

A preliminary report is presented on a six-year study now in progress in Newburgh and Kingston, N. Y., to determine time and cost factors in regular dental care for school children in a fluoridated and a nonfluoridated area. Data presented for the first two years indicate that such programs can be considerably less expensive in communities benefiting from water fluoridation.

TIME AND COST FACTORS TO PROVIDE REGULAR, PERIODIC DENTAL CARE FOR CHILDREN IN A FLUORIDATED AND NONFLUORIDATED AREA

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THE caries prophylactic effect of fluoridated water ingested during the years of tooth development has been amply demonstrated.¹ The evidence is incontrovertible that fluoride, at the optimum concentration in potable water, will prevent the onset of dental caries by approximately 60 per cent among children who ingest this water starting early in life. These benefits continue into adult life. The caries prophylactic effect results in fewer teeth which succumb to caries, requiring fewer and less extensive fillings and fewer teeth to be extracted and replaced with artificial teeth. It has also been demonstrated that the hazard of malocclusion, which may result from early loss of teeth, is reduced appreciably.

As of December, 1963, there were approximately 47 million persons in 2,600 communities in the United States using controlled fluoridated water supplies. An additional seven and a half million people use potable water which is naturally fluoridated. This constitutes

36.6 per cent of the total United States population which uses public water supplies.² The problem of dental care, while considerably reduced by water fluoridation, remains one of appreciable magnitude. Students of this problem are in agreement that unless regular, periodic dental care is started early in life and continued throughout life, our adolescents, young adults, and older people will continue to present accumulated dental defects and their concomitant results.

While the prophylactic benefits of water fluoridation have been well documented there has been little documentation in the literature to point up the economic benefits which may accrue from fluoride caries prophylaxis. In general terms it should be self-evident that a reduction in the number of carious teeth, and in the concomitant results of extensive caries, will result in economic benefits to individuals, families, and the community. The extent of this saving, however, has not been well

Table 1—Number of Children Treated by Age, Race, and Sex, Newburgh and Kingston, N. Y.

	1962		1963 (First	
	(Initial Care Year)		Incremental Care Year)	
	Newburgh	Kingston	Newburgh	Kingston
Total	182	141	114	113
White	98	100	55	78
Male	55	52	27	40
Female	43	48	28	38
Nonwhite	84	41	59	35
Male	34	26	21	22
Female	50	15	38	13
5 year olds	73	56	—	—
White	36	39	—	—
Male	24	17	—	—
Female	12	22	—	—
Nonwhite	37	17	—	—
Male	10	10	—	—
Female	27	7	—	—
6 year olds	109	85	48	43
White	62	61	16	30
Male	31	35	10	13
Female	31	26	6	17
Nonwhite	47	24	32	13
Male	24	16	5	7
Female	23	8	27	6
7 year olds	—	—	66	70
White	—	—	39	48
Male	—	—	17	27
Female	—	—	22	21
Nonwhite	—	—	27	22
Male	—	—	16	15
Female	—	—	11	7

documented and certainly not in a controlled study.

This study was designed to permit detailed comparisons of the actual time and cost factors involved in providing regular, periodic dental care to children who have ingested waterborne fluorides from birth, with those who have not had the benefit of fluoridated water. This paper presents some preliminary data based on the first two years of a six-year study in Newburgh and Kingston, N. Y.

Study Plan

Since 1945, the water supply in Newburgh, N. Y., has been fluoridated to a concentration of 1-1.2 ppm F, while that in Kingston, N. Y., has remained fluoride deficient. During this time a continued cooperative relationship has been maintained between the New York State Department of Health and the city and school officials and dental societies in these communities.

A group of five- and six-year-old chil-

dren in each city was selected for the present study based on the criteria of residence in the poorest socioeconomic areas of the cities, and permission from their parents to participate. In addition, the children in the Newburgh group must have had continuous residence in that city from birth. The children included in the initial treatment groups in 1962 were pupils in the kindergarten and first grades of six Newburgh and three Kingston schools. During the first year, the necessary dental services were given to treat all accumulated carious defects in these children. In successive years, new groups of five- and six-year-old children are to be admitted to the study while those already under treatment will return for incremental care. It is planned to continue new admissions for about three years, but the study will continue for six years, at the end of which the original groups will be 11 and 12 years of age.

All dental treatment is provided in

the New York State Department of Health Dental Trailer, which is a modern, fully equipped, mobile dental office. During 1962 clinical treatment was given by a dental officer on loan to the department from the United States Public Health Service. In 1963 he was replaced by a staff dentist from the State Department of Health, and it is expected that this staff dentist will continue as the clinician for the balance of the study.

All children are given a complete clinical and bite-wing x-ray examination and a prophylaxis on their first visit each year. This examination is made without reference to a child's previous records. Services rendered include all those usually provided by a dentist in his office, except that no orthodontic treatment is given. Anesthetics are frequently used and quadrant dentistry is practiced where possible. High speed equipment is available and used as needed.

A detailed record is kept of the results

Table 2—Dental Caries Experience of Initial Care Groups by Age and Race, Newburgh and Kingston, N. Y., 1962

Age	Color	Newburgh				
		Per cent of Children Caries Free*	DMF Teeth per Child	Per cent DMF Teeth Requiring Treatment	df Teeth per Child	Per cent df Teeth Requiring Treatment
5	Total	47.9	0.03	100.0	2.5	89.0
	White	41.7	0.00	—	3.2	89.6
	Nonwhite	54.0	0.04	100.0	1.9	88.1
6	Total	33.9	0.09	87.5	2.8	94.7
	White	32.2	0.14	85.7	2.7	93.5
	Nonwhite	36.1	0.02	100.0	2.8	96.2
Kingston						
5	Total	14.2	0.12	66.7	5.7	94.0
	White	15.3	0.15	100.0	6.1	94.8
	Nonwhite	11.7	0.09	0.0	4.9	91.7
6	Total	16.4	0.65	100.0	5.6	89.4
	White	13.1	0.70	100.0	6.0	87.1
	Nonwhite	25.0	0.52	100.0	4.8	96.5

* Children who had no df or DMF teeth. (DMF includes decayed, missing (lost subsequent to eruption), or filled permanent teeth; df includes decayed or filled deciduous teeth.)

Table 3—Total Services and Mean Number of Services per Child, Initial Care Year, Newburgh and Kingston, N. Y., 1962

	Newburgh		Kingston	
	No.	%	No.	%
Total services*	425	100.0	757	100.0
Restorations	379	89.2	603	79.7
One-surface fillings	171	40.2	160	21.1
Two-surface fillings	184	43.3	340	44.9
Three or more surface fillings	24	5.6	103	13.6
Pulpotomy or pulpectomy	—	—	3	0.4
Extractions	46	10.8	86	11.4
Miscellaneous treatments†	—	—	65	8.6
Mean number of services* per child	2.3	—	5.4	—
Number of children	182	—	141	—

* Excluding clinical exams, x-rays, and prophylaxis.

† Cement bases, sedative fillings, postoperative care, etc.

of each dental examination as well as of the types and numbers of services rendered. The exact chair time required for each procedure is recorded using an electric clock-time card device.

Results

The number of children treated in Newburgh and in Kingston is shown in Table 1. The children are divided into those entering the study for the first time in 1962, and those returning for their second year of care in 1963. The original selection criteria resulted in a similar age distribution among the groups who began treatment in both cities in 1962. Despite losses to follow up no significant between-city age differences had arisen when these children returned for incremental care in 1963. However, no attempt was made to select participants on the basis of either sex or race, and imbalances in the composition of the treatment groups with respect to these variables are apparent. In particular, the proportion of non-white children among the Newburgh study groups remained considerably

higher than in Kingston, a fact which was predictable from documented differences in racial composition in the two cities as reported in the 1960 U. S. Census.³ Differences in dental caries experience between white and Negro children have been reported with Negro children usually having a lower caries experience.⁴ As a result, direct comparisons between the Newburgh and Kingston children in this study, in terms of services needed and the estimated cost of providing care, may not be entirely justified. However, the cost data presented in this report have been adjusted to eliminate any possible bias from this source.

Amount of Care Required

Of critical importance in planning any incremental dental care program is the volume of accumulated defects which must be corrected in those children first entering the program. Table 2 shows the extent of this backlog in terms of the number of df and DMF teeth per child diagnosed in those children who began treatment in 1962. As expected,

the mean number of df and DMF teeth per child in fluoridated Newburgh was considerably lower than in Kingston. Considering permanent and deciduous teeth together, the average Newburgh child admitted to treatment had fewer than three teeth attacked by caries, while in Kingston the average participant had over six df plus DMF teeth. Children in both cities had received little prior dental care, and over 90 per cent of teeth attacked by caries were unrestored. In Newburgh, however, 41 per cent of children required no treatment whatever, while in Kingston only 15.5 per cent needed no care.

The actual number of services, by type, required to complete all needed first year treatment in these groups is shown in Table 3. Comparisons of the proportion of simple one-surface fillings with that of compound (two or more surface) fillings and extractions made in each city during the first treatment-year indicates that carious defects were not only more numerous in Kingston, but also required relatively more extensive operative procedures for correc-

tion. In addition, those children in Kingston who were in need of treatment required, on the average, more than twice as many services per child (5.4) as did the children treated in Newburgh (2.3 services per child).

When these children returned for their first year of incremental treatment in 1963 their numbers had been substantially reduced. This was due to the loss of children who transferred from public to parochial schools after completing kindergarten, and of those who moved away from the study areas as a result of urban renewal programs. The latter reason was especially true in Newburgh. Of those children who remained in the study, the proportion who needed no treatment had now increased to 58.8 per cent in Newburgh, and to 28.3 per cent in Kingston. The per cent distribution of the types of services rendered to these incremental care groups (Table 4) suggests that those new defects requiring treatment were less severe in both cities, as two or more surface fillings and extractions comprised a considerably smaller proportion of the en-

Table 4—Total Services and Mean Number of Services per Child, First Incremental Care Year, Newburgh and Kingston, N. Y., 1963

	Newburgh		Kingston	
	No.	%	No.	%
Total services*	96	100.0	204	100.0
Restorations	87	90.6	179	87.7
One-surface fillings	31	32.3	51	25.0
Two-surface fillings	50	52.1	122	59.8
Three or more surface fillings	6	6.2	6	2.9
Pulpotomy or pulpectomy	—	—	—	—
Extractions	7	7.3	25	12.3
Miscellaneous treatments†	2	2.1	—	—
Mean number of services* per child	0.8	—	1.8	—
Number of children	114	—	113	—

* Excluding clinical exams, x-rays, and prophylaxis.
 † Cement bases, sedative fillings, postoperative care, etc.

Table 5—Mean Chair Time (Minutes) per Child by Race and Sex, Newburgh and Kingston, N. Y.

	1962 (Initial Care Year)		1963 (First Incremental Care Year)	
	Newburgh	Kingston	Newburgh	Kingston
Total	76.9	117.3	25.6	35.9
White	86.6	118.4	31.2	35.5
Male	86.5	124.7	28.6	32.4
Female	86.8	111.4	41.1	38.7
Nonwhite	65.6	114.7	20.3	36.9
Male	61.5	116.1	15.6	37.8
Female	68.4	112.2	22.9	35.4

tire treatment program than in 1962. The most distinct improvement was noted in the number of services needed for each child who required any incremental treatment. These had decreased to an average of 0.8 per child in Newburgh, and 1.8 per child in Kingston.

Economic Aspects of Providing Regular Periodic Care

The actual minutes of chair time required to provide both initial and incremental care are, of course, dependent upon more factors than simply the number and types of operations performed. Certainly the working speed and habits of the individual clinician, and the cooperation of the patient are of critical importance, and results in one situation may not apply to another. Furthermore, in the present study it was necessary to change clinical personnel at the end of the first year, so that the initial and the first incremental year of care were provided by different dentists. During 1962, the clinician spent a considerable amount of time on child management in both cities. The second clinician did not find this necessary, no doubt partly because in 1963 the children were already familiar with the dental trailer and had been treated previously. The actual minutes of chair time recorded

are, nevertheless, presented in Table 5, because it is felt that they provide a qualitative, though not necessarily precise basis for comparison of the professional time required to provide treatment to children in a fluoridated and nonfluoridated community.

The financial basis for most clinical dental treatment in this country remains as a fee per service rather than a fee per unit of time. Although in private dental practice the fee associated with each service may be flexible, in public health care programs a standard fee-for-service schedule has traditionally been employed. The actual dollar costs of providing treatment are therefore considered to be the most meaningful statistics to be developed in the present study as they are not apt to be greatly influenced by individual or local differences. The fee schedule now in use by the New York State Department of Health provides fees of \$4 for one-surface fillings, \$7 for two-surface fillings, \$10 for three or more surface fillings, and \$5 per tooth for extractions. Using this schedule and the actual number and types of services rendered, the costs of providing care to both initial and incremental care groups were computed. These are shown in Table 6 and in Figure 1. Costs for those groups underlined in Table 6 have been adjusted

for age, race, and sex to the entire population of five- and six-year-old children in New York State in 1960.

These data show that for initial care the cost was more than twice as much in the nonfluoridated area. The cost for incremental care is reduced to almost one-third of the cost for initial care in each city but the comparative cost for incremental care is about twice as much in the nonfluoridated city.

Discussion

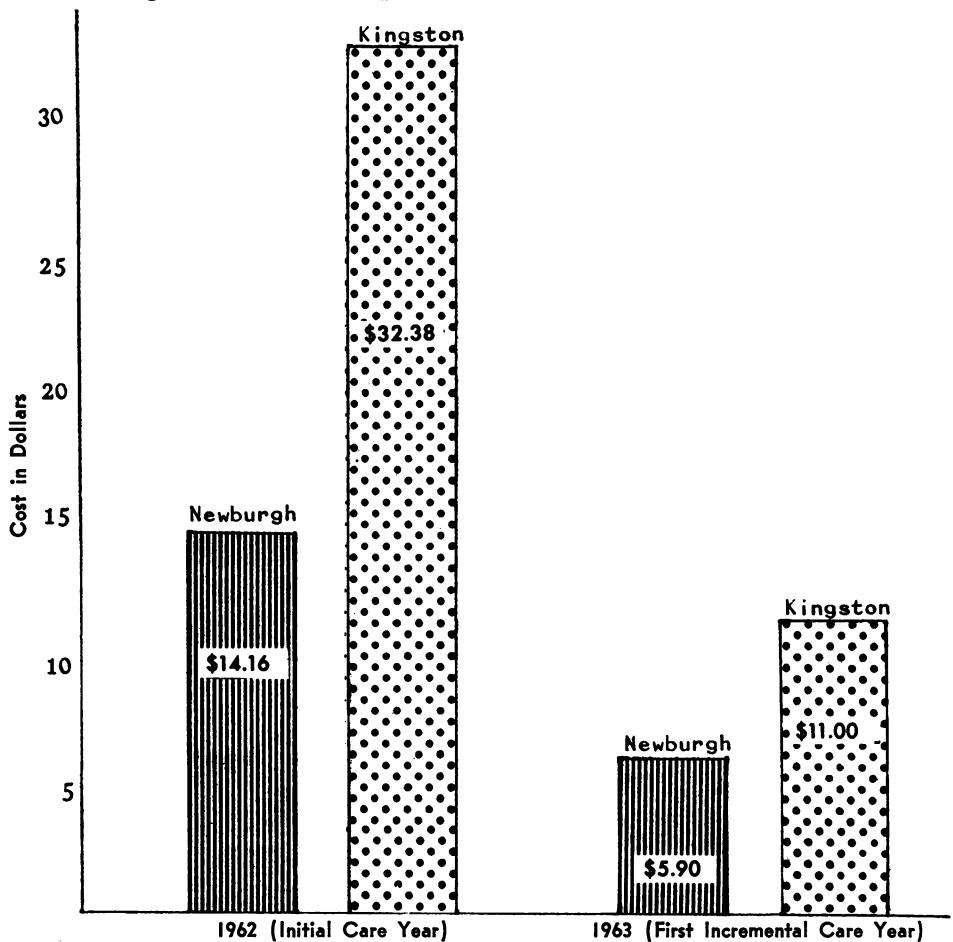
Incremental dental care studies among children have been reported and demonstrate that with this kind of program it should be possible to control dental caries so that these lesions do not progress to require extensive dental care or result in tooth loss.⁵ The preliminary data in the present study add further confirmation to this thesis, as the new

Table 6—Mean Cost per Child* by Age and Race and Sex, Newburgh and Kingston, N. Y.

	1962 (Initial Care Year)		1963 (First Incremental Care Year)	
	Newburgh	Kingston	Newburgh	Kingston
Total	\$14.16	\$32.38	\$5.90	\$11.00
White	14.48	32.79	6.21	10.78
Male	15.50	35.12	6.33	8.79
Female	13.43	30.37	6.01	12.86
Nonwhite	11.37	28.85	3.23	12.84
Male	10.88	29.09	1.57	10.86
Female	11.85	28.60	4.89	14.83
5 year olds	13.52	32.18	—	—
White	13.98	32.91	—	—
Male	13.96	36.00	—	—
Female	14.00	29.68	—	—
Nonwhite	9.68	25.99	—	—
Male	7.80	26.40	—	—
Female	11.56	25.57	—	—
6 year olds	14.82	32.59	4.17	11.72
White	15.01	32.67	4.46	11.71
Male	17.10	34.20	4.10	8.62
Female	12.84	31.08	4.83	14.94
Nonwhite	13.19	31.94	1.76	8.31
Male	14.21	32.00	1.00	8.29
Female	12.17	31.87	2.52	8.33
7 year olds	—	—	7.69	10.24
White	—	—	8.02	9.82
Male	—	—	8.65	8.96
Female	—	—	7.36	10.71
Nonwhite	—	—	4.82	13.99
Male	—	—	2.19	13.27
Female	—	—	7.45	14.71

* Costs for underlined groups are adjusted for age, sex, and race using a standard population of five- and six-year-old children. (New York State, 1960 U. S. Census)

Figure 1—Mean Cost* per Child, Newburgh and Kingston, N. Y.



* Costs are adjusted for age, sex, and race using a standard population.

lesions found in the incremental year of care (1963) were fewer and less extensive in both cities. Klein and Palmer have reported on the disparity between new incremental carious lesions and the annual care rendered to children by dentists.⁶ It is this disparity which leads to the accumulation of dental defects and their serious sequelae as noted in our present generation of adults.⁷

It is hoped that the data from this six-year study will not only demonstrate that a program of incremental dental care for children will result in a

markedly reduced hazard of extensive dental caries and its sequelae, but will make it possible for families on very modest incomes to provide this care for their children.

It should also be of interest to communities which must assume responsibility for providing needed health services to their citizens who cannot purchase it privately, that this kind of program may make it economically feasible.

Still others who may find the results of this study of special interest to them are those concerned with providing

Table 7—Per cent Distribution by Age, Race, and Sex of a Standard Population (New York State, 1960 U. S. Census)

	Total	Age	
		Five	Six
Total	100.0	51.0	49.0
Male	50.9	26.0	24.9
Female	49.1	25.0	24.1
White	89.6	45.6	44.0
Male	45.7	23.3	22.4
Female	43.9	22.3	21.6
Nonwhite	10.4	5.4	5.0
Male	5.2	2.7	2.5
Female	5.2	2.7	2.5

health insurance. Both commercial and nonprofit insurance agencies are showing increasing interest in prepaid dental care plans. Dental care is a relatively new addition to health insurance plans for which few actuarial data are available. The Public Health Service has just published a Digest of Prepaid Dental Care Plans and reports that in 1963 there were 1,176,385 persons in 305 privately sponsored groups in the United States who had dental coverage. These figures include only those whose coverage meets certain minimum benefits.⁸

Still another benefit which may accrue from an incremental dental care program is a lasting educational effect resulting in the establishment of a positive attitude toward good dental health habits. Recently reported data indicate that children exposed to regular periodic dental care in an organized community program tend to continue in the established pattern after leaving the program.⁹

A determination of what constitutes a reasonable investment in the dental health of children will vary from person to person and from community to community, requiring as it does a value

judgment, rather than a reference to any established standards. It is felt, however, that the present study will at least make it possible to measure the extent of the investment that may be necessary to maintain a high standard of care among these age groups. It should be kept in mind that the children in this study are deliberately being selected from the poorest sections of the communities involved, and very few had any prior dental treatment. The cost of a similar program among children who had received dental care during pre-school years might be somewhat lower than established here. In any case it seems very clear that the expense for care will be greatly reduced if the community has previously fluoridated its water supply. We do not hesitate to say that we hope, as a result of this study, to be able to add a simple and demonstrable dollar value to the many benefits of fluoridation already recorded.

Summary

A six-year study is in progress in Newburgh and Kingston, N. Y., to determine the time and cost factors in a program of regular, periodic dental care for school children in a fluoridated and a nonfluoridated area. New groups of five- and six-year-old children will be admitted to treatment annually during the first three years of the study while those previously treated will return each year for the correction of new defects.

Data have been presented for the first two years of the study. These demonstrate that in the nonfluoridated area (Kingston) the cost for providing initial dental care was more than twice as high, and for incremental care, just about twice as high as in the fluoridated area (Newburgh). In both cities, the cost for incremental dental care was only about one-third that of initial care.

These preliminary results suggest that such a program may prove to be both

effective and feasible, and will be considerably less expensive in communities with the benefit of water fluoridation.

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