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AN INQUIRY INTO PEDODONTIC ACTIVITIES IN THE
ELEMENTARY CURRICULUM

A Thesis

Presented to

the Faculty of the Department of Education
Indiana State Teachers College

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In Partial Fulfillment
of the Requirements for the Degree
Master of Science
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by

Lucile Scott Keefer

April 1950

The thesis of LUCILE SCOTT KEEFER,
Contribution of the Graduate School, Indiana State
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AN INQUIRY INTO PEDODONTIC ACTIVITIES IN THE
ELEMENTARY CURRICULUM

is hereby approved as counting toward the completion
of the Master's degree in the amount of 8 hours'
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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

In recent years educators have accepted the point of view that in order to obtain maximum results from current educational practices, it is necessary to enlarge the curriculum until it includes every phase of instruction that in any way enriches the life of the pupil. Health is considered one of the important phases of modern education. Since dental health is a contributory factor to the general well-being of the individual, it is worthy of being considered an integral part of the modern school curriculum.

I. THE PROBLEM

Statement of the problem. It is the purpose of this study (1) to show the need of a dental health program in the elementary schools; (2) to discuss suggestions for improving the dental health of the school population of elementary school age; and (3) to inquire into some experiments that show what widely separated communities are doing toward integrating a dental health program into their school curriculums.

Importance of the study. Health was listed as the

first of the seven cardinal objectives of education. Recently the Educational Policies Commission stated: "An educated person knows the basic facts concerning health and disease . . . works to improve his own health . . . and works to improve community health." ¹

The schools of today, through the medium of their curriculums, are entrusted with the responsibility of training children for a much longer period of time than any other public agency. It is in the school that the child is formally grouped for the greater part of his formative years; it is in the school that the health standards are set and can best be improved. ² The school alone cannot do an effective job in educating the child to meet every one of his health problems adequately. The author of this paper hopes that through a study of the difficulties surrounding a potential school dental program and a recognition of the objectives of existing dental health programs that the attention of cooperative community resources will be focused on pupil dental needs; that from this cooperation will come an insistent demand for the inclusion of a planned dental program as an integral part of the elementary school curriculum.

¹ L. E. Burney and Ben H. Watt, "Preservice and Inservice Preparation in Health of School Personnel," American Journal of Public Health, 38:25, January, 1948.

² Ibid.

Limitations of the study. Some of the experiments studied when assembling the data for this research interpret the elementary grades as being grades one through six. Other experimenters have considered grades one through eight as being the elementary grades, but in order to have the cooperation of children of a wider differentiation in age level, they have included junior high school children in their experiments. For the limited purposes of this paper, the author has used statistics pertaining to children aged six through fifteen; or, stated in other terms, children in grades one through nine.

Specific school dental programs are of fairly recent origin. Due to the fact that ten years is the minimum time that a dental health experiment must function before positive conclusions can be drawn,³ most of the programs today are still in the first experimental stages. As yet, few definite conclusions have been reached; thus the available literature on dental programs is scanty and still somewhat theoretical.

II. DEFINITIONS OF TERMS USED

Annual increment. This term refers to the yearly increase of dental defects over and above the defects in

³ Statement by Dr. Waterman, the head dentist of the dental experiment in Richmond, Indiana.

existence the previous year.

Caries. This term is synonymous with tooth decay. It is a process in which the hard structures of the teeth are broken down and the organic portions are disintegrated. Teeth in that condition are said to be carious teeth.

Deciduous. This is a term that refers to teeth that are shed at a certain stage of development and are replaced by permanent teeth.

Dental assistant. The assistant is a person with technical training designed to augment the dentist's work in treatment procedures. The assistant is not required to have a degree.

Dental health. When a child has had a dental examination, has been informed of existing defects, and has had a course of proper treatment suggested and made available to him, then the objective of dental health has been reached.

Dental hygiene. The adoption of practices that promote the health of the mouth, the teeth and their supporting structures is known as dental hygiene.

Dental hygienist. In this paper, a hygienist is referred to as a person who has trained from one to two

years in a recognized dental school and holds a degree in dental hygiene. The duties of the hygienist may include simple gum treatments, prophylaxis, and x-rays.

Dental needs. The term is restricted in this paper to the educational and professional practices that are designed to prevent caries and to promote dental health.

Dental prophylaxis. The scientific and practical efforts made to prevent diseases of the teeth and their surrounding tissues are known as prophylaxis. However, in this paper the term is used to indicate the thorough cleansing of the teeth and gums. Prophylaxis may be carried on by either the dentist or as a program of dental hygiene in the home.

Health education consultant. This is the title for a person who works with both schools and dental clinics. He initiates health education in the schools in an attempt to bridge in the gap between the schoolroom and the dental clinic. He is also sometimes called a "follow-up worker".

Orthodontia. This is the division of dentistry that deals with straightening the irregularities of the teeth.

Pedodontia. The term is used to denote child dentistry. Pedodontic practices are those that deal with the dental health of children.

Quadrant. This is a sector representing a quarter

part of the whole mouth.

Tooth mortality. The author has used the term to refer only to the number of teeth already extracted plus the number of permanent teeth with cavities so severe that extraction is indicated.

Topical applications. A local application of a solution or a dental treatment applied to a particular place or part of the teeth is said to be topical.

CHAPTER II

REVIEW OF THE LITERATURE

Current periodicals were the most helpful source of materials for this study. The list of authors was not long; the material was not extensive. Many of the same authors wrote articles describing different angles of the existing programs for school children, but only a brief summary of those articles to establish a background for this study will be given.

Johnson¹ stated that carious and ill-formed teeth can have a devastating effect upon the personality of a young child. Fear of ridicule and criticism often results in antisocial behavior that may carry over into adulthood.

Hollister and O'Brien² gave an account of a dental program carried on in the schools of Westchester County, New York. As an introduction in one school, during the first week the teeth of seventy-seven children were cleaned and examined, the teeth of 161 others were examined only, and twenty-five classroom lectures on dental hygiene were given. The cost was nominal because the dental equipment

¹ Ina G. Johnson, "Can Bad Teeth Affect Personality?" Hygeia, 566, August, 1948.

² Harold E. Hollister and Irene Cooper O'Brien, "Share the Care, A Successful Program of Dental Hygiene," Nation's Schools, 32:14-15, September, 1943.

was rented. After enthusiasm for the program became more general, portable equipment was purchased and rented to the schools for a small fee. As a result of this small beginning, an extensive dental educational program has been set up in every school of the district.

Hagen³ summarized the findings of a study made of 24,092 school children in twelve Georgia communities that were differentiated by location and economic status. The study demonstrated these facts:

1. The prevalence of dental caries in permanent teeth varied in different places studied.
2. The annual increment of dental caries in permanent teeth also varied with the location.
3. Evidence indicated that no significant variation in caries experience could be attributed to economic status.
4. There was some evidence that the prevalence of caries in permanent teeth may be increasing.
5. The tooth mortality rate of a community adhered quite closely to the relative pattern established by the caries attack rate, except in those localities where dental health promotion was carried out extensively.

³ Thomas L. Hagen, "Dental Caries Prevalence and Tooth Mortality," Public Health Reports, 62:1757-1767, December 19, 1947.

6. Individuals in the higher economic strata experienced significantly lower tooth mortality rates than those persons in the lower economic levels, except where concerted efforts were made to save the teeth by good dental care.

Nyswander's ⁴ report of the four-year study of school health service in Queen's borough on Long Island, known as the Astoria Demonstration Study, stated findings that indicated the need for earlier detection of caries and subsequent treatment. The point was emphasized that for maximum efficiency the dental hygienist should work with the teacher and not directly with the pupils.

⁴ Dorothy B. Nyswander, Solving School Health Problems (New York: The Commonwealth Fund, 1942), p. 221.

CHAPTER III

DENTAL NEEDS

The greatest single factor in tooth mortality is caries. The etiology of this dental affliction has not yet been determined, but researchers have been concentrating on the problem in recent years. No definite prognosis has been given. The single definite thing that can be done about carious teeth is to treat them after they appear. Therefore, the primary purpose of existing dental health programs must be concentrated upon the adoption of functional plans by which the early detection and treatment of carious teeth can be made and tooth mortality prevented. As a part of that program, dental prophylaxis is also emphasized.

The United States has been called "a nation of dental cripples."¹ Public health records show that nine out of ten American children suffer from some form of tooth decay or other dental defects such as gum diseases and malformation of the teeth and jaws.² The American Dental Association statistics show that from ninety to ninety-six per cent of

¹ Herman N. Bundesen, "Let's End Dental Crippling," Ladies' Home Journal, p. 170, February, 1949.

² Editorial in the Richmond (Indiana) Palladium, February 2, 1949.

the children in the United States need some form of dental work and that these defects occur six times more rapidly than they are cared for under existing conditions.³

Dental caries is the most common ailment of mankind. If carious teeth are neglected, they may provide an opportunity for dental abscesses to form. In turn, these abscesses may allow infection to spread through the system. Even if the spread of infection is checked before serious results can occur, there may be a general slowing down of physical efficiency and alertness due to the insidious infiltration into the system by the toxins generated by the decay. This condition may seriously threaten the health of the child; it may cause him to miss school, get low marks, and repeat grades. A broken, decayed, and abscessed tooth or inflamed, unhealthy gums may prevent the child from chewing on one side of the mouth. Over a long period of time, these conditions may interfere with proper jaw development.

Teachers and parents need to have an adequate knowledge of the role healthy teeth play in the development of the child. It is at the beginning of his elementary school

³ These statistics were given to the author of this paper during an interview with Dr. Waterman, the head dentist of the Richmond, Indiana, dental project.

experience that the first permanent teeth erupt. These sixth year molars are the most important teeth of all because they act as anchors to hold the jaws in proper relation to each other while all the deciduous teeth are lost and the permanent ones are taking their places. Parents often fail to realize that these four molars are permanent teeth, and they neglect to have them filled when caries appears. During the intermediate grade years, more of the permanent teeth erupt. Normal eruption of these teeth both as to time and position helps to develop normal mastication and facial contour. A knowledge of the progress in tooth development at each age level is an asset to the individuals who have a share in promoting the health of the elementary school child. ⁴

The need for a program designed for the early detection and prevention of caries led to a detailed study of dental disease in an eastern urban community. All of the elementary schools in the city were interpreted as demonstrating the magnitude of the caries problem confronting the community agencies responsible for the development of the whole child. It is to emphasize the need for a program of caries prevention that detailed statistics for this study are included in this chapter.

⁴ National Education Association of the United States, Health Education (Washington, D. C. : National Education Association, 1941), p. 128 ff.

The findings presented in the study were basically concerned with an analysis of tooth mortality rates in the elementary grade population of Hagerstown, Maryland.⁵ The distribution of these children with respect to age and sex was considered representative of urban communities in the United States which have a population of about thirty thousand. The total grade school population for grades one through eight was 4,700. Of this total 4,416, or ninety-four per cent, were given dental examinations. This group included 2,232 boys and 2,184 girls. The number of boys exceeded the number of girls by forty-eight.

Tooth mortality rates were determined by counting extracted permanent teeth and those that had such severe decay that they were indicated for extraction. This sum divided by the number of children and multiplied by one hundred gave the tooth mortality rate per one hundred children.⁶

The age and sex distribution of tooth mortality in terms of numbers of permanent missing teeth is presented in Table I.⁷ Girls for each age, except that of ten, had a

⁵ Henry Klein, et al., "Studies on Dental Caries," I, Public Health Reports, 53:752, May 13, 1938.

⁶ John W. Knutson and Henry Klein, "Studies on Dental Caries," II, Public Health Reports, 53:1022, June 24, 1938.

⁷ Ibid., p. 1023.

TABLE I

A COMPARISON OF THE NUMBER OF PERMANENT TEETH
MISSING IN BOYS AND GIRLS AT CONSECUTIVE AGE
LEVELS IN THE SCHOOLS OF HAGERSTOWN, MARYLAND

Age	Boys		Girls		Total	
	Total number of cases	Number of teeth missing	Total number of cases	Number of teeth missing	Number of cases	Number of teeth missing
6	171	0	156	1	327	1
7	197	5	206	6	403	11
8	231	10	256	15	487	25
9	253	35	240	55	493	90
10	270	88	259	68	529	156
11	262	77	269	86	531	163
12	299	121	297	154	596	275
13	267	160	278	209	545	369
14	199	148	165	144	364	292
15	83	98	58	69	141	167
All Ages	2232	742	2184	807	4416	1549

significantly higher loss of permanent teeth than boys.⁸

The table also shows the speed with which tooth mortality increased with chronological age.

The higher caries experience of girls in comparison with boys of the same chronological age was explained by the finding that girls' teeth erupt earlier than do those of boys. They are, therefore, exposed longer to the risk of attack by caries than the teeth of boys. The determination of this fact led to the conclusion that girls showed no greater susceptibility to attack by caries than did boys.⁹

Table II shows the mortality rate of permanent tooth loss per one hundred children. For boys of six years of age the rate was 0; for the age of seven, it was 2.5, and it increased gradually until the age of fifteen when it became 118.1. Since this rate was cumulative, the annual increments of numbers of missing teeth per one hundred children were easily calculated. For example, since boys aged six had no missing permanent teeth, the rate at the age of seven was considered as equal to the increment which accumulated between the ages of six and seven. It followed, therefore, that the

⁸ Infra.

⁹ Henry Klein and Carrol E. Palmer, "Sex Differences in Dental Caries Experience of Elementary School Children," Public Health Reports, 53:1689, September 23, 1938.

TABLE II

TOOTH MORTALITY RATE FOR EACH ONE HUNDRED CASES
IN THE SCHOOLS OF HAGERSTOWN, MARYLAND

Age	Boys	Girls	Total
6	0.	0.6	0.6
7	2.5	2.9	5.4
8	4.3	5.9	10.2
9	13.8	22.9	36.7
10	32.6	26.3	58.9
11	29.4	51.9	81.3
12	40.5	75.9	116.4
13	59.9	75.2	135.1
14	74.4	87.3	161.7
15	118.1	119.0	237.1
Average for all ages	32.2	37.0	35.0

total annual increment of tooth mortality in the elementary school population of this community was the sum of all the annual increments for each age-sex group from six through fifteen years.¹⁰ That the knowledge of increments of missing teeth is a factor in a well-planned dental program for the elementary schools will be shown in a later chapter.

All authorities emphasize the need for instruction in the field of oral prophylaxis. From the time he enters kindergarten, each child should feel that the hygiene of his mouth is his own responsibility. Dental hygienists or trained teachers should not only make sure that the child understands why his mouth and teeth should be kept clean and healthy, but they should also make sure that ample time is allowed for practicing the principles of prophylaxis under trained supervision.

Each individual child in the elementary grades needs practical training, at his own developmental level, in the benefits of a good nutrition program. He needs to be taught how the different kinds of food affect his teeth and how to choose foods wisely from a dental viewpoint. Good nutrition is one phase of dental health that can be integrated successfully and easily with other subject-matter activities in the

¹⁰ Knutson, loc. cit.

elementary school.

Until scientific research has discovered, tested, and recommended reliable methods for the prevention of dental caries, the present dental needs of the elementary school may be summarized as follows:

1. A planned program for the early detection of caries is necessary.
2. Opportunity for treatment should be made available to all children.
3. A supervised program of dental prophylaxis should be included in the curriculum as a help in the prevention of caries.
4. Wider, more specific knowledge of dental development in young children should be gained by adults who work with children.
5. More nutrition programs should be included in the daily school schedules as a means of promoting better dental health.
6. Continued experimentation by dental researchers is indicated as a means for the prevention of caries.

CHAPTER IV

DENTAL ACTIVITIES AND EXPERIMENTS WITH NEW CARIES- PREVENTING MEDIA IN THE ELEMENTARY SCHOOL

Since the cause of the most common dental disease is still unknown, experiments with revolutionary ideas in the prevention of tooth decay are being carried on in the elementary grades of a few school systems today. Fortunately, education has progressed beyond emphasis only on rigidly controlled subject matter and has in recent years developed a more flexible program. This flexibility permits activities to be carried on that give knowledge and actual practice in dental health procedures. The enlarging curriculum includes time for dental health instruction and activities to meet the health needs of the children.

I. DENTAL ACTIVITIES

Practical dental hygiene. A type of dental program that serves many family units is the one that is built around practical hygiene. A good example of this program is the one in Westchester County, New York, that was mentioned in Chapter II of this research.¹ In the first grades, children

¹ Cf. ante, p. 7.

learn what kind of toothbrush to buy, how to care for it, how to brush their teeth, how to make their own tooth powder if commercial dentifrices are not available, the importance of visiting a dentist, and what foods are effective tooth builders. The upper elementary grades learn the position of the teeth in the mouth, and especially they learn about the all-important six-year molars. Everyone learns how a tooth decays, how a dentist aids in maintaining a sound set of teeth, and the importance of clean, healthy teeth to good health and attractive appearance. The Westchester experiment is an example of the economical, practical type of dental hygiene that can be carried on in any elementary school under the guidance of the regular teacher.

II. EXPERIMENTS WITH NEW CRIES-PREVENTING MEDIA

Dental scientists have produced two spectacular methods for prevention of tooth decay that are being tried out as activity programs in schools at the present time. These experiments are not very far along in the ten-year proving period; therefore, they have not yet produced conclusive data, but the outlook is hopeful.

Ammoniated dentifrice. One of these methods is being carried on in the fifth and sixth grades of the public schools of Aurora and Peoria, Illinois. In this mass experiment, the

children are brushing their teeth with an ammoniated dentifrice that is made from a formula developed at the University of Illinois.² The ammonia contained in the dentifrice has a tendency to counteract the acid tendencies of the gluey coatings found on the teeth. It is believed that this acid is a factor in the development of caries. Whether the ammonia-ion dentifrice is an answer to the mystery of caries or whether it can be used as an effective preventive is a fact that the Illinois experiment hopes to discover.³

Sodium fluoride. Another new weapon that may help in keeping down dental caries is sodium fluoride, a chemical compound. Its relationship to tooth decay was discovered accidentally several years ago when public-health doctors noticed a peculiar gray tone on the teeth of the residents of certain areas in the Southwest. Investigation showed that little dental decay was present in these same geographical areas. Both circumstances were traced to sodium fluoride in

² Dr. Robert G. Kesel, J. F. O'Donnell, Dr. E. R. Kirch, and Dr. E. C. Wach are responsible for the formula.

³ J. D. Lawrence and Lawrence Galton, "Now You Can Slam the Brakes on Tooth Decay," Better Homes and Gardens, p. 48-49, December, 1948.

the water supplying the localities. After isolating this chemical, experimenters have gone a step further. They apply sodium fluoride directly to the teeth, and they have had results that indicate a 40 per cent reduction in dental decay.⁴

In 1944 Jordan⁵ made a study to try to determine the minimum number of applications of 2 per cent sodium fluoride solution necessary to obtain the maximum results. The study was made on groups of children in the public schools of Hibbing, Chisholm, and Virginia, three cities in northern Minnesota. Each city had a full-time school dentist in a reasonably well-equipped dental office. The children included in the study were examined and treated in those offices.

Permission for treatment was obtained from the parents of 1,130 school children aged six to twelve years. One treatment was given to 300 children in Hibbing. Two treatments were given to 630 children in Chisholm, and three treatments were given to 200 children in Virginia.

Prior to the fluoride applications, each child received a thorough prophylaxis by the dental hygienist. The dentist made the examinations with mouth mirror and explorer under

⁴ Dental Health for Young America, American Dental Association, (n. d.), p. 21.

⁵ W. A. Jordan, et al, "The Effects of Various Numbers of Topical Applications of Sodium Fluoride," The Journal of the American Dental Association, 33:1385-1386, November 1, 1946.

good light. Only the teeth in half of the mouth of each child were treated; one upper and one lower quadrant were given topical applications of the fluoride solution. The teeth in the untreated half of the mouth were used as controls.

The treatment, after prophylaxis, consisted of isolating with cotton rolls the teeth to be treated, drying them with compressed air, and applying a 2 per cent solution of sodium fluoride to the crowns of the teeth by means of a cotton swab. The teeth were kept free of saliva, and the mouth was held open for four minutes after the application to allow the solution to dry on the teeth. In the schools where more than one treatment was given, the treatments were given at intervals of one week. The second and third treatments were not preceded by other than the initial prophylaxis.

In the autumn of 1945, approximately a year after the fluoride treatments were administered, the teeth of the children in all of the schools were reexamined. The second examination was made by the same person and with the same equipment as the initial examination. It included all of the treated children who were still available.

In the Hibbing study, 241 children were reexamined after having received the one application of sodium fluoride.⁶ It was found that the treated upper quadrants on both the right

⁶ Ibid., p. 1388.

and the left sides of the deciduous teeth showed some advantage from the single topical application of sodium fluoride. The treated lower quadrants of both the deciduous and the permanent teeth failed to show any benefit from the single application of sodium fluoride.

The data gathered from this one application indicate that there is a difference of about 4.9 per cent between the treated and the untreated quadrants of both the deciduous and the permanent teeth.⁷ These findings indicate that one application of sodium fluoride had only a slight effect in preventing dental caries, and this effect was confined to the upper quadrants.

In the Chisholm study, 575 children were reexamined after having received two applications of sodium fluoride.⁸ After combining the findings for the treated and the untreated quadrants, it was found that the results were more favorable than those found after the single application of sodium fluoride given in the Hibbing study.⁹ In the Chisholm study, 14.5 per cent less caries developed in the treated deciduous teeth than in those untreated, and 10 per cent less caries developed in the treated permanent teeth than in the untreated

⁷ Loc. cit.

⁸ Loc. cit.

⁹ Supra.

ones.¹⁰

In the Virginia study, 161 children were reexamined after having received three applications of sodium fluoride.¹¹ This study was a restricted one as compared to the Hibbing and Chisholm studies, because it was limited only to children in the third, fourth, fifth, and sixth grades. All treatments were given only on the teeth in the left quadrants. The treated upper quadrants showed better results than the treated lower quadrants. The combined treated quadrants of the deciduous dentition showed 40 per cent fewer teeth becoming carious in the treated than in the untreated teeth.

Table III¹² gives statistics for comparison of the results of one, two, and three applications of sodium fluoride on both permanent and deciduous teeth. An analysis of the findings of the three studies indicates that there is a reduction of dental caries corresponding to the increased number of applications of sodium fluoride. However, in comparison with the results of a similar investigation by Knutson,¹³ a

¹⁰ Jordan, loc. cit.

¹¹ Jordan, op. cit., p. 1389.

¹² Ibid., p. 1390.

¹³ Senior dental surgeon of the United States Public Health Service.

TABLE III

A COMPARISON OF THE EFFECTS OF ONE, TWO, AND THREE APPLICATIONS OF SODIUM FLUORIDE SOLUTION TO BOTH THE PERMANENT AND DECIDUOUS TEETH

Kind of teeth	Number of sound teeth in 1944		Number of sound teeth in 1944 which became carious or filled in 1945		Percentage of sound teeth in 1944 which were carious or filled in 1945		Percentage less caries in treated than in untreated teeth
	T	U	T	U	T	U	
Deciduous Permanent	One application						
	674	664	78	82	11.6	12.3	4.9
	1366	1337	77	81	5.6	6.1	4.9
	Two applications						
	1950	1929	136	159	7.0	8.2	14.5
	2422	2281	179	199	7.3	8.7	10.0
Deciduous Permanent	Three applications						
	192	200	9	15	4.7	7.5	40.0
	1215	1229	49	62	4.0	5.0	21.0

Note: T means treated teeth
U means untreated teeth

discussion of which follows this analysis, maximum results were not obtained by the three treatments used in the Hibbing, Chisholm, and Virginia experiments. It is evident, therefore, that more than three treatments are necessary to obtain the best results.

This study furnished evidence for the investigators to conclude that two treatments for permanent teeth gave a result more than twice as effective as that obtained by one treatment, and that three treatments gave a result twice as effective as that obtained by two. Statistics revealed in Table IV ¹⁴ support these conclusions.

A brief summary of the study made by Jordan and his associates indicates that:

1. The number of treatments has a direct bearing on the results achieved by topical application of a 2 per cent solution of sodium fluoride to the teeth of children of elementary school age.

2. Three treatments are not sufficient to provide the maximum possible amount of caries control; to achieve maximum results, the minimum number of treatments needs to be more than three.

3. Topical application of sodium fluoride in one,

¹⁴ Jordan, op. cit., p. 1389.

TABLE IV

THE NUMBER OF CARIOUS OR FILLED TEETH THAT DEVELOPED
DURING THE STUDY OF THREE MINNESOTA SCHOOL COMMUNITIES

Deciduous		Permanent	
One Treatment			
Treated quadrant.....	78	Treated quadrant.....	77
Untreated quadrant.....	82	Untreated quadrant.....	81
Difference: 4 (4.9 per cent)		Difference: 4 (4.9 per cent)	
Two Treatments			
Treated quadrant.....	136	Treated quadrant.....	179
Untreated quadrant.....	159	Untreated quadrant.....	199
Difference: 23(14.5 per cent)		Difference: 20(10 per cent)	
Three Treatments			
Treated quadrant.....	9	Treated quadrant.....	49
Untreated quadrant.....	15	Untreated quadrant.....	62
Difference: 6(40 per cent)		Difference: 13(21 per cent)	

two, or three treatments had little effect on teeth that were previously carious or filled.

4. Topical applications of sodium fluoride are effective in lowering the incidence of dental caries.

Another investigation into the efficacy of sodium fluoride as a factor in the reduction of dental caries was made by Knutson under the authority of the United States Public Health Service.¹⁵ It was conducted under similar conditions and in the same general geographical area as the investigation made by Jordan and his associates.¹⁶ During the three-month treatment period beginning in September, 1943, three groups of Rochester, Minnesota, school children received a series of topical fluoride applications to the teeth in half of the mouth.¹⁷ The children in the first of these groups received two fluoride applications, the second group received four applications, and the third group received six applications. Half of the children in each group were treated in the left side of the mouth, and the other half in the right side of the mouth. The teeth in the untreated mouth quadrants served as controls. A dental

¹⁵ John W. Knutson, Wallace D. Armstrong, and Floyd M. Feldman, "The Effect of Topically Applied Sodium Fluoride on Dental Caries Experience." Public Health Reports, 62:425-430, March 21, 1947.

¹⁶ Supra.

¹⁷ Knutson, op. cit., p. 426.

examination and a record of findings were made for each of the 2,016 children who participated. The children ranged in age from seven to fifteen years.

The examinations were made with mouth mirror and explorer under artificial light. Compressed air was available for use if the examiner wished to use it. In each case, only the teeth in the upper and lower quadrants of one side of the mouth were treated with fluoride. The treatment consisted of isolating the teeth with cotton rolls, drying with compressed air, and wetting the crown surfaces with a 2 per cent solution of sodium fluoride. The applied solution was allowed to dry in air for about four minutes. This investigation omitted prophylaxis. For each child a maximum of two treatments was given each week, and the entire series of treatments was completed in three weeks or less.

Two years after the series of applications, the teeth of the children in the treatment groups were reexamined.¹⁸ Although there were initially 2,016 children included in the study, the two-year report presented in this paper is based on the 1,458 cases available for the reexamination. The analysis of the data on caries experience is confined to the erupted permanent teeth present in the mouth at the time of

¹⁸ Ibid., p. 427.

the initial examination. The age classification of the children refers to age at the time treatment was given.

Table V ¹⁹ indicates the age distribution of the children included in the analysis of the study. It also shows the number of topical applications of sodium fluoride at each age level. The proportion of children at each age level from seven to fifteen, included in each treatment group, was approximately equal. Boys and girls were somewhat equally represented, and the children in each treatment group were selected in nearly equal proportions from the seven grade schools and two junior high schools in Rochester.

Table VI ²⁰ presents the caries experience in fluoride treated and untreated permanent teeth for the two-year study period by upper and lower mouth quadrants. This presentation is made separately for the different treatment groups.

Table VII ²¹ indicates the percentage reduction in new caries experience in teeth treated with sodium fluoride during the two-year period as compared with the untreated teeth in the control quadrants.

19 Ibid.

20 Ibid., p. 428.

21 Ibid., p. 429.

TABLE V

AGE DISTRIBUTION OF ROCHESTER, MINNESOTA, SCHOOL CHILDREN
AND NUMBER OF SODIUM FLUORIDE TREATMENTS AT TIME OF
RE-EXAMINATION AT THE END OF THE TWO-YEAR STUDY PERIOD

Children by age at time of treatment	Number of applications			Total
	2	4	6	
7	12	13	14	39
8	61	61	61	183
9	66	76	63	205
10	64	72	72	208
11	68	64	63	195
12	73	72	69	214
13	62	76	66	204
14	53	61	61	175
15	13	9	13	35
All ages	472	504	482	1458

TABLE VI

DENTAL CARIES EXPERIENCE FOR PERMANENT TEETH OF THE 1,458
ELEMENTARY SCHOOL CHILDREN INCLUDED IN THE ROCHESTER STUDY

Number of treatments	Treatment groups by treated and untreated quadrants	Number of non-carious teeth in Sept., 1943	New DF teeth in Nov., 1945	DF surfaces in new DF teeth	New DF sur- faces in previously carious teeth	Total new DF surfaces
UPPER						
2	Treated quadrant	1692	285	370	165	535
	Untreated quadrant	1684	316	416	213	629
4	Treated quadrant	1818	245	304	178	482
	Untreated quadrant	1810	324	380	197	577
6	Treated quadrant	1726	223	266	160	426
	Untreated quadrant	1740	300	343	208	551
LOWER						
2	Treated quadrant	1939	181	245	186	431
	Untreated quadrant	1920	198	259	206	465
4	Treated quadrant	2053	156	191	170	361
	Untreated quadrant	2039	178	234	188	422
6	Treated quadrant	1964	124	146	176	322
	Untreated quadrant	1947	141	174	224	398

DF refers to carious teeth either decayed or filled

TABLE VII

A COMPARISON OF NEW CARIES EXPERIENCE IN TREATED AND UNTREATED
TEETH BY MEANS OF A PERCENTAGE REDUCTION

Percentage reduction in newly carious teeth			
Number of applications	Upper jaw	Lower jaw	Both jaws
2	9.8	8.6	9.3
4	24.4	12.4	20.1
6	25.7	12.1	21.3
Percentage reduction in newly carious surfaces in previously carious teeth			
Number of applications	Upper jaw	Lower jaw	Both jaws
2	22.5	9.7	16.2
4	9.6	9.6	9.6
6	23.1	21.4	22.2

An analysis of the statistics in Tables VI and VII indicates that:

1. The incidence of initial caries in permanent teeth which were non-carious at the time of treatment is 9.3, 20.1, and 21.3 per cent less in teeth treated with two, four, and six applications of fluoride solution; respectively, than in untreated teeth.

2. The numbers of additional permanent tooth surfaces which became carious in teeth which already were carious at the time they were treated were 16.2, 9.6, and 22.2 per cent less in fluoride-treated carious teeth given two, four, and six applications, respectively, than in untreated carious teeth.

3. A comparison of the results of this investigation with that of Jordan's cited above shows that omission of a dental prophylaxis from the treatment procedure materially reduces the caries-inhibiting effects of the topically applied fluoride solution.

A comparison of Knutson's and Jordan's investigations is of special interest. In both investigations, 2 per cent sodium fluoride was topically applied, and the same treatment procedure was used with the exception that one was preceded by a thorough dental prophylaxis and the other was not. In Jordan's study, the reduction in caries' incidence associated with one, two, and three fluoride applications was 5, 10, and

21 per cent respectively. In Knutson's study, two, four, and six applications effected a 9.3, 20.1, and 21.3 per cent reduction, respectively. Thus four and six applications of 2 per cent sodium fluoride solution to the teeth without dental prophylaxis were only as effective in preventing dental caries as three treatments preceded by a dental prophylaxis.

Study of the composite findings suggests, therefore, that four fluoride treatments preceded by dental prophylaxis are likely to give the maximum reduction in caries incidence obtainable with 2 per cent fluoride solution when using the treatment procedure utilized by the two studies. Confirmation and proof of this conclusion must await the results of studies now in progress. The initial studies of these two groups may point the way toward planned programs of caries control among children in the elementary schools.

Cambridge City, Indiana, is carrying on a small-scale experiment with the use of sodium fluoride in the elementary grades. This study is being conducted by the Indiana State Board of Health. A team of one dentist, two hygienists, and a clerk has been conducting the treatments. The teeth are thoroughly cleaned first. Then they are painted with a diluted solution of sodium fluoride and allowed to dry for fifteen minutes. A series of four treatments are given less than a week apart. It is too soon to evaluate the results

of the Cambridge City experiment. ²²

This chapter has discussed three distinct types of dental programs in operation in the elementary schools at the present time. An ammoniated dentifrice experiment is in progress in Illinois. In Cambridge City, Indiana, children's teeth are being treated with sodium fluoride as a direct result of hopeful data gained by experiments conducted by such experts as Knutson and Jordan. Many localities have initiated practical dental hygiene programs as typified by the Westchester County, New York, schools. As all of these programs are still in the early and middle experimental stages, no definite long-term results or statistics can be quoted.

²² News item in The Richmond (Indiana) Palladium-Item, February 2, 1949.

CHAPTER V

THE RICHMOND DENTAL DEMONSTRATION STUDY

An outstanding dental program that is worthy of special discussion is now in progress in the elementary grades of two widely separated school systems. The activity might well be called a triple program because it has three sponsors and is working toward three objectives. The federal government, through the United States Public Health Service, contributes 40 per cent of the operating costs; state boards of health contribute 30 per cent of the expense, and the remaining 30 per cent is borne by the local school city in which the program is functioning. Two pilot programs have been set up: one is Woonsocket, Rhode Island, and the other is Richmond, Indiana. The two programs operate under similar organizations, but the Richmond program is the one which will be discussed as representative of the federal-state-local study. It can not be treated conclusively because it, too, is in the middle of the experimental period.

In December, 1946, the federal-state-local program was set up in the elementary schools of Richmond, Indiana, a city of approximately forty thousand population. The specific purposes of the pioneer program were:

1. To determine the dental care needs of school children on an annual increment basis.

2. To determine the ratio of dental personnel to population in terms of complete dental care.

3. To determine the extent to which the output of dental care services can be increased by the effective utilization of trained auxiliary personnel.¹

To achieve these objectives, facilities were installed in each elementary and junior high school to permit dental clinics to be established there once each year. Standard portable equipment required for modern pedodontic practice was furnished by the United States Health Service. The clinics were planned to operate on a rotating schedule among schools. They were to be available to the school population twelve months in the year.

Staff. The staff consisted of five dentists from the United States Public Health Service who had previous training in pedodontia. The nine dental assistants were local girls who were given a ten-weeks' training course at the National Naval Medical Center at Bethesda, Maryland. The rest of the original staff consisted of one dental hygienist, who gave

¹ All of the data concerning the Richmond project, unless specifically attributed to other sources, was gained first-hand by the author through actual experience with the school dental clinics or through personal interviews with Dr. George Waterman, the senior dentist in charge of the project, and Mr. Henderson, the health education consultant on the staff.

prophylaxes and had some experience with treatments, and a secretary whose responsibility was the formulation of financial and progress reports to the sponsors. The secretary also compiled the day-by-day statistics from the clinics. It was originally planned that after the first two years the dental staff would be decreased to a force just large enough to meet the maintenance requirements of children under treatment, or to take care of the annual increment of caries. That adjustment in the staff has not been possible, for in 1950, three years after the study was initiated, the staff has been increased by the addition of a health education consultant. The Richmond study has its staff of special consultants.² They visit the survey approximately every six months. In addition to the clinic staff and its consultants, the program has the support of the American Dental Association and the state, the district, and the local dental societies.

Scope. All children in the elementary and junior high schools, both public and parochial, are eligible for examination and treatment. Approximately five thousand children are checked and treated by the clinics once a year. Treatment is not compulsory. After a child is examined, he carries home a typed

² Dr. Ralph L. Ireland, University of Nebraska Dental College, Dr. Roy Elam, Nashville, Tennessee, Dr. George Paffenbarger, Bureau of Standards, Washington, D. C., and Dr. Kenneth A. Easlick, University of Michigan.

form for his parents' signature. This gives the parents an opportunity to signify whether they wish their child to participate in the school dental program or prefer to employ their own family dentist. No treatment is given a child without the consent of the parents. No fees are charged.

Type of treatment. Complete dental care with the exception of orthodontia is given each participating child. Orthodontic needs are not ignored, because when the condition of the mouth and teeth warrant the recommendation, the parents are advised to consult an orthodontist. The federal program, however, places its emphasis on treatment and care of the permanent teeth. Topical fluoride therapy was not included in the original plans for the survey. However, when other operating programs began to indicate favorable results, the fluoride therapy was incorporated as an integral part of the Richmond program about one year after the survey was begun. Sodium fluoride applications are now given experimentally to the children every three years. Local anesthesia is used extensively in operative procedure. General anesthesia is not used by the survey dentists, and cases requiring it are referred to local dentists who have the facilities for administering it. Prophylaxis is considered an important part of the dental program.

All children who have been receiving periodic care by

their family dentist are encouraged to continue their original dental program. The study provides for a follow-up program to encourage non-participants to go to their family dentist. A child who develops a need for treatment in a school where the clinic is not in operation at the time is termed an emergency case. He can obtain immediate dental care by applying to a supervisor of one of the clinics. When he presents himself at the clinic at an appointed time with a signed authorization from his parent or guardian, he is given the care that he needs. There is no excuse for prolonged toothache among the children in the elementary schools of Richmond.

Approach to treatment. The dentist who specializes in pedodontia must know child psychology as well as dental techniques. A good psychological approach means the difference between success and failure in the objectives of the Richmond program. The first essential of treatment is to gain the confidence and interest of the patient. The survey dentist never hurries a patient. He talks to the boy or girl in the chair and shows the instruments he is going to use. The treatment progresses from the simple to the difficult phases. The prophylaxis is given first. It is followed by an examination of the teeth with the dentist using the instruments which the child was allowed to examine. The fluoride application is given next. In cases of severe caries a local anesthetic is

used. In filling carious teeth a wet technique may be used to minimize pain by reducing the amount of heat from the burr. In a great many cases the dread of going to the dentist is eliminated by the friendly, casual, matter-of-fact approach used by the dentist.

Educational phase. The dental staff of the Richmond pilot program has not neglected the health education phase. Educational devices that appeal to children are constantly used to stimulate interest and cooperation with the program. The devices used are magic shows, puppet shows, convocation talks, chalk talks, flannelgraph pictures, dental health pamphlets and books at different developmental levels, and attractive poster units that rotate among the schools. All of these devices emphasize nutrition, actual care of the teeth, and the importance of visiting the dentist whenever his services are needed. The central theme and ultimate aim of every teaching aid is good dental health. Most of this program is carried on through the medium of the schools. Every phase of the planned educational program is preceded by classroom instruction and discussion by the teacher and the pupils.

This educational phase of the survey program also includes a dental health education program for parents. It is designed chiefly for the homes of those children without any dental care at all. A great deal of this is done through

newspaper releases that inform the general public in understandable terms just what the study is doing and what it hopes to do. In cases where it is necessary, individual calls are made at homes in an attempt to obtain cooperation with the clinics and to induce parents to become aware of the need for good dental care.

Statistics of the first three years of the experiment. The findings gleaned from the first three years' experiment cannot be termed conclusive in any sense. They can only point the way toward general conclusions of worth and indicate to some extent whether or not the individual local program is functioning efficiently in terms of the need of the community.

Table VIII ³ is a report of the participation in the Richmond study by individual schools. The statistics pertain to the period from November 30, 1948 to November 30, 1949. These dates begin and terminate the third year of the study.

Column 1 gives the total number of participants in both the clinical program and private practice that has been reported. Column 2 reports the total enrollment of the individual schools on October 31, 1949. Column 3 gives the total number of those children that signed to have treatment carried on in the school dental study clinics. Column 4 gives

³ The statistics that are in this table were compiled by the personnel of the clinic.

TABLE VIII

PARTICIPATION REPORT OF THE RICHMOND FEDERAL-STATE-LOCAL DENTAL CARE
STUDY FROM NOVEMBER 30, 1948, TO NOVEMBER 30, 1949

School plant	1 Total number participants both private and clinical	2 Enrollment	3 Number signed for clinics	4 Number signed for private den- tal care	5 Percentage of participation in clinics	6 Number of completion cards returned	7 Percentage of participation in private practice	8 Total average percentage of participation
Baxter	253	313	237	76	76.6	16	21.0	80.9
Easthaven	225	280	218	62	78.0	7	11.3	80.0
Fairview	441	460	423	37	92.0	18	48.7	96.0
Finley	170	173	167	6	96.5	3	50.0	98.2
Garfield	267	362	262	100	72.4	5	5.0	73.7
Hibberd	899	949	876	73	92.5	23	31.5	94.9
Joseph Moore	214	271	198	73	73.1	16	21.9	79.0
Nicholson	568	599	567	32	94.7	1	3.2	95.0
Starr	433	487	432	55	88.6	1	5.5	89.0
Vaile	167	202	164	38	81.3	3	7.9	82.6
Warner	316	320	311	9	97.2	5	55.5	98.8
Dennis	363	490	360	130	73.5	3	2.3	74.1
Test	410	489	407	82	83.4	3	3.6	84.0
St. Andrews	315	330	286	44	86.6	29	57.1	95.5
St. Marys	243	280	234	46	83.6	9	19.5	86.9
Total	5284	6005	5142	863	84.6	142	22.9	87.3
Average Participation in clinics					84.6	* 80.0		
Average participation with private dentists						22.9	* 15.9	

* Figures for 1948 given for comparison purposes

the total number of children who signified their desire to participate in the dental care study in the office of their family dentist. Column 5 indicates the percentage of participation in the school clinics in comparison with the total enrollment of elementary pupils. Column 6 shows the number of completion cards per school returned this year. Each completion card represents the completed dental care of a child who preferred his family dentist. The sum of the numbers in column 6 and column 3 should equal the corresponding number in column 1. These numbers represent the pupils who cooperated with the study. The difference between column 4 and column 6 represents the number of pupils who either have had no dental care or who have failed to return their completion cards. Column 7 indicates the percentage of participation with the private dentists. Column 8 gives the total average participation of all pupils using either the clinical program or the family dentist.

The interpretation of this table indicates four elements that are significant to the research. They are:

1. There has been nearly a five per cent increase in pupil participation in the third year of the operation of the clinic.

2. Private practitioners are making an effort to report completed cases to the dental research care program.

3. The greater degree of preliminary education preceding the clinic's entrance into a school by the administrator and the faculty is most helpful in bringing about the desired result of dental consciousness on the part of the children and parents.

4. The total participation of the private dentists and the clinic study is approaching the 90 per cent mark. With a little added effort on the part of all personnel concerned, this percentage is expected to be exceeded.

The prognosis for the successful termination of the dental research project in Richmond is a hopeful one. All present findings and facts point toward worthwhile conclusions. The federal government, however, will be a member of the operating triumvirate only until the triple objectives are realized. Then the federal government will withdraw its financial support. The statistics gained from the study will be compiled by the United States Public Health Service and used as a basis of reference by other organizations that wish to establish dental care programs.

The State of Indiana at the present time favors a continuing dental program in Richmond after federal support is withdrawn, but whether the present study will show that the operating costs will be prohibitive for the combined state and local agencies to finance is yet to be determined.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Elementary school educators today are determining the needs of children as a basis for building a functional curriculum for the elementary schools. Public health surveys have established the fact that the dental needs of elementary school children are serious and require immediate attention. Therefore, dental health becomes a modern elementary curriculum problem.

I. SUMMARY

Dental caries is man's most common ailment. Scientists have not yet been successful in determining the cause of the disease. Caries can be responsible for a lowered physical efficiency, a poor school performance, and a malformed facial contour that may be the cause of a maladjusted personality.

The need for a program planned to counteract the effect of caries is demonstrated by the study of tooth mortality in the elementary schools of Hagerstown, Maryland. This study showed that not only was the dental situation serious at the moment, but it also showed that the incidence of caries increases with chronological age. The finding that girls had a greater number of dental defects than boys was explained by the fact that girls' teeth erupt earlier than boys' and

naturally are exposed to caries attack for a longer period of time. A fact that was brought out by the Maryland study is that a knowledge of annual increments of dental defects is necessary for the organization of a functional dental maintenance program.

The Westchester County, New York, schools furnish a good example of a practical dental hygiene program that can be carried on in any school regardless of the socioeconomic status of the community.

Dental science is responsible for two spectacular methods for experimentation with tooth decay. An activity program using one of these methods is being carried on in the schools of Aurora and Peoria, Illinois. Fifth and sixth grade children are brushing their teeth with an ammoniated dentifrice in order to gain experience with a medium that may possibly furnish evidence of arrest of caries.

Sodium fluoride is the other substance that is being used in experiments for the prevention of caries. Several researches are in progress using this medium. One of the earliest studies was made by Jordan who used three Minnesota elementary school communities as experimental groups. This study indicated that topical applications of sodium fluoride are effective in lowering the incidence of caries, but that to achieve maximum results, the minimum number of treatments should be more than three.

The United States Public Health Service, under the leadership of Knutson, conducted another investigation into the possibility of the use of sodium fluoride as a factor in the reduction of caries. This investigation was carried on in the elementary schools of Rochester, Minnesota. It followed a treatment pattern similar to that of Jordan's study with the exception that the later experiment did not include prophylaxis while Jordan's emphasized it. The United States Public Health Service experiment purposed to gather evidence to establish the optimum number of topical applications of sodium fluoride to lower the rate of attack by caries. A comparison of the facts brought out by the two parallel investigations indicates that four fluoride treatments preceded by dental prophylaxis are most likely to give the maximum reduction in caries incidence. Confirmation of the facts brought out by the two parallel studies awaits the results of studies now in progress.

A small-scale experiment in which the teeth of elementary school children are painted with sodium fluoride is in progress at Cambridge City, Indiana. This study is conducted by the Indiana State Board of Health.

An outstanding experiment in dental health programs is being carried on in the schools of Richmond, Indiana. It is a joint program sponsored by the federal, the state, and the local governments. A complete dental and educational staff

has charge of the yearly examination and treatment of approximately five thousand children. It is a pilot program designed to gather facts that will determine the ratio of dental personnel to population and to determine the dental care needs of school children on an annual increment basis. This study is not yet developed to the point where conclusive evidence can be quoted.

II. CONCLUSIONS

After the facts and statistics gained from authoritative sources for this inquiry were compiled and evaluated, the author submits the following general conclusions:

1. Dental health should be included as a part of the elementary curriculum because of the high incidence of caries among the elementary school population.
2. The elementary teacher has a definite responsibility for creating in the pupil a favorable attitude toward wise selection of food, regular care of the teeth, and regular trips to the dentist.
3. It is the duty of the elementary schools to support all experimental dental programs designed to improve the health of the school population.
4. The problem of dental health in the elementary school should continue to enlist the cooperation of all three levels of government, the federal, the state, and the local,

to the point where experimental programs in dental health will continue to be carried on in the schools.

5. The path to dental health is a complex curricular problem; it involves the interaction of the pupil, the home, the school, the community, and the dentist.

Recommendations for further study. The dental studies that are in the process of experimentation should present some pertinent information about the efficiency of the present programs in from three to seven years' time. A comparative tabulation of the findings would be of value to any school community in search of a method of procedure to meet dental needs. A study of the completed experiments should point the way toward a planned program for other school communities. A study of the federal research project in Richmond, Indiana, in four years from this date, should be especially valuable for this purpose.

A follow-up of the information gained from the Maryland study might possibly establish the reason why only at the age of ten, boys have a greater tooth mortality than girls of the same age.

Statistics available at the present time give no information about the length of time that topical applications of sodium fluoride are effective. A further study of this factor in dental health would be valuable as well as informative.

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