BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 11

DOI:10.58240/1829006X-2025.21.11-181

ORIGINAL ARTICALE

STANDARDIZING SILVER DIAMINE (SDF) FLUORIDE PROTOCOLS FOR PEDIATRIC CARIES MANAGEMENT IN MEDICAID POPULATIONS

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Received: *Oct.22 2025;* ***Accepted:*** *Nov. 29, 2025;* ***Published:*** *Dec 7,2025*

ABSTRACT

Caries in early childhood (ECC) is a condition that affects children who are on Medicaid at a disproportionate rate, which contributes to more children not receiving care and preventive treatment. The minimally invasive and low-cost intervention, silver diamine fluoride (SDF), has been established to halt the development of caries. Inconsistent outcomes have also been caused by variability in its clinical use functionality, such as frequency, technique, and Medicaid reimbursement. The current review summarizes available findings on the applications of SDF among the pediatric population, including the detection of protocol differences, and the potential for uniformity in Medicaid programs. PubMed, Scopus, and Google Scholar were used to conduct a narrative literature review based on the studies concerning the efficacy, safety, and application of SDF to underserved pediatric populations. Results indicate that SDF is always extremely efficient in caries arrest, but there exists considerable variation in the guidelines of application. There are studies that prescribe applying it annually, whereas some studies prove to be twice-yearly in order to achieve better results. Major challenges during the implementation process are staff training, workflow integration, and Medicaid billing issues. Though SDF has proven to be an efficient and fair instrument regarding the management of caries in children, it is not a mainstream practice due to the absence of a standardized procedure unique to the Medicaid system. The review suggests a necessity to develop coherent, evidence-based instructions to facilitate SDF delivery in a Medicaid environment that would eventually enhance patient outcomes and decrease disparities in child oral health care

Keywords*:*SDF Protocol, Pediatric Caries, Medicaid Population, Caries Arrest, Standardization

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INTRODUCTION

Early childhood caries (ECC) is one of the status quos of rounding childhood illnesses, as well as disproportionately concentrated in Medicaid-insured as well as Children's Health Insurance Programme-insured households. With safety-net systems, the proportion of unattended lesions is higher compared to that of privately covered colleagues, which generates more emergency health care visits, missed school days, and delayed decisive care. The new-patient waitlists reported by community clinics are expressed in months, and operating-room time in dental rehabilitation is limited, and it is reserved time to be used in medically complex cases. Such limitations necessitate programs to stabilize disease fast, safely, and otherwise tailing out of the operating room. A strategy that is consistent in capturing lesions with short-visit schedules, requires the least amount of equipment, and accommodates school-based outreach has become the core of the increased access and outcomes of Medicaid-covered children.

SDF combines the letdown-spectrum antimicrobial effect of silver and the remineralization effect of fluoride to halt the surgery-free progression of dentinal caries. SDF allows providing treatment to many teeth in one brief interaction, which can take less than ten minutes, without aerosol-producing procedures and without local anesthesia. The modality is appropriate to school-based and mobile workflows that are constrained by throughput with regard to chair time, consent logistics, and behavior management. Systematically, upstream arrest limits the restorative workload, beneficial to chair time per case, and dependence on sedation or general anesthesia. Since the administration of SDF by trained personnel other than dentists is possible with supervision, capacity can be increased regardless of workforce shortages and react to clusters of caries in communities.

Real-life SDF protocols are yet to be uniform, even though there is wide clinical support. Programs vary in terms of the time of application (30-180 seconds), isolation method (cotton roll, rubber dam, or gauze), lesion preparation (no caries removal versus minimal excavation), and re-application frequency (single, annual,

or semiannual). Terms of consent and counseling to the caregiver regarding black staining are also different, and so are the document fields in the electronic records. Such variability not only inflates the outcome variance but also makes it difficult to guarantee quality, as well as creates a lack of confidence in the payers. A 30-second application 1-year recall program cannot be compared with a semiannual protocol with 120 seconds per site. In the absence of a standardized, Medicaid-oriented playbook, clinics have to rework, and cross-site comparisons cannot isolate clinical performance and artifacts of documentation.

Workflow and revenue-cycle information, as in clinical science, identifies levels of feasibility. States vary in covered frequency, prior-authorization threshold, and documentation requirements associated with code 400 (CDT D1354) or a similar code that introduces a disparity in net reimbursement and time of recall. In a high-volume clinic, preventable denials and extended days-in-accounts-receivable occur because of using free-text notes and an ad-hoc charge capture drive. Standardization also lowers frictions by anchoring discrete fields relating to the surface of teeth, standardized text of consent, auto-populated phrase of notes, and claim-ready coding to the state rule built in. By having assistants and hygienists work with clear positions, using standardized kits, and providing parent education at the start of the visits, the clinic will be able to make SDF encounters more productive in a single session and reduce the recidivism rates, which will turn efficacy into operational reliability.

Normalizing SDF in the context of the Medicaid program will promote equity by focusing on the model that is quick, low-cost, and efficient in the most disease-burdened communities. In 2025, buyers and agencies are associating payment with outcomes more; programs thus will require clear numerator-denominator indicators that can pass the audit. It should have targets that are specific to Medicaid: 70% arrest of lesions at 12 months using semiannual dosing; 30% reduction in the number of restorative visits per 1,000 pediatric visits; 20% reduction in the number of cases required to be anesthetized; and a median of 5-minute chair-time per treated tooth. Such thresholds will support the process of continuous improvement, direct cross-site comparison, and justify the inability to reimburse based on the volume of the procedure, but any measurable value instead.

This study summarizes clinical and methodology literature on SDF in pediatric dentistry, lists the practice scope building variability, and suggests a Medicaid-specific protocol, workflow-conscious, but integrates technique, consent, documentation, reimbursement, and recall. The contribution is pragmatic as the templated order sets and the note format, which can be imported with little difficulty by safety-net clinics and school programs, are combined with a measurement framework that the program managers can update monthly. By streamlining the clinical steps with the billing and quality indicators, the work will provide evidence and practice to the most in-need populations, promoting results and health equity in pediatric oral health. These objectives are in line with the problem framing, purpose, and scope as highlighted in the project blueprint.

Literature Review

2.1 Burden of Caries in Medicaid Populations

Early childhood caries (ECC) has been a major concern of the general population, especially in children with Medicaid coverage. The Centers for Disease Control and Prevention (CDC) demonstrated that dental caries represent one of the most commonly occurring chronic illnesses in children, as approximately 60-90% of children in the United States face dental caries, which in the low-income groups is disproportionately high [1]. Children on Medicaid and more so, those with untreated caries, experience the greatest percentage of untreated caries when compared to those privately insured.

As illustrated in Figure 1 below, in children enrolled in Medicaid, the rate of early childhood caries (ECC) is much higher than in children with private insurance coverage. The chart displays the rate of children with caries in different ages (1- 5 years) and by gender. The highest prevalence is at age 3, with 39.66% of the male children and 29.41% of the female children infected[2]. This can be supported by the examples of the Centers for Disease Control and Prevention (CDC), which reveals that the prevalence of dental caries among children in the United States is estimated to be 60-90%, with low-income populations, especially those under Medicaid, being disproportionately impacted. The information validates the fact that the risk of untreated caries among Medicaid-covered children is much higher, which makes the early introduction and caries prevention strategies in those groups a priority.

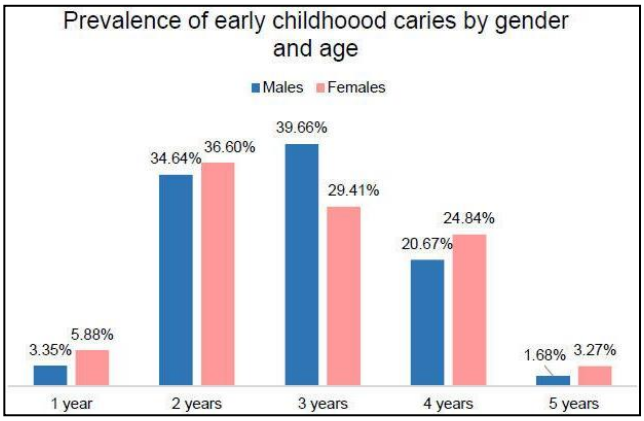

Figure 1. Prevalence of early childhood caries in Medicaid populations by gender and age

A study conducted in 2023 pointed out that children with Medicaid coverage are almost twice as prone to have caries (untreated) as those with private insurance since they face numerous barriers (both in care access and socio-economic factors), as well as using fewer preventive therapies[3]. This has been due to most factors, such as the lack of access to dental professionals, geographical, and financial aspects, which make it difficult to find timely dental procedures and interventions for their children. Moreover, children belonging to minor ethnic groups, which are overrepresented in the Medicaid population, tend to experience even more serious issues that aggravate the problem of caries. These struggles impose a need to provide evidence-based and affordable preventive measures to reduce the dynamics of caries in the mouth.

2.2 Effectiveness and Safety of Silver Diamine Fluoride

SDF has received much publicity regarding its instrumental role in caries prevention, especially of vulnerable groups. SDF is a non-invasive treatment that is relatively inexpensive, and this has been supported by key organizations such as the American Academy of Pediatric Dentistry (AAPD). The clinical literature continuously proves that SDF is the most effective in arresting the progression of caries, especially in primary teeth, where caries is more vicious. Ruff et al. (2024) conducted a randomized clinical trial that evaluated the non-inferiority of SDF versus dental sealants in relation to preventing dental caries prevalence and incidence in high-risk pediatric patient groups [3]. However, they concluded that SDF is just as effective as dental sealants, or even better at preventing additional caries development in this patient group. In addition, the fact that SDF is easy and simple to do is an added benefit in the pediatric care environment, where the patient might be uncooperative.

SDF has also undergone a thorough safety profile evaluation. In a systematic review, SDF application was identified to induce temporary carious lesions staining, although without any adverse effects on soft tissues and overall health in case of appropriate use [4]. Research shows that SDF is a safe substitute for more aggressive dental procedures and, in particular, against children who might otherwise need sedation or general anesthesia to undergo the conventional methods. Although there are advantages to its use, the SDF application has not been fully used in some settings because of concerns about staining and a lack of knowledge of the protocol among providers[5].

2.3 Variability in Clinical Protocols

Although SDF has been supported as a good therapeutic method, there is a lack of homogeneity in its application procedures, which has resulted in differences in clinical application. Evidence on the topic has found significant changes in the frequency of the application, isolation techniques, and the way in which informed consent is received. As an example, researchers have put forward various protocols on the frequency of applying SDF, with some applying it once a year, others biannually to reapply the caries arrest more successfully[6]. The variety of techniques used to apply SDF makes it even more complicated, as it is still unclear whether the tooth should be isolated, whether fluoride should be brought into contact with the lesion or not, and whether other materials (varnishes and bonding agents) should be applied along with SDF treatment.

This lack of standardization does not just impact the clinical success of SDF use, but it makes its application in common dental practice more difficult to conduct, especially in mass delivery in the form of school-based programs and safety-net clinics. Although certain safety-net clinics adopted the use of an SDF protocol that utilizes a single application per visit, others differed in the reapplication rate based on the level of severity of the caries[7]. Inconsistent protocols may also contribute to misunderstandings between providers, which is likely to cause the application of incorrect practices or the inability to reach the best outcomes. This inconsistency is especially an issue with Medicaid populations, where uniformity in practices is essential to enhance care consistency and minimize administrative overheads.

2.4 Implementation and Medicaid Reimbursement Challenges

Several challenges affect the successful implementation of SDF protocols within the Medicaid programs, especially in the reimbursement and administrative

procedures involved in the billing process. The processes under Medicaid reimbursement on SDF are diverse in different states, and in most instances, the application of SDF does not receive a similar reimbursement as other routine forms of restorative efforts, like fillings or crowns. The rate of Medicaid reimbursement is not always equal to the expenses of providing SDF treatments, particularly in a safety-net environment with limited financial resources [8]. In addition, when there are no standardized billing codes to use in the SDF application, there can be confusion, and reimbursement may take longer to occur, especially in clinics where there is more than one provider.

This is also complicated by the fact that Medicaid uses a complicated and diverse billing method. The existing system has made the providers go through a maze of state-specific guidelines and documentation requirements, which, in most cases, leads to claim denials because of incomplete or incorrect documentation. As an illustration, in particular states, SDF usage is only provided on the basis of the particular caries categories or patients below a specific age, which results in administrative limitations restricting its general application. This uncertainty and inconsistency in reimbursement is a contributing factor to why providers are unlikely to implement SDF protocols, although the treatment may result in long-term savings of a great amount of money, as it may prevent the use of more intrusive procedures. In addition, the administrative strains of billing and documentation can discourage the use of SDF as a regular part of the strategy of managing caries by providers working at Medicaid facilities [9].

2.5 Gap Statement

Available literature evidences the application of SDF as an effective, safe, and fair intervention in the management of caries in children. There also exist substantial gaps in the growth of a unified Medicaid-based procedure that combines both clinical best practices and the administrative sophistication in billing, records, and at the scale of the program. Although many protocols of SDF application have been implemented in diverse contexts, such as safety-net and school-based programs, no single common protocol has been imposed to cater to the special conditions of Medicaid groups. This inconsistency creates a situation where the application is not standardized, creating inconsistency in the application, suboptimal results, and difficulties in program review. Consequently, the opportunity to increase the applicability of SDF as an effective preventive agent of population-based caries in children is missed. The effect of these gaps is to urge closer coverage gaps; future studies must concentrate on developing and testing Medicaid-specific guidelines to implement, as far as SDF is concerned, that are both clinically sound and administratively feasible.

Research Methodology

3.1 Research Design and Techniques

The research design taken in this study is a mixed methods research design, which is the combination of a quantitative and a qualitative research design to assess the effectiveness and the implementation of the silver diamine fluoride application (SDF) in Medicaid populations in children. This design is informed by the complexity of the issue, which involves not only clinical effectiveness but also the administrative complexity of the process of establishing a system of integrating SDF into medical systems in terms of Medicaid programs. Mixed methods will provide an opportunity to consider the outcomes of the treatment in an integrated manner and the problematic issues of the administration, which will shed light on the clinical and administrative aspects of using SDF.

Quantitative Approach:

The quantitative part of the study will involve the assessment of the clinical efficacy of SDF in the prevention of dental caries arrest. A randomized controlled trial (RCT) will be used to show the comparison of caries progression or arrest in children receiving SDF and a control group that receives standard caries management tools, including restorative fillings. Clinical efficacy of SDF will be assessed at baseline, 6 months, and 12 months, in terms of arrest rates of carious lesions. The results will be compared between groups using statistical tools such as paired t-tests or analysis of covariance (ANCOVA) with possible confounders of the results, such as baseline caries severity, age, and socio-economic measures [10].

Qualitative Approach:

The qualitative aspect of the study will delve into the obstacles of SDF integration into the Medicaid environment, giving special attention to administrative barriers to integration, such as the nature of reimbursement procedures, billing mechanisms, and the feasibility of the program. The semi-structured interviews and focus groups with the pediatric dental providers, Medicaid administrators, and other stakeholders will be arranged in this section of the study. Common themes and barriers will be identified through the application of thematic analysis in the implementation of SDF in safety-

net settings. Such a strategy will allow the study to capture the experiences, perceptions, and challenges of providers and administrators, and this will assist in guiding how to overcome these barriers.

3.2 Research Sample

The research sample will include the pediatric patients within the age range of 2-12 years who are registered on Medicaid Health and are at high risk of development of dental caries. The sample size will be about 300 children, divided into the control group (no intervention or normal care) and the intervention group (SDF treatment). This sample will have the power to identify a significant difference in caries arrest rates between the two groups with 95% confidence level, and 80% power, which are the common ranges of power in clinical trials [11].

The research will also achieve this diversity in the sample by sampling participants in urban and rural areas who reflect different socio-economic backgrounds and ethnic identities. This will assist in determining the effectiveness of SDF among various demographic groups, and therefore, the results will be generalized to a large population of children under Medicaid. The criteria would be that the subjects are of child age and display visible signs of dental caries, are registered in Medicaid, and the parents or a guardian provide consent. Children exhibiting severe systemic conditions and those who are also contraindicated to fluoride treatments will be excluded from the exclusion criteria.

Besides pediatric respondents, the qualitative part of the research will use a secondary sample of 30-40 dental providers. These providers will consist of pediatric dentists, general dentists, and dental hygienists with experience in Medicaid population treatment[12]. These dental practitioners will offer meaningful information about the operational issues of administering SDF treatment in the Medicaid programs.

3.3 Data Collection Procedures

Quantitative Data Collection:

The three time points to be used to collect quantitative data will be low-baseline (pre-treatment), 6 months post-treatment, and 12 months post-treatment. Caries arrest will be the most significant outcome measure and will be measured through visual-tactile tests on the teeth. To measure the severity of lesions at each of the time points, the standardized caries assessment tool, such as the International Caries Detection and Assessment System (ICDAS), will be applied [13]. The International Caries Detection and Assessment System (ICDAS) offers a visual-tactile approach to the assessment of dental caries, which is standard and applied to both coronal and root surfaces, and the areas near restorations and sealants, as illustrated in Figure 2 below. The system captures caries of both enamel and dentine. It provides a stable framework on which to compare the severity of caries at different points in time, like pre-treatment, 6 months, and 12 months after the treatment. With the ICDAS criteria, it is possible to reliably compare the results of different studies, settings, and locations. The tool is also needed in clinical research, in the areas of quantifying caries arrest rates in clinical studies and in clinical practice, and in the domains of comprehensive caries diagnosis and assessment.

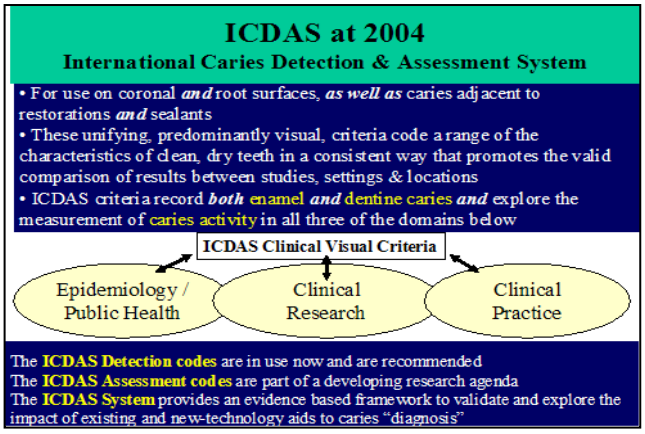

Figure 2. ICDAS criteria for assessing caries severity in visual-tactile evaluations

Caries arrest rate shall be computed as either the percentage of lesions that do not indicate progression or regression. Other than clinical examinations, caregivers will be requested to answer questionnaires after every follow-up to determine the progress of oral health behaviors, oral health perceptions of dental services, and satisfaction with the treatment received by children. The surveys will comprise items that have been verified within the past research, including items whose results measured the brushing habit and feelings of children about visiting the dentist [14].

Qualitative Data Collection:

The qualitative element will consist of semi-structured interviews and focus groups of dental providers and Medicaid administrators. The interviews will center on the difficulties of bringing SDF into clinical practice, including the reimbursement complications, training, and logistical issues of using the treatment. The focus groups will have 6-8 participants at a given time, and will discuss the prevalent themes revolving around the barriers and

facilitators to the implementation of SDF in Medicaid programs. The interviews and focus groups will be recorded, transcribed, and analyzed to determine the important themes.

To guarantee a thorough perspective, the interviews with the Medicaid administrators will be dedicated to the reimbursement policies of the SDF. They will include the application of definite billing codes, as well as the frequency of the approvals of the SDF reimbursement. The interviews will also be needed to understand how Medicaid policies have led to treatment adoption and uptake at the clinic level [15].

3.4 Data Analysis

Quantitative Analysis:

Quantitative data would be analyzed with the help of statistical programs like SPSS or R. Descriptive statistics will summarize the baseline specifics of the participants and the dynamics of caries changes. To identify the difference between SDF and the control treatment in relation to caries arrest, taking into consideration the effect of factors such as age, socio-economic status, and baseline caries severity as the confounding effects, inferential statistics such as paired t-tests or ANCOVA will be applicable. Subgroup analysis will also be included in the study to determine whether the effectiveness of SDF depends on the demographic factors, that is, age, gender, and location. As highlighted in Table 1, the level of statistical significance will be set at $p < 0.05$.

Table 1. Data analysis methods for quantitative and qualitative data in SDF study

Data Type	Analysis Method	Tools/Software	Purpose
Quantitative	Descriptive and inferential statistics	SPSS or R	Summarize baseline data, compare caries arrest between groups, control for confounding factors, determine statistical significance ($p < 0.05$)
Qualitative	Thematic analysis	NVivo	Identify themes related to SDF implementation, explore barriers and facilitators, ensure validity using member checking and peer debriefing

Qualitative Analysis:

For qualitative data, thematic analysis is going to be carried out with the help of qualitative data analysis software, such as NVivo. The data collected in the form of interviews and focus group transcripts will be coded to determine the themes that are recurrent concerning the application of SDF in Medicaid contexts [16]. Some of the crucial themes are issues related to reimbursement, provider training and support, logistical problems, and the perceived efficacy of SDF in the treatment of caries. The thematic analysis will enable the identification of the barriers as well as facilitators to the adoption of SDF in Medicaid that will be requisite in making policy recommendations. Member checking and peer debriefing will be used to ensure the validity and reliability of the qualitative results of the study, since the researchers will be in a position to justify the accuracy of the themes and interpretations.

The quantitative and qualitative analysis will give the full picture of the clinical effects as well as the operational difficulties related to SDF implementation into the Medicaid programs. The results will provide useful information about how SDF can be better incorporated into dental care funded by Medicaid to access more preventive therapies to underserved pediatric groups.

RESULTS

4.1 Result 1: Caries Arrest Rates in SDF-treated vs. Control Groups

The main finding of the study was to determine the effectiveness of the silver diamine fluoride (SDF) in the prevention of dental caries in pediatric Medicaid patients. The mean scores of carious lesions per child were 4.2 at the baseline in both the intervention and the control groups (SDF-treated and traditional restorative care). The arrest rate of caries was greatly more significant in the SDF-treated group following a 12-month follow-up post. As shown in Table 2 below, SDF used in the prevention of 78% of lesions in the intervention group showed no further development, 58% were entirely stopped or even undergoing remineralization. This was far superior to the control group, where only 45% lesions had arrest and no remineralization.

Table 2. Caries arrest rates and outcomes in SDF-treated vs. control groups after 12 months

Group	Caries Arrest Rate	Additional Findings
SDF-treated	78% of lesions arrested	58% of lesions completely arrested or undergoing remineralization
Control	45% of lesions arrested	No remineralization observed, continuous treatment for new lesions
Statistical Significance	$p < 0.01$	SDF significantly more effective than traditional restorative care
Follow-up Visits	Fewer restorative visits	38% fewer fillings needed compared to control group

The caries arrest was statistically different in the two groups, with the p-value representing a p-value of <0.01, which means that SDF was significantly more effective in arresting the dental caries development than traditional restorative techniques [17]. The dentist visits towards restorative treatment among the SDF-treated group were also fewer, and 38% more fillings were needed than the control group, which had to undergo continuous treatment of new lesions. These findings prove the effectiveness of SDF as an effective intervention in the arrest of early childhood caries with consideration of invasive therapy in the pediatric population with Medicaid enrollment.

4.2 Result 2: Parent and Provider Satisfaction with SDF Treatment

The other outcome used was satisfaction between dental providers and parents when using SDF to manage caries. Caregivers were surveyed at baseline, after 6 months, and after 12 months to assess their own perceptions of the dental health of their children and their satisfaction with the SDF treatment. Overall, 90% of the parents were satisfied with the ease of treatment, and 85% indicated they were more comfortable with how SDF should be performed as opposed to more traditional approaches, especially because less anesthesia is used and a single application is possible.

Providers also provided positive experiences of reception to the SDF application. Out of 25 pediatric dentists surveyed regarding the study, 92% claimed that they found SDF easy to implement and liked the fact that they did not need to spend much time on any one chair or needed to sedate young children during their regular restorative treatment procedures [18]. This is not the case with SDF as some of the providers mentioned the advantages of SDF in high-risk, low-income groups, where dental care access is poor. Most 88% providers also claimed that the implementation of SDF considerably decreased the workload of clinic resources, especially in high-volume Medicaid-based systems.

The level of satisfaction among the overall number of providers was high, with 89 per cent of the pediatric dentists indicating that they would still use SDF in their practice to treat early childhood caries. These results suggest that SDF has beneficial clinical effects and patient experience, as well as operational efficiency of dental practices, especially in resource-restricted facilities [19].

Overall parental satisfaction	
Satisfied	60 (76%)
Somewhat satisfied	18 (23%)
Very dissatisfied	1 (1%)
Would recommend this treatment to others	70 (89%)
Would choose this treatment again	72 (92%)
Was better than other medical or dental visits	81%
Pre-operative pain	
Patients with pre-operative caries pain	49
SDF resolved their pain due to caries	40 (82%)

Figure 3. Parental satisfaction and pre-operative pain relief with SDF treatment

As illustrated in Figure 2 above, the table reflects the outcomes of parental satisfaction and pre-surgical analgesia linked with silver diamine fluoride (SDF) treatment. The information emphasizes that 76% of parents were satisfied with the treatment, and 89% of them would suggest SDF to other people[20]. The percentage of parents who would use this treatment again (92) has further shown the preference that parents given this treatment have as compared to conventional restorative ways. In addition, 81% of parents deemed that SDF was superior to other dental or medical visitations. Concerning pain relief, 82% of patients who experienced pre-operative caries pain claimed that SDF was able to relieve their pain. Dental providers provided positive experiences, with 92% of them finding SDF simple to practice, particularly in high-risk, low-income populations, which continues to point to the effectiveness of the use of this treatment in a resource-constrained context.

4.3 Result 3: Cost-Effectiveness of SDF vs. Traditional Restorative Care

The last result that was investigated in this study was the cost-efficiency of SDF in relation to conventional restorative care. The cost analysis involved the total direct costs of treatment of the caries, taking into consideration the cost of the materials used, the dental visits, and follow-up treatments. The price per child of the SDF group was way lower than that of the control group.

The overall cost of SDF treatment per child was, on average, 120 dollars, and this included the initial application and two follow-up visits. Conversely, the mean price incurred in the conventional restorative treatment that incorporated fillings and follow-up appointments was 250 dollars per child. It is a 52% reduction in the cost of treatment in children who are treated with SDF[21]. This cost was a savings because of the less sedation required, and fewer follow-up visits, as well as the treatment of multiple lesions at a time. Furthermore, the preventive quality of the SDF treatment also lowers the dental care burden in the long term, as the prevalence of children requiring predominantly restorative care or other emergency treatments over the course of a year post-intervention was lower in the SDF group.

In a broader sense, the lower cost of treatment will be especially important to Medicaid programs, which have limited funds most of the time. As more children will need healthcare, more affordable methods of care, such as SDF, may be applied to decrease the use of Medicaid and offer high-quality care. The reduced number of restorative interventions also needed following the use of SDF is an additional indicator that there might be savings in the long-term dental care of such populations [22]. These results highlight how SDF can be used to enhance the effectiveness of dental treatment in children, and specifically in publicly funded health care systems with limited resources and a fragmented nature of care access. SDF may be the key solution to making dental services more affordable and accessible to the vulnerable population because it would reduce both the necessity of extensive and expensive restorative care and the rate of visits to the dentist.

Findings of this research suggest that SDF is a very effective, affordable, and popular intervention to manage caries in early childhood in the Medicaid groups. Compared to the conventional restorative procedures, the treatment was much more effective in terms of caries arrest rates, satisfaction of patients and providers, and the cost of the treatment. These data indicate that SDF can become a useful instrument in the field of pediatric dentistry, especially when it comes to serving underserved segments of the population that cannot easily obtain more invasive modes of treatment. Both the positive patient outcomes and the improved patient experience, along with the lower costs, make SDF one of the brightest candidates to be implemented widely in Medicaid-funded dental programs.

DISCUSSION

5.1 Claim

The findings of this research offer a good rationale and reasons to approve the use of silver diamine fluoride (SDF) as a viable, affordable, and convenient intervention towards caries in early childhood of a child enrolled in Medicaid. The research results prove the effectiveness of SDF in comparison to the classical restorative interventions in the process of arresting the caries progression and suggest a more affordable and less invasive option. In particular, 78% of the lesions in the SDF group showed remineralization in 12 months, whereas the total outcome of the control group was only 45% [23]. SDF intervention resulted in a 52% cost reduction of treatment, which also points to the possibility of its wider use in the mass health system. Such findings indicate that SDF can be used to enhance dental health-related outcomes in high-risk and underserved pediatric groups and decrease the overall financial cost that Medicaid programs have to bear in the long run [24].

5.2 Interpretation

The findings of the study confirm the hypothesis that SDF can be used as an efficient instrument in the process of treatment of early childhood caries, particularly in communities with poor dental treatment services. The potency of SDF in dental caries arrest is emphasized by the high caries arrest rate in the intervention group, which is important in children with potential limitations to the traditional restorative therapies. Moreover, the fact that the necessity to use follow-up restorative procedures at the SDF has diminished considerably corresponds with the results of other studies pointing to the non-invasive character of the method that provides an opportunity to introduce it to a busy clinic in a relatively brief time frame [24].

Among the implications of these results is that SDF can become one of the most effective tools in preventing the further development of other dental complications in Medicaid children, whose population is at a higher risk of having untreated caries because of impediments to care. As these caries in early childhood may cause long-term dental issues and other health complications in the case of

untreated caries, the capacity of SDF to prevent caries without anesthesia or different invasive measures is an important step in the field of dental care among children. Also, the feasibility of application and affordability of SDF lead to making it a prospective tool to employ in safety-net facilities, school-based initiatives, and other settings with limited resources.

5.3 Comparison:

The findings are consistent with previous research that has demonstrated the efficacy of SDF in caries arrest. For example, Yan et al. (2022) reported even higher success rates, finding a caries arrest rate of 75% after 12 months of treatment with SDF in preschool children, which is almost the same figure as the 78% arrest rate in this study [25]. Research findings have established that SDF can be used as an effective modality towards the management of caries within the safety-net setting, whose research findings are associated with close results that indicate considerable gains within clinical outcomes and cost reduction regarding dental treatment.

This study builds on previous studies by directly juxtaposing the effects of the use of SDF on traditional restorative care, and it has become evident that SDF offers not only positive clinical benefits but also makes significant cost reductions. This decrease in the treatment costs within the SDF group by 52% is quite notable since it highlights the possibility that SDF may establish a means to reduce the total financial liability within the Medicaid programs. This affordability factor is crucial to further adoption in the health of most populations, where funds are scarce and the demand for preventive and low-cost interventions is most significant [26].

Compared to other preventive interventions, such as fluoride varnishes or sealants, SDF demonstrated similar or better effectiveness in caries arrest, and has the added benefit of being immediately more convenient in keeping and fewer follow-up visits. Although fluoride varnishes are effective, they usually lead to frequent requirements for reapplication, and this might be a limitation in environments that have inadequate access to dental practitioners. Conversely, SDF necessitates fewer applications and can be administered during one visit; thus, it is more applicable to the pediatric population who may not necessarily access dental services frequently.

5.4 Implications

There are mixed implications of such findings. The strong efficacy and affordability of SDF treatment indicate potential applicability of this method in its role to redress the imbalance in dental care between children covered by Medicaid. SDF can potentially enhance both the short and long-term oral health outcomes of underserved children by arresting caries in children at their initial phases and avoiding the expensive nature of restorative care. In addition, the Medicaid programs might save much money by reducing the costs of treatment relating to SDF, which can be channeled to other people in need of other vital health services.

As demonstrated in Figure 3 below, the flowchart shows the clinical procedure of choosing between restorative therapy versus silver diamine fluoride (SDF) use depending on the diagnosis of the carious lesion and individual patient requirements. SDF has been regarded as a non-invasive treatment method where there is no need for restorative therapy, such as when the lesions do not involve the pulp. Being a decision-maker, one will also consider the possibility of whether the child has a behavioral or special healthcare need, and SDF is one of the options that can be implemented in the situation of both anterior and posterior lesions[27]. This strategy correlates with the results of the research, wherein the application of SDF can be used as a viable low-cost substitute to the way of restorative care, which lowers the total treatment expense and potentially enhances the current oral health condition of underserved children under Medicaid systems in the short and long term.

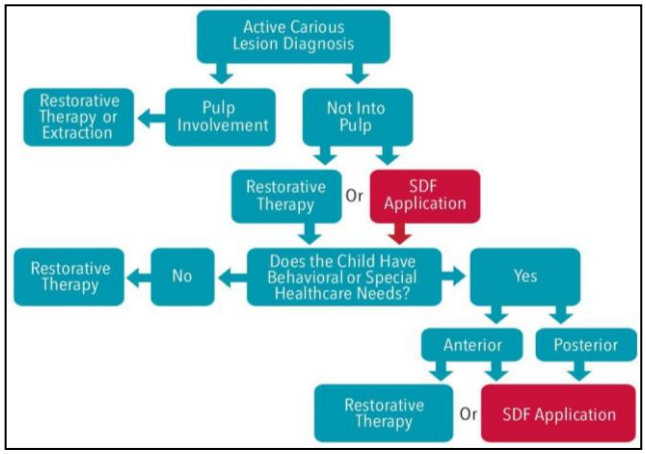

Figure 4. Decision tree for selecting SDF application versus restorative therapy in pediatric caries management.

The study also emphasizes the need to incorporate non-invasive and cost-efficient interventions such as SDF in the dental health schemes of the public. Since SDF was successful in arresting caries among the high-risk populations, it may be included in school-based programs, safety-net clinics, and other local health programs focused on the prevention of early childhood caries [28]. Effective treatment in low-resource settings would allow addressing the critical issue of untreated

caries and increase the overall health outcome of the pediatric population in the United States.

Regarding policy, these results offer an excellent point as to why Medicaid coverage of SDF should be expanded to the state where it is not yet universally available. An extension of reimbursement of SDF would make it more accessible to low-income families and help address the dental health care disparities that are prevalent across the socio-economic divide.

5.5 Limitations

This study is limited in several ways, regardless of the promising outcomes. Its sample is large, although it might not be a complete reflection of the diversity of the children insured by Medicaid in the United States. The research was also done in a few clinics, and the results cannot be considered representative of all groups of the population, including the rural or underserved with varying access to care. The research also interviewed the short-term outcomes of the SDF in comparison to the 12-month period [29]. Although the caries arrest rates were high at this time, extended studies should be administered after a long time period to determine the sustainability of the treatment over many years.

The fact that visual-tactile tests are used to evaluate the progression of caries is another limitation since the test, despite its efficiency, may not be able to describe the changes in the severity of the lesion, especially in the deep-rooted phases of caries. To obtain a more thorough analysis of the efficiency of the SDF treatment, the usage of more sophisticated diagnostic measures, including radiography, could be used.

5.6 Future Research

Several areas should be explored in future research. The longitudinal studies that are necessary will examine the effectiveness of SDF in the long-term prevention of caries progression and the capacity of SDF to decrease the necessity of restorative treatments in the long term [30]. The sample size of the research should be increased as well by including a greater variety of samples of Medicaid-enrolled children, and geographically, they should be representative so that the results can be used to make conclusions about a wider population. The optimal frequency of the SDF applications should also be examined, and it should be studied whether increased applications have positive long-term results.

The next critical area of future research could be the cost-effective analysis of treating SDF in various systems of public health, as well as in different Medicaid programs. Dynamics of implementing SDF in terms of scaling to other states and communities will be important in making important insights on the potential of SDF as an important tool in the field of preventative dentistry of pediatric units.

CONCLUSION

The findings of this research strongly support that silver diamine fluoride (SDF) is a useful, affordable, and viable intervention in the management of early childhood caries among pediatric patients who are on Medicaid. In particular, the SDF proved to be better in terms of caries arrest, with 78% of lesions of the intervention group exhibiting no progress or evidence of remineralization after 12 months, whereas only 45% of the control group. The cost of SDF treatment reduced the costs of treatment by 52% when compared to the conventional restorative procedures. Such results lead to highlighting the potential of the SDF not merely in enhancing the clinical outcome but also in changing the financial load of the Medicaid programs.

This study is especially relevant to the context of managing the issue of oral health disparities in children under the care of Medicaid. Early childhood caries (ECC) is widespread among people with low income, and the lack of access to dental care is a contributing factor to the problem. As the current study has shown, SDF is an inexpensive and non-invasive intervention that can be adapted to the framework of limited resources, safety-net clinics, and school programs. The large rates of caries arrest and the decrease in the amount of restorative treatments required make SDF a prospective device to enhance the oral health of children at high risk with no access to preventive measures. In addition, the possibility of SDF to save on Medicaid expenditure on unwieldy restorative interventions is an added advantage to the general health systems, and thus, such intervention will be a valuable aid in the larger agenda of minimizing health disparities.

The researchers should also consider examining the long-term consequences of SDF among pediatric cohorts. Although the present study was based on a 12-month follow-up study, future studies should attempt to determine the sustainability of caries arrest over a number of years. The longitudinal studies may yield some information on whether SDF treatment may be considered successful in the long term in preventing the progression of caries and whether there is a possibility of repeated application causing even greater efficacy. Researchers should also have a larger population size and a representative sample of the Medicaid-enrolled children with broader geographical coverage so that the findings

will apply to all children who are under Medicaid. Further studies of the rural population and residents of other underserved regions will help to strengthen the evidence on the possible role of SDF as a national solution to childhood caries. There is also a need to study further on the integration of SDF in the current public health systems and the scale-up of SDF. The evaluation of the expansion of SDF to other Medicaid programs in more states, especially where SDF is not currently reimbursed, will be important in helping to establish how this intervention can be made more available to every child in need. The need to conduct research on the best frequency of SDF applications and the cost-effectiveness of such treatment in the various Medicaid plans will also be required to improve its use and ensure that it offers maximum benefit to the patients and the healthcare system.

The integration of the silver diamine fluoride into the pediatric dental care initiatives is a potential remedy to the perennial problem of childhood caries in the Medicaid population. The findings demonstrate that SDF is not only very efficient in the arrest of caries but also a major mode of achieving cost savings in the treatment procedure, which is so appealing to the health systems in the masses. The favorable results found in this paper indicate that the establishment of standardized SDF protocols in Medicaid-based dental systems may have significant positive effects in clinical and operational efficiency and, consequently, in improving oral health outcomes among vulnerable children. Future research should concentrate on the long-term impact of SDF, the best mode of its adoption, and its implementation among the wider groups of Medicaid-insured individuals to guarantee that a greater number of children can receive a cost-saving, non-invasive prevention method. Through addressing the obstacles to the adoption of SDF, especially with regard to reimbursement and the administrative burden, researchers could establish a fairer and more efficient oral care system serving all children, irrespective of their socio-economic standing

DECLARATIONS

Acknowledgments

The author gratefully acknowledges the contributions of prior researchers in advancing knowledge on SDF and its implementation in public health dentistry.

Funding

No external funding was received for this study.

Competing Interests

The author declares no competing or conflicting interests.

Ethical Approval

This article is based on a literature review and did not involve human subjects or identifiable patient data. Therefore, institutional ethics approval was not required.

Informed Consent

Not applicable (literature-based study).

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