \$549K. #CA351

**RIALTO:** 5 Ops in free-standing historic bldg. 50+ years of Goodwill. Building also for sale. Dentrax, 2016 GR \$253K. #CA421

**SAN PEDRO:** 4 Ops, EagleSoft, Digital, 6 yr old equip. Bright and spacious build-out, modern. 2016 GR \$519K. #CA449

**SANTA ANA:** 4 Ops in shopping center on busy corner w/signage. PPO/Denti-Cal. 2016 GR \$434K with \$199K Adj. Net. #CA460

**SANTA BARBARA:** Creekside location, 4 Ops in 1500 sq. ft. bldg. 20+ years. 7 days Hygiene/week, 10 staff. FFS. GR of \$955K on 4 day week. #CA291

**SANTA CLARITA VALLEY: New Listing!** General/Multi-Specialty Practice. 8 Ops, 5 chair Ortho bay. Great visibility. 100 NP/mo. PPO/HMO w large CAP check. #CA435

**SOUTH PASADENA AREA:** 5 Ops, 4 equipped with 23 yrs Goodwill. Digital x-rays. Great location #CA436

**TEMECULA: New Listing!** 3 Ops, and 1 add'l plumbed for expansion. Practice has 14 + years of Goodwill and utilizes Dentrax, retail center location. PPO practice, no HMO. 2016 GR \$281K with room to grow. #CA474

**TEMECULA:** 5 Ops, 4 Equipped, PracticeWeb, Digital, Pano. 2016 GR \$548K w/\$241K Adj. Net on 3 day wk. #CA430

**UPLAND:** 3 Ops (possible 4th Op used as office) in shopping center w/ 30 yrs in business. 2016 GR of \$324K. #CA450

**UPLAND:** Facility Only - 4 Ops, 2 Equip. All Brand New Equipment, OpenDental w/ 4 workstations, hand instruments, equipment, some patients. #CA434

**VAN NUYS:** Multi-Specialty Practice with 6 Ops in retail center. Digital x-rays, paperless. PPO/HMO/Denti-Cal. 2016 GR of \$1.09M with \$384K Adj. Net. #CA431

**WESTERN SAN FERNANDO VALLEY:** Pedo Practice upscale location, 4 Ops, EagleSoft, Intra-Oral Camera, Pano. 9 yrs Goodwill. #CA399

**YUCCA VALLEY:** 5 Ops, retiring seller works a 4 day week with 27 years of Goodwill. Office condo also for sale. 2016 GR of \$586K #CA423

**RIVERSIDE COUNTY: New Listing!** Turn-key 4 Ops in single story Prof. Bldg w/ signage. Dentrax, Digital, Paperless. 2016 GR \$688K w/ \$223K Adj. Net. #CA471

**SAN DIEGO**

**CHULA VISTA/BONITA AREA: New Listing!** 8 Ops, well-established, stand-alone bldg near busy section of Bonita has excellent visibility and parking. Open 5 days and has 9 days hyg/wk. SofDent, Dexis, Pano, I/O cameras, and Laser. FFS, Indemnity, and PPO. Specialty work is referred out. #CA476

**INLAND NORTH COUNTY, SAN DIEGO:** 5 Op General/Pros. EagleSoft, Digital, 2D Digital Pano, E4D, Full Pros Lab On-site. Great location, 26 yrs Goodwill. 2016 GR \$802K w/ \$316K Adj. Net. #CA432

**LA JOLLA: New Listing!** 8 Ops, 7 Equip, Dentrax, Digi, & Intra-Oral Camera. 4 days Hyg/wk w/GR of \$738K. \$264K Adj. Net on 4 day work wk. 60 yrs goodwill, 29 w/current owner. Specialty work referred out. #CA477

**NORTH COUNTY, SAN DIEGO: New Listing!** 6 Ops, Digi Dentrax, busy retail corner. 17 yrs Goodwill. Seller does Ortho, Cosmetic, and Implants. 2016 GR of \$1.3M+ w/ 6 days hygiene/wk. #CA468

**NORTH COUNTY, SAN DIEGO:** 5 Ops, Dentrax, Digital, Pano, PPO Practice, Excellent and Convenient Location. 2016 GR of \$635K, \$242K Adj. Net. #CA428

**SAN DIEGO:** 3 Ops, EagleSoft, Digital, Paperless, Laser, 5 day work week - room to grow! 2016 GR \$522K. #CA404

**OUT OF CALIFORNIA**

**CENTRAL OAHU, HAWAII: New Listing!** Family-oriented rural Practice with 3 Ops, Digitized X-Rays, Pano, and Innova. Retiring seller, PPO, Medicaid. 2016 GR of \$923K with \$322K Adj. Net. #HI109

**CENTRAL OREGON COAST: New Listing!** 1,080 sq. ft. office, 3 Ops, equipped, Digital x-ray and Daisy software. Building Available. Owner retiring. #OR106

**HONOLULU, HAWAII:** 5 Ops in the Pearl City/Waipahu area. 2016 GR \$548K, Laser, Excellent location, Highly-profitable, Rare opportunity. #HI108

**HONOLULU, HAWAII:** 4 Ops plumbed, 2 equipped, Dentrax, Excellent location w/ ample parking, retiring dentist, priced for quick sale. #HI106

**MAUI, HAWAII:** 3 Ops, Innova, Planmeca Panoramic x-ray, excellent location and patient base, dentist retiring, seller is motivated. GR \$475K. #HI107

# Cybersecurity Tips and News

CDA Practice Support Staff

Cybersecurity awareness must be an almost daily responsibility for a dental practice owner. New cybersecurity threats develop every day and a dentist cannot afford to believe that cyber criminals will not target small businesses. According to a news story published in mid-2017, one hacker entity known as The Dark Overlord has had “a far greater impact in the United States than the (WannaCry) ransomware attack, inflicting heavy — even crippling — costs on small clinics across America.”<sup>1</sup> The Dark Overlord’s many targets in the past year include dental practices in New York, Virginia and California.

Ransomware attacks are not 100 percent preventable because hackers adapt to new security settings. However, it is possible to reduce the likelihood of falling victim to a hacker.

*Top 10 Tips for Cybersecurity in Health Care* describes key steps to protect your valuable information assets and is published by the U.S. Department of Health and Human Services (HHS). HHS has focused resources to assist small health care practices align business practices with cybersecurity and risk management principles. The tips and other resources can be found online at [healthit.gov/providers-professionals/cybersecurity-shared-responsibility](http://healthit.gov/providers-professionals/cybersecurity-shared-responsibility). The 10 tips are:

1. *Establish a security culture.* Your security system is only as strong as your weakest user. Information security should occupy the same plane of consciousness as workplace safety among all health care workers. Provide ongoing training and security reminders. A practice owner should model behavior that promotes information security, for example, don’t share passwords. Hold workers accountable. Look

out for or ensure your IT advisor apprises you on newly identified IT issues. For example, your IT advisor should have discussed recently how the so-called “Krack” Wi-Fi vulnerability<sup>2</sup> may affect your system or mentioned the “digital hurricane”<sup>3</sup> information security experts predict.

2. *Protect mobile devices.* Their small size make them easy to steal or lose. Encrypt when possible and utilize password protection. Use a secure communication method if electronically transmitting protected health information from devices. Maintain a log of these devices and their users.

3. *Maintain good computer habits.* Uninstall nonessential software that may be included with the purchase of hardware or other devices. Do not automatically accept default settings when configuring software. Understand the options before selecting a setting. Ensure external access to the system is secure when needed and is disabled when not in use (for example, remote access by software technicians). Automate software updates and apply security patches as soon as available. Disable user accounts for former employees as soon as possible. Perform malware, vulnerability, configuration and



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other security audits regularly. Use professional IT advisors when practice owner or staff are uncertain about their ability to secure or monitor security of the information system. A simple misconfiguration can lead to a data breach.<sup>4</sup>

4. *Use a firewall.* A firewall is essential. Software firewalls typically are included with popular operating systems. A dental practice that uses a local area network should consider a hardware firewall because it provides centralized management of firewall settings.
5. *Install and maintain antivirus software.* Use an antivirus product that provides continuously updated protection. Ensure configuration allows for automated updating.
6. *Plan for the unexpected.* Regularly backup data. Consider doing multiple backups stored in different locations, for example, on site, removable and in the “cloud.” Regularly restore data to ensure backup process works. Develop a business recovery plan.
7. *Control access to protected health information (PHI).* Set access permissions in the operating system and software for individual workforce members so each may only view or use patient information necessary to do their work.
8. *Use strong passwords and change them regularly.* The current recommendation is to have a password that is at least eight characters in length, uses a combination of upper-case and lower-case letters, one number and one special character. The password should not include personal information such as a

birthdate or the name of a favored team. Be aware, however, that security experts are moving to change this recommendation. The National Institute of Standards and Technology (NIST) recently published digital identity guidelines<sup>5</sup> that call for less complex passwords, use of longer passwords or passphrases and less frequent changing of passwords.

9. *Limit network access.* Prohibit staff or vendors from installing software or devices without prior approval. Secure wireless routers and ensure they operate only in encrypted mode. Remove peer-to-peer applications such as file sharing.
10. *Control physical access.* Make it difficult to steal or lose devices with PHI. Store servers in locked rooms or locked cages. Adopt policy that restricts the physical movement of devices/media with PHI.

A PDF document that provides more detailed information on these tips, plus maintenance, firewall, antivirus, backup and recovery and other checklists, can be downloaded from the HealthIT website. A collection of information security resources, regulatory guidance, NIST publications and cyber awareness newsletters can be found on the HHS Security Rule Guidance Material website.<sup>6</sup> ■

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*Regulatory Compliance appears monthly and features resources about laws that impact dental practices. Visit [cda.org/practicesupport](http://cda.org/practicesupport) for more than 600 practice support resources, including practice management, employment practices, dental benefits plans and regulatory compliance.*



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**6135 SAN FRANCISCO'S NORTH BAY** 2017 collected \$1.4 Million, reflecting nice growth over 2016 which collected \$1.1 Million. The foundation here is 6-days of hygiene. There shall be no change in fees for the successor.

**6134 SANTA CLARA** On part-time basis due to time constraints, collections shall top \$400,000 in 2017. With more time in recent past, practice has topped \$900,000. Strong profits. Long term tenancy. Great location.

**6133 SAN RAMON'S BISHOP RANCH** Beautiful 4-op, computerized and digital office. Located in the Bishop Ranch Medical Center. Bring Business Plan. Great addition to existing network. Full Price \$115,000

**6132 NORTH FREMONT AREA** \$420,000+ invested here. Very high-end for great patient experience. 3-ops equipped (4th available), Panorex, completely networked and digital. \$600,000+ in revenues.

**6131 SAN RAFAEL** Part-time practice. 2016 collected \$243,000. Profits totaled \$146,000. 2017 trending \$265,000. No Delta Premier hit here! 3-ops. Owner lives out of area.

**6129 PROSTHODONTIC PRACTICE – SAN MATEO** 2016 collected \$775,000 on 3.5 day week. Beautiful 5-op office. Excellent candidate for acquisition by nearby practice. Seller shall work back to assist in orderly transition. Acquire here or move into nearby practice. Choice is yours.

**6128 LOS GATOS AREA** Capitation & PPO. 3-Adec equipped ops, Pano, Digital charting. Collects \$420,000+ year. Available Profits of \$190,000 in 2016. Full Price \$225,000

**6127 SAN RAFAEL'S NORTHGATE** Collected \$210,000 in 2016 on part-time schedule. Available profits of \$106,000.

**6125 OAKLAND AREA** Collections average \$735,000 per year. High income zip code with well employed Millennials next door. 10+ new patients per month. Digital and paperless.

**6124 SAN RAMON** 100% Out-of-network. 5-Ops. 6-days of Hygiene. \$700,000 per year.

**6122 SANTA CLARA - STARBUCKS "LIKE" LOCATION!** Best exposure in beautiful strip center. Office just remodeled. 5-Ops. 2017 trending \$1+ Million in Collections on 4-days. Perfect platform to operate 6-days a week. Wants to do \$1.5-to-\$2 Million.

**6121 NAPA VALLEY FAMILY PRACTICE** Highly respected community asset. Collections last 5-years have averaged \$1.28 Million per year. Beautiful facility. Condo optional purchase.

**6120 OAKLAND'S PIEDMONT AREA** Highly coveted area. Right off Highway 13. 3-days of Hygiene. 4-Ops with 5th available. 2016 collected \$650,000+.

**6118 SAN FRANCISCO'S EAST BAY** Forty percent partnership in well positioned and branded practice. 2016 collected \$2.53 Million. 2017 trending \$3.2+ Million in collections. Full complement of specialties. 6-month Trial Association wherein interested Candidate shall see ability to make \$350,000+ per year.

**6114 LINCOLN** \$1.1+ Million year performer. Profits tracking \$425,000+. Beautiful and expanded facility leases for \$1.60 sq.ft. PPO Practice.

**ENDODONTIC PRACTICE** Central California Beach City. Established 20+ years. Grosses \$1,200,000 & Nets \$800,000.

**ANAHEIM** Korean clientele. Part-time grossing \$200,000+. 3-Ops, some ortho. Rent \$2,300. Close to Harbor Freeway exit. Full Price \$110,000.

**ANTELOPE VALLEY / SANTA CLARITA VALLEY** Two separate Million Dollar Opportunities. Absentee Owners.

**BELLFLOWER** Female owned Hispanic practice. Part-time. Low overhead opportunity.

**DIAMOND BAR** Absentee Owned. Grosses \$500,000. Gorgeous high identity shopping center. State-of-art facility. Million Dollar potential. 5-Ops. Chinese / Korean / Hispanic.

**EAST LOS ANGELES** Part time senior female grossing \$20-to-\$35,000/month. Established many years, Low overhead. Full time will do \$600,000.

**INLAND EMPIRE** Long time Union Patient Practice. Part-time Seller works 3 days. Grossing \$650,000. Patients are available to go to 6-days. Great union benefits.

**INLAND EMPIRE** Shopping center. Great Lease. 3-ops in 1,650 sq.ft. Absentee Owner. Grosses \$30,000/month. Working Seller used to do \$50,000/month. 20-to-30 new patients/month. Full Price \$285,000.

**INTERSTATE 405 & ARTESIA** Established many years. 2-Ops. Full Price \$150,000.

**IRVINE LOCATION** 6-Ops, Beautiful state-of-the-art office. Full Price \$150,000.

**IRVINE** Professional Building. Chinese clientele. Grosses \$500,000-to-600,000 6-Ops in 2,000 sq.ft. Rent only \$5,000. Seller here 2 days per week.

**IRVINE** Lady DDS Grossing \$1,2 Million. Professional Building. 5-Ops. Only Dentist in building. Full Price \$885,000

**LA PUENTE** Established 20-years. Small shopping center. 3-Ops. Full Price \$150,000

**LAKE ELSINORE** Great second location for DDS working part-time. 6-Ops. Rent \$2,700. Grossing \$500,000-to-\$600,000. Some HMO.

**NEVADA DENTURE PRACTICE** Add Implants. Will do \$2 Million. 4,000 sq.ft. rents for \$4,000. Full Price \$850,000.

**NEWPORT BEACH'S FASHION ISLAND** Grossing \$400,000-to-\$500,000.

**ORANGE COUNTY BEACH CITY** Location, location! Previous Gross One Million. Facility only. 6-Ops with computerized monitors, TV's and Dentrux. Full Price \$150,000.

**ORANGE COUNTY BEACH HMO** Absentee owned. Grosses \$1.6 Million. High identity shopping center. 10-Ops. Full Price \$1.3 Million.

**PEDO** Chinese / Hispanic. Grosses \$450,000. 4-Ops, low rent. Digitized office. Lots of options to grow to Million Dollar practice.

**REDLANDS** Great Location. Rent \$1,100/month. 3-ops. Nice patient base. Full Price \$150,000.

**WEST LOS ANGELES** High Identity Location. 3-Ops. Room to grow. Free parking. Grossing \$450,000. Full Price \$500,000.



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## BAY AREA

**AC-566 SAN FRANCISCO:** Spectacular views of Washington Square. 3 ops + 2 add'l, 1400sf **\$170k**

**AC-624 SAN FRANCISCO:** Wonderful patients, solid income in great stand-alone bldg **\$475k**

**AC-649 SAN FRANCISCO Facility:** Richmond District, 3 ops+1 add'l, Equipment less than 5yrs old **\$120k**

**AG-562 SAN FRANCISCO:** Strategically located with huge growth potential. 2 ops + 1 add'l, 600sf **\$175k**

**AN-513 REDWOOD CITY:** Practice of your dreams! 900sf w/ 4 ops + 2 add'l **\$350k**

**AN-686 SAN FRANCISCO:** Office designed w/ patient flow & maximum office efficiency. 1000sf w/ 4 ops **\$825k**

**AN-712 SAN FRANCISCO:** Easy accessibility, exceptional visibility, free parking & **extremely low rent!** 1000sf w/ 2 ops + 2 add'l **\$89.5k**

**AN-752 SAN FRANCISCO Facility:** **3 months Free Rent!** Opportunities like this one are few and far between! 1007sf w/ 4ops. **\$125k**

**BC-682 CONCORD:** Located in desirable, bustling community w/ seasoned, caring staff. 836sf w/ 3 ops **\$224k**

**BC-710 WALNUT CREEK:** Desirable location in stand-alone, single-story bldg. 1313sf w/ 3 ops **\$150k / RE \$850k**

**BC-741 DANVILLE (FACILITY):** Move in Ready facility to build the practice of your dreams! ~ 1600sf w/ 3 fully equipped ops **\$195k**

**BC-758 PLEASANT HILL (FACILITY):** Gorgeous décor & remarkable location! 768 sf w/ 2 ops **\$42,500**

**BC-780 RICHMOND:** Contemporary design, warm environment, large windows. 1300 sf w/ 3 ops **\$675k**

**BC-781 LAFAYETTE:** Located in Dental Professional bldg complex. 1400 sf w/ 3 ops. Desirable Locale! **\$275k**

**BG-724 RICHMOND:** Spacious office w/ enormous growth potential! 2000sf w/ 4 ops **Practice \$138k / Real Estate \$700k**

**BG-731 LAFAYETTE:** Well-educated, health conscious patient base. 1,000 sf w/ 3 ops 35+ years goodwill **\$229k**

**BG-762 EAST BAY:** Stellar, high Quality practice consistently generates ~ \$3M annually. 3000 sf w/ 6 ops **\$1.99M**

**BG-734 ANTIOCH:** The perfect place to work, live and play! Located in desirable professional neighborhood. 1,323 sf w/ 4 ops. **\$315k**

## BAY AREA CONTINUED

**BG-765 FREMONT:** This quality practice is the true definition of a "Family Practice". 1000sf w/ 2 ops. **\$295k**

**BN-777 OAKLAND:** Providing a full spectrum of quality dentistry to a wide range of patients. 1,297sf w/ 3 ops. **\$295k**

**CC-661 SAN RAFAEL:** Starter practice in beautiful location w/ like-new equipment. 3 ops, 900sf **\$190k**

**CC-720 SONOMA COUNTY:** Well-established practice w/stable pts base. Excellent signage, 3 ops, 940sf w/ newer high-end Equip **\$375k**

**CG-616 NAPA:** State-of-the-Art practice. Seller moving out of state! **\$425k**

**DC-671 SAN JOSE:** Starter practice. Desirable area. 6 npts/mo, 3 ops in 900sf **\$150k**

**DC-738 WATSONVILLE:** 6ops in beautiful remodeled 2,600sf office, visibly located in attractive shopping complex **\$480k**

**DC-786 LIVERMORE Facility:** Move In ready & recently updated! 2380 sf w/ 3 fully equipped ops. Plumbed for 3 add'l **\$190k**

**DG-635 CASTRO VALLEY:** Excellent location & stellar reputation! Solo Group Practice **\$650k**

**DG-756 LOS GATOS:** Rare & Remarkable Opportunity in affluent community! 920 sf w/ 3 ops **\$275k**

**DG-767 CUPERTINO:** "Dream Practice" near Apple Headquarters! Real Estate also available. 3 ops 1284 sf **\$438k**

**DN-665 SANTA CRUZ AREA:** Loyal, stable, multi-generational patient base. FFS. 1460sf w/ 4 ops **\$540k**

**DN-693 SAN JOSE Facility:** Attractive & spacious! Faces one of the city's major thoroughfares. 1080sf w/4 ops **\$95k**

**DN-713 CASTRO VALLEY Lease:** Well maintained, attractive, "Move-In Ready" dental office. 1500sf w/ 5ops **Call for details!**

**DG-723 SAN JOSE:** The practice exceeds \$1.2mil in collections annually! 1,450 sf w/ 5ops. **\$850k**

**DN-771 SOQUEL Facility:** The perfect place to sink down roots, raise a family & build an empire! 1100sf w/2 ops + 1 add'l. **\$50k**

**DN-774 FREMONT:** This opportunity has it all and awaits your talent and skill! 1,150sf w/3 ops + 1 add'l **\$150k**

**DG-785 SANTA CRUZ:** Known for its amusement park & beach boardwalk, this community has much to offer! 1000sf w/ 4 ops. **\$245k**

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### NORTHERN CALIFORNIA

**EC-729 GREATER SACRAMENTO AREA:** Seller retiring! FFS Practice and Real Estate Available!

**EG-722 ROSEVILLE:** On track to collect \$1.5M in 2017 with increased profit compared to last year! Price Reduced even though collections are increasing! 1919sf w/ 4 ops **\$1.05M**

**EN-628 ORANGEVALE:** Great place to work, play & live. HMO 1310sf w/ 4 ops + 1 add'l **\$375k**

**EN-660 ROSEVILLE:** Highly-esteemed, well-respected, fee-for-service practice w/ loyal patient base. 2950sf w/ 5 ops **\$995k**

**EN-664 SACRAMENTO Facility:** Great corner location, excellent visibility & easy access! 2300sf w/ 4 ops. **Now Only: \$30k**

**EN-702 SACRAMENTO:** Long-established practice w/ emphasis on preventative dentistry! 1600sf w 4 ops + 1add'l. **\$450k Real Estate \$325k**

**EN-708 SACRAMENTO:** Family-oriented practice with appreciative & loyal patient base. 1600sf w 4 ops + 1add'l. **\$150k**

**EN-747 CITRUS HEIGHTS Facility:** Be the only dental office in this attractive, popular Retail Shopping Center! 2200sf w/5 ops + 6 add'l. **\$100k**

**EN-749 LINCOLN:** Come sink your roots down and enjoy a fantastic lifestyle which can't be beat! 1877sf w/4 ops + 1 add'l. **\$320k**

**EN-755 FOLSOM:** A perfect location, envied by all! Enjoy an amazing quality lifestyle in this thriving city. 1200sf w/ 4 ops. **\$175k**

**EN-768 WEST SACRAMENTO:** family-oriented practice, equipped with updated technology! 1612sf w/4 ops. **\$275k**

**FC-650 FORT BRAGG:** Family-oriented practice. 5 ops in 2000sf, 6 npts/ mo **\$350k for the Practice & \$400k for the Real Estate**

**FC-677 FORT BRAGG:** Beautiful, FFS Practice, 4 ops +1 add'l, in 2375sf, Gross \$1M+/yr **\$500k**

**FN-754 SOUTHERN HUMBOLDT:** If you love the lure of sea air, a relaxed lifestyle & charm of coastal living, then look no further! 1500sf w/ 3 ops + 1 add'l. **\$195k**

**GC-472 ORLAND:** Live & practice in charming small town community. 1000sf w/ 2 ops. Seller Retiring **\$160k**

**GG-454 PARADISE:** 2550sf w/ 9 ops. 40 yrs goodwill! Amazing Opportunity! **\$450k**

**GN-656 NO. TEHAMA CO:** **Great Location!** Ideal place to work, live & raise a family! 2468sf w/ 5 ops **Now Only \$225k**

**GN-667 OROVILLE:** **Great place to work & play!** Constant growth attracting an influx of residents! 1000sf w/ 3 ops **\$195k**

**GN-668 BUTTE COUNTY:** Remodeled in 2010! Well-maintained, long-established professional complex. 1200sf w/ 2 ops **\$95k**

**GN-717 YUBA CITY:** Seller Retiring. All reasonable offers considered. **Building available for purchase!** 2400sf w/ 5 ops **\$475k**

**GN-746 YUBA CITY:** State-of-the-Art Equipped! **Includes the latest technology in CBCT Imaging.** Real Estate also available! 1600sf w/ 3 ops +1 add'l. **Practice \$480k/ Real Estate TBD.**

**GG-769 REDDING AREA:** Offering a full spectrum of general dentistry and total care! 2700sf w/ 6ops. **Practice \$390k, Real Estate \$540k**

**HG-732 GRASS VALLEY:** Seller retiring. Well established practice. 1250sf w/ 3 ops. Real Estate also available. **\$215k**

### NORTHERN CALIFORNIA CONTINUED

**HN-280 NORTHEAST CA:** Only Practice in Town! 900sf w/ 2 ops **\$60k**

**HN-618 SIERRA FOOTHILLS:** Seller Retiring! Huge opportunity for growth by increasing office hours! 750sf w/ 2 ops **\$95k**

**HN-740 SHASTA CO:** Warm, caring atmosphere that is magnified by the exceptional, long-term staff. 2400+sf w/ 5 ops + 1 add'l **\$475k**

**HN-773 SUTTER CREEK:** Located in an area known for beautiful scenery, excellent wine and rich history! 1536sf w/4 ops + 1 add'l **\$195k**

### CENTRAL VALLEY

**IC-468 SAN JOAQUIN VALLEY:** High-end restorative practice! 6 ops in 2500+sf office. Call for Details! **\$425k**

**IG-687 TURLOCK:** Established quality practice - remarkable opportunity! 2000sf w/ 5 ops **\$298k**

**IN-761 MODESTO:** Practice philosophy: "Patient First Care" quality care in a warm, comfortable, and yet professional environment. 5,395 SF W/ 12 + 1 add'l. **\$150k**

**IN-764 STOCKTON:** Well-established, fully computerized, paperless, digitalized practice just waiting for your talent & skill! 5,000sf w/10 ops **\$267.5k**

**IN-776 STOCKTON:** Step right in and you won't miss a beat in this long-established, quality practice! 1046sf w/2 ops add'l. **\$25k**

**JG-753 VISALIA:** Pedito/GP Practice AND Real Estate Available! Stellar reputation, 30 pts w/ 15 hyg pts daily! Spacious 2600 sf office! **Call for Details!**

**JG-778 FRESNO:** What a steal. Consistent collections over \$600k with cash flow over \$300k!! 1452 sf w/ 4 ops **\$328k**

### SOUTHERN CALIFORNIA

**KC-678 LOMPOC & SANTA MARIA:** Live & practice along the central coast. Plenty of room for growth, Call for Details! **\$240k**

### SPECIALTY PRACTICES

**AC-748 SAN FRANCISCO Perio:** Practice in this prestigious building in desirable central location. 3 ops, 980sf **\$800k**

**AC-759 SAN FRANCISCO Endo:** Union Square. 1190 sf w/3 ops (plumbed for 1 add'l) **\$495k**

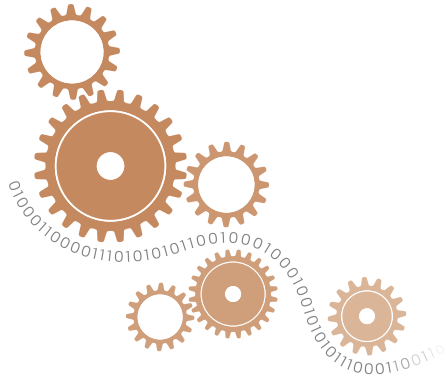
**BC-784 CENTRAL CONTRA COSTA CO Perio:** Seasoned Staff. Office runs like well oiled machine! 3 ops **\$450k**

**IC-543 CENTRAL VALLEY Ortho:** 1650sf w/ 5 chairs in open bay & plumbed for 2 add'l. Strong referrals and PT base **\$125k**

**HG-763 GRASS VALLEY Ortho:** Avg 30+ pts per day. Newer retail Shopping Center **\$210k**

**JG-757 VISALIA Perio:** Keep implants in house and imagine the growth possibilities! 9 hygiene days per week! Rare Gem! 2,000 sf w/ 5 ops **\$395k**

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## A look into the latest dental and general technology on the market

### iPhone X (Starting at \$999, Apple)

Apple released the high-end model of its line of iPhones, the iPhone X, in November. Boasting a full edge-to-edge OLED screen, Face ID technology and numerous other improvements, Apple boasts that this model is as revolutionary a leap as the original iPhone was 10 years ago.

The most noticeable change with the iPhone X is the screen itself – while the form factor of the phone is nearly identical to the non-Plus models, the viewable area of the screen takes up nearly the entire front face of the phone. Gone are the top and bottom bezels (including the home button), leaving only a small chunk of the upper screen containing the front-facing camera and sensors. The OLED screen delivers much more detailed and brighter resolution. While Apple touts the strength of the all-glass enclosure, reports indicate that this phone is especially susceptible to cracking when dropped, so a case is definitely recommended.

FaceID is the most notable new feature of the iPhone X, replacing the need to hold your fingerprint over the home button for authentication. Instead, FaceID uses the camera and sensors to scan your face while holding and looking at the phone, authenticating and unlocking the phone as fast (if not faster) than the previous fingerprint scan. Even more impressive is that FaceID will still work regardless of hair style, haircut, glasses, facial hair, etc.

As is the norm with new iPhones, Apple has made improvements to the onboard cameras as well. The dual rear cameras still include optical image stabilization and portrait mode, while the front camera has been upgraded to 7MP and also features portrait mode allowing for even better selfies with more styling options.

The battery life has been improved to add longer usage times on a single charge. With the iPhone X (as well as iPhone 8), wireless charging via the Qi standard is now an option, making it quick and easy to charge the phone simply by resting it on a Qi-compatible charging pad. Worth noting is that upcoming iOS software updates promise even faster wireless charging times.

– Blaine Wasylikiw, CDA director of online services

### Sickweather (Free, Sickweather Inc.)

Getting sick is not fun; getting others sick is worse. Any means of proactively preventing illness has the potential to save countless hours of time and money. Sickweather is an app and service that collects reports and information from a variety of sources to create “personalized sickness forecasts.” Awareness of sicknesses in an area empowers people to take more active preventative measures.

Sickweather is a service that works by scanning an area for available sickness data and, through an algorithm, calculates the likelihood of getting sick from specific illnesses. Signing up for an account or logging in using Facebook and enabling location services are required. The service listens to social media (Twitter, Facebook, etc.) posts of thousands of individuals along with their location data whenever they mention themselves or others getting sick. Users can self-report their sickness directly on the app by choosing from a list of sicknesses ranging from simple allergies to whooping cough. People can also post messages of their illness in user-created forums, or “Sickweather Groups,” that they follow. All these reports are then combined with other third-party partner reports to create a crowdsourcing database that tracks sickness trends. The service also correlates data from the Centers for Disease Control and the sale of over-the-counter medications. This entire set of extensive data is processed through machine learning and a patent-pending algorithm to display a simple forecast over a map of the local area with the top three illnesses going around in the region.

As with many services that rely on the aggregation of data, Sickweather is only as good as the data it collects. Although the app and service cannot predict that a specific person will or will not get sick, the awareness of an increase in sickness trends is valuable in promoting proactive defensive measures to prevent the spread of contagious diseases.

–Hubert Chan, DDS

### Would you like to write about technology?

Dentists interested in contributing to this section should contact Andrea LaMattina, CDE, at [andrea.lamattina@cda.org](mailto:andrea.lamattina@cda.org).

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