Identifying Children with Dental Care Needs: Evaluation of a Targeted School-based Dental Screening Program

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Abstract

Objectives: *It has been suggested that changes in the distribution of dental caries mean that targeting high-risk groups can maximize the cost effectiveness of dental health programs. This study aimed to assess the effectiveness of a targeted school-based dental screening program in terms of the proportion of children with dental care needs it identified.* ***Methods:*** *The target population was all children in junior and senior kindergarten and grades 2, 4, 6, and 8 who attended schools in four Ontario communities. The study was conducted in a random sample of 38 schools stratified according to caries risk. Universal screening was implemented in these schools. The parents of all children identified as having dental care needs were sent a short questionnaire to document the sociodemographic and family characteristics of these children. Children with needs were divided into two groups: those who would and who would not have been identified had the targeted program been implemented. The characteristics of the two groups were compared.* ***Results:*** *Overall, 21.0 percent of the target population were identified as needing dental care, with 7.4 percent needing urgent care. The targeted program would have identified 43.5 percent of those with dental care needs and 58.0 percent of those with urgent needs. There were substantial differences across the four communities in the proportions identified by the targeted program. Identification rates were lowest when the difference in prevalence of need between the high- and low-risk groups was small and where the low-risk group was large in relation to the high-risk group. The targeted program was more effective at identifying children from disadvantaged backgrounds. Of those with needs who lived in households receiving government income support, 59.0 percent of those with needs and 80.1 percent of those with urgent needs would be identified.* ***Conclusions:*** *The targeted program was most effective at identifying children with dental care needs from disadvantaged backgrounds. However, any improvements in cost effectiveness achieved by targeting must be balanced against inequities in access to public health care resources. [J Public Health Dent 2004;64(2):63-70]*

Key Words: dental screening, children, targeted programs, epidemiology.

In the past few decades, there has been a significant change in the epidemiology of dental caries in child populations (1). While the disease remains a major public health problem, it is no longer universal, with an increasing proportion of children remaining caries free. Moreover, studies in both the United States (2) and the United Kingdom (3) indicate that 20 to 25 percent of children experience the majority of the decay that now occurs.

The decline in caries prevalence and its uneven distribution in the child population, along with other changes—such as differences in caries risk between teeth and tooth surfaces, a slowing of the rate of progression of the caries lesion, and evidence that those susceptible remain at risk beyond the early adolescent years—reflect a number of important implications with respect to the prevention and treatment of the disease (1). One outcome of the changing epidemiology of caries has been the development of guidelines for the use of preventive technologies such as pit and fissure sealants (4-7). Since the indiscriminate use of sealants is not considered to be cost effective (2,8-10), it is recommended that they be applied to selected surfaces of selected teeth in children deemed by their caries history to be at "high" risk. Similarly, since the resources for community-based programs are usually limited, it has been recommended that these be targeted at populations or communities in greatest need (5). For example, some public health sealant programs are targeted at lower socioeconomic schools with children with a previous history of caries and/or teeth with deep pits and fissures selected to receive sealants (11). It has also been suggested that school-based screening programs, which are intended to identify children in need of treatment and stimulate demand for dental care, should, as a matter of principle, be targeted at areas or groups where disease levels are high and/or access to dental care limited (12).

While the targeting of high-risk populations has a certain appeal, Brown and Selwitz (1) have suggested that the uneven distribution of disease within the child population provides only limited opportunities to improve the cost effectiveness of community-based programs. Targeting is less effective when differences in the prevalence of disease between high- and low-risk groups are not large and/or where the size of the high-risk group is small in comparison to the low-risk group. In these situations, targeting

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high-risk groups means that large numbers of high-risk individuals in low-risk groups are missed. Similarly, Tickle (13) and Tickle et al. (14) have argued that the geographic distribution of high-risk children is such that targeting prevention programs at economically deprived communities is unlikely to be effective since children at high risk of decay are not confined to such communities. If a reduction in the total burden of dental decay is the aim, then whole population approaches are to be recommended. Batchelor and Sheiham (15) also recommend whole population preventive programs because the majority of new caries lesions occur in individuals who would not be reached by programs that were confined to high-risk individuals.

In the Canadian province of Ontario, dental public health programs are provided by the dental divisions of 37 municipally based public health departments. These programs are delivered to children aged 5 to 13 years and include screening, referral, prevention, and, in some geographic locations, clinical care. The aim of the dental screening program is to identify children with selected dental care needs and ensure that appropriate clinical and preventive care is provided to those children. The parents of children identified as being in need are informed, and these children are followed up to ensure that care is provided within the public or private dental care systems. Provincial child welfare legislation stipulates that parental failure to ensure care for children with urgent dental care needs constitutes child neglect and such cases can be referred to the Children's Aid Society of Ontario, who have the power to compel parents to provide necessary care.

The specific objectives of the dental screening program are: First, to identify children who are eligible for clinical preventive dental services, such as sealants and/or topical fluoride treatments provided free of charge under a program jointly funded by the Public Health Department and the provincial Ministry of Health. Second, to identify children with urgent dental care needs who are eligible for treatment under the province's Children in Need of Treatment program. This program covers the costs of dental care for children whose parents are not covered by private or public dental insurance schemes who declare that the provision of such care would result in financial hardship. Consequently, the screening process acts as a gateway to other services delivered to Ontario children by the public and private dental care sectors and to public funding for dental care. The criteria for identifying which children have preventive and urgent needs are determined by the Public Health Branch of the Ontario Ministry of Health and issued to public health departments in the form of screening protocols.

The requirement that public health departments identify and ensure necessary care to children with preventive and urgent dental care needs is mandated by provincial legislation (16). Consequently, these are designated as mandatory programs. Individual public health departments can, at their discretion, develop and deliver any additional oral health promotion or treatment programs consistent with the needs of the populations they serve. Accordingly, many public health departments screen for other dental care needs, such as nonurgent restorative care, scaling, and oral prophylaxis. A third objective of the screening program is to identify children in need in a cost-effective manner.

Prior to the 1997–98 school year, public health departments provided dental screening to children aged 5 years (junior and senior kindergarten), 7 years (grade 2), 9 years (grade 4), 11 years (grade 6), and 13 years (grade 8) in every junior high school on an annual basis so that each child was screened every other year. During the 1997–98 school year this mandatory universal approach was changed by the Ministry of Health to a targeted approach. The aim was to reduce program costs by eliminating the requirement to screen schools likely to contain few children in need of dental care.

Under the terms of the targeted program, schools are classified into risk strata based on the caries experience of children in junior and senior kindergarten (JK, SK). JK and SK students in all schools are screened and schools are classified as low risk if 0 percent to 9.4 percent of these students have two or more decayed teeth, medium risk if 9.5 percent to 13.9 percent have two or more decayed teeth, and high risk if 14.0 percent or more have two or more decayed teeth. In schools deemed to be high risk, children in grades 2, 4, 6, and 8 are then screened, which is consistent with the prior universal approach. In medium-risk schools, additional screening is conducted in grades 2 and 8 only, while in low-risk schools no further screening program is implemented. These targeting criteria were based on data on the prevalence of caries in the Ontario child population.

A preliminary study conducted in the final year of the universal program suggested that many children in need of dental care would be missed by the targeted approach. Consequently, some children who are excluded from the screening program on the basis of the risk designation of the school they attended may fail to access the preventive and treatment services they need and public funds that pay for dental care. The study reported in this paper replicates and extends this initial research. The main aims of the study were: (1) to estimate the proportion of the population eligible for public dental health services (i.e., children in junior and senior kindergarten and grades 2, 4, 6, and 8) who would be identified by the universal screening program as having restorative and preventive dental care needs; (2) to determine what proportion of those deemed to have needs would be identified by the targeted screening program; (3) to compare the personal and family characteristics of children deemed to have dental care needs who would and would not be identified by the targeted program; (4) to determine whether more of these children would be identified by modifying the targeting criteria; and (5) to determine the resource implications of modifying the criteria.

Methods

Study Locations. The study was undertaken in four Ontario communities: the York region, the city of Hamilton, the Durham region, and Thunder Bay. While this is not a random sample of Ontario communities served by public health departments, they cover populations living in metropolitan, urban, rural, and northern communities. These communities were selected because of the capacity of the dental divisions of their public health departments to undertake the research project described below.

Study Population and Sampling

Design. The study population was all children in junior and senior kindergarten and grades 2, 4, 6, and 8 who attended schools in the areas served by the four participating public health departments. Prior to the implementation of the screening program, parents are informed and may refuse permission for their child to be screened.

The sampling design used to select children for the study was a stratified random cluster sample. In each area, schools were stratified by risk level based on 1999–2000 screening data. In each area nine schools were randomly selected to take part in the study—three high risk, three medium risk, and three low risk. Where necessary, additional schools were sampled to ensure that adequate numbers of children were included in the study.

In the selected schools, universal screening was undertaken. That is, all children in the grades designated above (JK, SK, 2, 4, 6, and 8) were screened, regardless of the school's risk level, using a common dental screening protocol. Children whose parents refused consent for screening, children who refused to be screened, or children absent from school on the day(s) the screening program was undertaken were excluded.

Data Collection. The dental screening was undertaken by experienced dental hygienists employed by the four participating public health departments under the general supervision of each department's dental director. The screening consisted of a visual inspection and was conducted with a mirror and tongue depressor only. Prior to data collection, all hygienists were trained with respect to diagnostic classifications, criteria, and coding procedures using a detailed Screening Diagnostic and Coding Manual.

The diagnostics classifications and the criteria used to assign diagnostic categories were identical to those described in Ministry of Health protocols and used routinely by the participating public health departments when implementing their screening programs. For example, for the purposes of the screening program, a child is deemed to be in urgent need if any of the following criteria apply:

- Pain—Conditions that are presently causing pain or have caused frequent pain recently.
- Infection—Visually apparent abscesses or swellings, and/or acute gingival conditions requiring immediate attention (e.g., ulcerative gingivitis and any suppurative gingival conditions).
- Hemorrhage—Hemorrhage associated with trauma or accidents or subsequent to dental surgery.
- Trauma—To premaxilla, maxilla, and/ or mandible that does or may affect the teeth and supporting structures.
- Pathology—Any pathological condition of the hard or soft tissues where further investigation is recommended, and developmental anomalies or pathology of a potentially serious nature (excluded are abnormal placement of successor teeth and cleft lip and palate).
- Caries—Large open lesions in permanent teeth and or in crucial primary teeth well into dentine (which must be visible), or in crucial primary teeth that if left untreated, the child might be deemed in a state of dental neglect and thus eligible for referral to a Children's Aid Society under the Family and Children's Services Act. The lesions should be obvious enough that they can be seen readily by the parent or guardian.

Because of the numbers of hygienists involved in data collection and their geographic dispersal and because the diagnostic classifications are fairly crude, calibration was not undertaken.

For each child screened, data on the following parameters were entered onto a screening report form: name, geographic location, school, risk level of school when sampled, sex, dmft/DMFT scores, nonurgent restorative need, need for scaling, need for sealants, need for topical fluoride, urgent treatment need. The last five were scored using a simple yes/no format. Children were designated as having a dental care need if they had a yes code for one or more of these parameters. Children with a yes code for one or more of the last three were designated as having a need for mandatory programs.

The names of all children identified as having dental care needs were abstracted from the Screening Report Forms by Public Health Department staff and a separate listing compiled. The parents of these children were informed of the findings of the screening examination and advised as to options with respect to dental treatment for their child. They were also sent a letter explaining the aims and objectives of the study and a short two-page questionnaire. A stamped, addressed return envelope also was included. The questionnaire collected the following information: availability of a regular dental care provider, time since child's last dental visit, experience of toothache/other tooth-related pain in last three months, parental rating of child's dental health, place of birth of child, family size, dental insurance coverage of family (private or government program), educational attainment of child's mother, receipt of government income support, and household income.

When completed, the questionnaire was returned to the Public Health Department from which it was sent. Data on the dmft/DMFT values and dental care needs were abstracted from the screening database and recorded in a special section on the questionnaire. The child's name and any other identifiers were then removed from the questionnaire.

After two weeks, parents who did not return a questionnaire were telephoned and invited to participate in the study. Those who gave their consent to participate were interviewed over the telephone. Where possible, non-English-speaking parents were interviewed in their native language. Questionnaires completed over the telephone were then subjected to the procedures described in the paragraph above. Once the questionnaire phase of the study was complete, screening data were added to a blank questionnaire for each child whose parent did not respond or refused to participate. This was to facilitate nonresponse bias analysis. All questionnaires were forwarded, without identifiers, to the investigators for data entry.

These research procedures, which were designed to ensure confidentiality, were approved by the University of Toronto Human Subjects Certification Committee.

Databases and Data Analysis. Two databases were created. The first contained dental screening data for all children who were screened and the second contained parental questionnaire and dental screening data for all children who were identified as having a need for dental care, irrespective of whether or not a parental question-

naire was returned.

Because equal numbers of schools were randomly selected from the three risk strata, and the strata differ in size, the data were weighted to take account of the differential probabilities of selection of schools and children. These probability weights were calculated for each area and each risk stratum by dividing the total number of children in the designated grades for all schools in the stratum by the number of children in those grades for those schools sampled from the stratum. When questionnaire data were used in the analysis, further weighting was undertaken to account for nonresponse bias (17). Data analysis was undertaken using the survey estimation procedures from Stata 7 (18). This statistical package automatically adjusts standard errors to account for the stratification and clustering components of the sampling design (19).

Using the database for all children screened, simple descriptive statistics were generated concerning dental caries experience and needs for dental care. These were produced for the sample as a whole and for each of the four areas in the study. Analysis was also undertaken by risk level of school to explore the validity of the risk classification. Using the second database, children whose parents did and did not return a questionnaire were compared with respect to their clinical characteristics. The results of these analyses were used to derive the nonresponse weights (17). Then, using information on the risk level of the school and grade, children with dental care needs were divided into two groups: those who would be identified by the targeted approach and those who would not. The clinical and personal/family characteristics of these two groups were compared using *t*-tests and chi-square tests.

Results

Number of Subjects. The study was conducted in 38 schools, two more than the original sample size of 36 schools. At the time of screening 10 were designated high risk, 12 medium risk, and 16 low risk. Screening data were obtained on 8,613 children, 2,062 of whom were deemed to have dental care needs. Parental questionnaires were obtained for 1,119 or 54.3 percent of those with needs. The response rate was 57.0 percent for parents of children with a dmft/DMFT score of 2 or less and 48.6 percent for parents of children with a dmft/DMFT score of 3 or more. The reciprocal of these proportions was used to calculate nonresponse weights for the questionnaire data (17). Consequently, when analyzing these data, the weights used to adjust for different probabilities of selection were multiplied by these nonresponse weights as described by Aday (17).

Caries Experience and Dental Care Needs. Almost two-thirds of the target population was caries free and one-tenth had one or more decayed teeth (Table 1). Examination of the distribution of dmft and DMFT scores indicated that dental decay was highly polarized in this population, with 80 percent of decay experience appearing in 20 percent of the children. The oral health of children in Thunder Bay, a northern community, was significantly worse than that of the other communities located in the south of the province. These differences by geographic location persisted after controlling for the age of the children in the four areas. Overall, 21.0 percent were identified as having dental care needs with 16.4 percent identified as having needs for the mandatory programs delivered by the participating health departments. Almost one-tenth, 7.4 percent, were judged to need urgent treatment. Again there were significant differences across the four areas in the percentage of children identified as having dental care needs (Table 2).

Percent with Dental Care Needs Identified by Targeted Screening Program. Overall, 43.5 percent of chil-

TABLE 1
Dental Caries Experience by Geographic Area: Weighted Estimates

Population	Unweighted *N*	% Caries Free	Mean dmft/DMFT Score	% w/1 or More Decayed Teeth
All subjects	8,613	64.5	1.27	11.8
Durham region	2,441	66.0	1.11	11.8
York region	2,721	67.3	1.10	10.9
Hamilton	2,189	64.1	1.24	9.5
Thunder Bay	1,262	48.5	2.61	21.3
P-value		<.05	<.01	<.05

TABLE 2
Percent with Dental Care Needs by Geographic Area: Weighted Estimates

		Need				
Population	Unweighted *N*	Dental Care	Mandatory	Urgent	Sealant	Topical Fluoride
All subjects	8,613	21.0	16.4	7.4	7.1	9.9
Durham region	2,441	24.2	19.1	3.2	12.0	8.5
York region	2,721	15.7	13.6	9.4	2.9	9.8
Hamilton	2,189	11.0	10.0	7.0	1.8	8.7
Thunder Bay	1,262	55.9	34.1	15.0	19.9	18.4

All differences in prevalence of need across geographic areas significant: $P<.05$.

TABLE 3
Percentage of Children with Needs Who Would Have Been Identified by Targeted Screening Program: Weighted Estimates

	Need				
	Dental Care (*n*=2,062)*	Mandatory (*n*=1,582)	Urgent (*n*=726)	Sealants (*n*=680)	Topical Fluoride (*n*=954)
All children	43.5	46.6	58.0	36.1	52.9
Geographic location					
Durham region	39.1	38.5	63.1	31.4	49.4
York region	37.5	40.4	44.3	18.9	41.3
Hamilton	57.7	61.7	70.6	34.0	66.3
Thunder Bay	50.9	62.9	75.6	57.7	68.6
Economically disadvantaged children					
Low-income households	56.3	60.5	70.7	59.7	64.3
Households w/ income support	59.0	65.3	80.1	51.4	74.6

*Unweighed *n*'s.

dren deemed to have dental care needs would have been identified by the targeted program, as would 46.6 percent of those eligible for mandatory programs. Almost three-fifths, 58.0 percent, of those with urgent treatment needs would be identified (Table 3).

There were marked differences between the four geographic areas in the proportion of children who would be identified. In the York region, 37.5 percent of those with dental care needs, 40.4 percent with mandatory needs, and 44.3 percent of those with urgent needs would be identified. The corresponding proportions in Thunder Bay were 50.9 percent, 62.9 percent, and 75.6 percent (Table 3).

Validity of Risk Strata Designation. Schools, and therefore children attending those schools, are allocated to risk strata based on decay rates among students in JK and SK. Analysis of the proportions with needs by risk stratum suggests that this allocation process has a certain validity. That is, in schools designated as high risk, 31.3 percent had dental care needs, and 13.2 percent had urgent treatment needs. The corresponding proportions for medium-risk schools were 29.3 percent and 11.0 percent, while for low-risk schools they were 17.1 percent and 5.4 percent, respectively. Although these differences between risk strata were statistically significant, they were relatively small in absolute terms.

Differences in the relative sizes of the three risk strata also account for differences in identification rates across geographic areas. In the York region, the area with the lowest identification rate, 2.3 percent of children were in high-risk schools, 17.7 percent in medium-risk schools, and 80.0 percent in low-risk schools. In Thunder Bay, the area with the highest identification rate, the distribution was 29.6 percent, 33.2 percent, and 37.1 percent. Consequently, in the York region, although the prevalence of dental care need in low-risk schools was only 14.4 percent, these schools contained 73.3 percent of cases. In Thunder Bay, the prevalence of need in low-risk schools was much higher at 56.1 percent, but these schools contained only 37.2 percent of cases.

TABLE 4
Personal and Family Characteristics of Children with Dental Care Needs: Weighted Estimates

	Children w/ Dental Care Needs (*n*=2,062)*	Children w/ Urgent Needs (*n*=726)*
% with no regular source of dental care	20.1	29.8
% not making dental visit in last year	24.6	38.5
% without dental insurance	30.7	41.1
% from households receiving government income support	9.9	11.7
% from low/income households (<$20,000 per annum)	17.9	20.0

*Unweighted *N*.

Personal and Family Characteristics of Children with Dental Care Needs. Of those found to have dental care needs, one-fifth had no regular source of care and one-quarter had not made a dental visit in the last year. When those with urgent treatment needs were considered, the proportions were 29.8 percent and 38.5 percent, respectively. In addition, almost one-third of all those with needs and four-fifths of those with urgent needs came from households not covered by dental insurance (Table 4). Further analysis indicated that children with needs who came from economically disadvantaged backgrounds were the least likely to have a regular source of dental care or to have seen a dentist in the previous year. For example, 52.4 percent of those from low-income households—i.e., annual incomes of less than $20,000—had not seen a dentist in the previous year, compared to 19.9 percent of those from households whose annual income was more than $20,000 per annum ($P<.0001$). Similarly, 48.5 percent of children from

households participating in government income support programs had not had a dental visit in the last year, compared to 22.3 percent of those from households whose incomes were too high to qualify for such support ($P<.001$).

These data suggest that economically disadvantaged children with dental care needs are likely to be the prime beneficiaries of a screening program that ensures access to preventive and restorative services. Consequently, estimates of the proportion of those with needs who would have been identified by the targeted program were calculated for children from low-income households.

Data in Table 3 suggest that the targeted program would have been more successful at identifying children with needs who came from disadvantaged backgrounds. Among children from low-income households, 70.7 percent of those with urgent treatment needs would be identified. When children from households receiving government income support (the most economically disadvantaged group) were considered, 80.1 percent of those with urgent needs would be identified. A greater proportion of economically disadvantaged children with needs would have been identified since the majority, 66.2 percent, attended medium- and high-risk schools where grades 2 and 8 and 2, 4, 6, and 8, respectively, are screened in addition to JK and SK.

Another way of examining the outcome of the targeted screening approach is to examine the characteristics of children who would not have been identified. Among this group, only 3.2 percent were children with urgent needs from low-income households, and only 1.2 percent were children with urgent needs from households receiving government income support.

Modifying Targeting Criteria. Since the targeted approach was relatively less successful when all children with needs were considered, the question arises as to whether identification rates could be improved by modifying the targeting criteria and the resource implications of so doing. The targeting criteria currently employed consist of four components: (1) the grades initially screened to allocate a school to a risk stratum (currently JK and SK); (2) a disease parameter (currently two or more decayed teeth); (3) cut-off points based on the prevalence of the disease parameter (currently—low risk: 0–9.4 percent; medium risk: 9.5–13.9 percent; high risk: 14.0 percent or more); and (4) the additional grades that are screened based on the risk designation of the school (currently—high risk: 2, 4, 6, 8; medium risk: 2, 8; low risk–none). Each of these components can be modified and will affect the distribution of schools across risk strata, the relative size of the risk strata and the percentage of students with needs who would be identified. The necessity to weight data meant that the effect on identification rates of modifications that change the risk designation of the schools in the sample could not be examined with the current data set.

However, one relatively simple way of increasing identification rates, which could be assessed using the current data set, is to screen additional grades in medium- or low-risk schools. Examination of distributions indicated that 16.4 percent of all children with needs and 17.3 percent of all children with urgent needs were in grade 2 in low-risk schools. By screening children in grade 2 in low-risk schools, identification rates would rise from 43.5 percent to 59.9 percent for the former and from 58.0 percent to 75.2 percent for the latter. Under universal screening, an estimated 134,736 children would be screened. Using the current targeted approach 60,356 would be screened, while the inclusion of grade 2 children in low-risk schools means that 76,506 would be screened. This would require an increase of approximately 27 percent in the resources allocated to the screening program.

However, these aggregate data mask considerable variation in the effect of screening grade 2 in low-risk schools (Table 5). In York, the proportion of children with urgent needs identified would rise from 44.3 percent to 69.2 percent, an increase of 24.9 percent, while in Thunder Bay it would increase by 8.0 percent, from 75.6 percent to 83.6 percent. The resource implications were an increase of 38 percent for York and 9 percent for Thunder Bay. Again, these differences are solely due to differences in the sizes of the low-risk group in the two areas.

Discussion

It has been suggested that one way of improving the cost effectiveness of community-based programs is to target populations at the highest risk of disease. Consequently, the school-based dental screening program implemented by public health units in Ontario was changed from what was, in effect, a universal program to one in which the extent of screening undertaken within a school was determined by the risk of disease among its child population. A school's risk level, and that of the children it contained, was determined by screening children in JK and SK and the proportion with two or more decayed teeth used to designate the school as high, medium, or low risk. A school's risk level determined which grades in addition to JK and SK were then screened. These additional grades meant that in high-risk schools the original universal program was implemented, while in low-risk schools no further screening was undertaken.

TABLE 5
Percent of Children with Needs Identified if Those in Grade 2 in Low-risk Schools Were Also Screened: Weighted Estimates

Population	Need			% Increase in Number Screened
	Dental Care	Mandatory	Urgent	
All children	59.9	65.8	75.2	26.8
Geographic location				
Durham region	60.0	63.1	77.8	31.1
York region	59.0	63.5	69.2	38.2
Hamilton	67.3	71.2	80.2	16.0
Thunder Bay	57.2	71.2	83.6	9.0

One implication of this targeted approach is that high-risk individuals who attend low-risk schools would, more than likely, be missed and may not as a result access the preventive and treatment services that they needed. The study undertaken here was designed to estimate the proportion and characteristics of children who met program criteria for dental care needs, and who were therefore eligible for public dental health services, who would and would not be identified by the targeted approach.

The data indicate that almost three-fifths of all children with such needs and two-fifths of children with urgent needs would be missed by the targeted program as currently designed. The reason for this relatively low yield was due to two factors: (1) differences in the prevalence of need across groups designated as high and low risk, were relatively small in absolute terms; and (2) the low-risk group was large in relation to the high-risk group. Consequently, the majority of children with needs were located in low-risk schools where screening was limited to JK and SK only. These data confirm the concerns expressed by Brown and Selwitz (1), Tickle (13), and Tickle et al. (14) with respect to the targeting of community-based programs.

The data also indicated that there were substantial differences across the geographic areas included in the study in terms of the success of the targeted approach with identification rates for children with urgent needs ranging from 44.3 percent in York, to 75.6 percent in Thunder Bay. Although the prevalence of need was significantly higher in Thunder Bay than in York this does not account for the differences in the outcome of the program in terms of identification rates. The prevalence of need in the city of Hamilton was almost the same as that in York, and substantially lower than in Thunder Bay; however, identification rates in Hamilton were similar to those in Thunder Bay. Rather, the differences in rates were largely due to differences in the relative sizes of the risk groups across these geographic areas. Consequently, the success of a targeted program where schools are the targeting unit is not uniform, but determined by the local spatial distribution of disease. The effects of modifying the targeting criteria in terms of increases in identification rates and the additional resources required also varied by geographic region.

The targeted program was more successful at identifying children with needs who came from economically disadvantaged backgrounds. In common with numerous other studies, the data indicate that these children have less access to dental care than others and should perhaps be considered the primary target of a program designed to promote access to dental care among those in need. Arguably, many of the children with needs who are not identified will receive dental care anyway, since they come from higher income households, households covered by dental insurance or have a history of using dental services. The most economically disadvantaged group consists of children from households receiving government income support. The program identified 60 percent of those with dental care needs, 65 percent of those with "mandatory needs" and 80 percent of those with urgent needs.

Although school-based dental screening programs are both common and believed to be important with respect to maintaining the dental health of children, few evaluations of such programs have been undertaken (20). Studies that have been undertaken have examined the accuracy of dental examiners in identifying children in need (21) or the effect on dental care utilization rates of screening children and informing parents of their needs for dental care (20,22,23). The evaluation reported here only considered the effect on identification rates of a targeted screening approach. Consequently, a comprehensive evaluation would need to include these other dimensions of screening. It would also need to consider the benefits in terms of oral health outcomes of populations that are screened compared to those that are not. Evaluations of prevention programs targeted at high-risk groups have lead to concerns about how useful they are compared to interventions directed at whole populations (11,24,25).

The results of this study indicated that the majority of children from low-income households with dental care needs are identified by the targeted screening program as currently delivered and, given the referral and follow-up procedures employed, are likely to be the main beneficiaries of the program. Other evaluations of screening programs have also reported that they tend to be most effective in increasing dental attendance rates among children from lower socioeconomic groups and areas (22,23). In this respect, community-based screening programs can promote equity in oral health.

However, targeted programs, while relatively cost effective, are themselves subject to a degree of inequity. Since all schools and all grades included in our study contained children with dental care needs, it is inevitable that any targeted program that selects children to be screened on the basis of schools and grades will fail to identify all of those eligible for public dental care programs. As currently designed, the program described here failed to identify some children with urgent needs who came from the most economically disadvantaged families. Consequently, to ensure equitable access to public resources, additional procedures need to be implemented in order to identify those children.

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