



November 30, 2001 / Vol. 50 / No. RR-21

**MMWR**<sup>TM</sup>  
MORBIDITY AND MORTALITY  
WEEKLY REPORT

*Recommendations  
and  
Reports*

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**Promoting Oral Health: Interventions  
for Preventing Dental Caries, Oral and  
Pharyngeal Cancers, and Sports-Related  
Craniofacial Injuries**

**A Report on Recommendations of the  
Task Force on Community Preventive Services**

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention (CDC)  
Atlanta, GA 30333



The *MMWR* series of publications is published by the Epidemiology Program Office, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30333.

**SUGGESTED CITATION**

Centers for Disease Control and Prevention. Promoting oral health: interventions for preventing dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries: a report on recommendations of the Task Force on Community Preventive Services. *MMWR* 2001;50(No. RR-21):[inclusive page numbers].

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# Promoting Oral Health: Interventions for Preventing Dental Caries, Oral and Pharyngeal Cancers, and Sports-Related Craniofacial Injuries

## A Report on Recommendations of the Task Force on Community Preventive Services

### Summary

*The Task Force on Community Preventive Services (the Task Force) has conducted systematic reviews of the evidence of effectiveness of selected population-based interventions to prevent and control dental caries (tooth decay), oral (mouth) and pharyngeal (throat) cancers, and sports-related craniofacial injuries. The Task Force strongly recommends community water fluoridation and school-based or school-linked pit and fissure sealant delivery programs for prevention and control of dental caries. Using the rules of evidence it has established, the Task Force found insufficient evidence of effectiveness or ineffectiveness of the remaining interventions reviewed. Therefore, the Task Force makes no recommendation for or against use of statewide or communitywide sealant promotion programs, population-based interventions for early detection of precancers and cancers, or population-based interventions to encourage use of helmets, facemasks, and mouthguards to reduce oral-facial trauma in contact sports. The Task Force's finding of insufficient evidence indicates the need for more research on intervention effectiveness. Until the results of such research become available, readers are encouraged to judge the usefulness of these interventions by other criteria. This report presents additional information regarding the recommendations, briefly describes how the reviews were conducted, and provides information designed to help apply the strongly recommended interventions locally.*

### BACKGROUND

Despite substantial improvements in oral health for most persons living in the United States during the 20th century, the nation spends an estimated \$60 billion annually on dental services (1), including approximately 500 million visits to dental offices (2). In 1996, estimated inpatient hospital charges for diseases of the mouth and disorders of the teeth and jaw were \$451 million (3). Dental caries, oral cancers, and sports-related craniofacial injuries are potentially preventable conditions. The financial and human costs associated with these conditions, including mortality, indicate the need for interventions that promote oral health and prevent disease for all persons, regardless of age, throughout their life span.

The prevalence of dental caries (i.e., the percentage of persons with  $\geq 1$  decayed, missing, or filled teeth) in permanent teeth increases with age, from 26% among persons aged 5–11 years to 67% among persons aged 12–17 years and 94% for dentate adults (with  $\geq 1$  natural teeth) aged  $\geq 18$  years (4,5). The prevalence of dental caries among children aged 12–17 years has declined from 90% during 1971–1974 to 67% during 1988–1991. Severity (i.e., the mean number of decayed, missing, or filled teeth) has declined from 6.2 to 2.8 during this period (4,6). Eighty percent of dental caries identified in permanent teeth of children aged 5–17 years in the United States occur in 25% of children (4,6,7). Lower-income, Mexican-American, and African-American children and adults have more untreated decayed teeth than their higher-income or non-Hispanic white counterparts (4,5,8,9). Among low-income children, approximately one third have untreated caries in primary teeth that could be associated with pain, difficulty in eating, and underweight (9).

Dental caries on smooth tooth surfaces (those without pits and fissures) also has decreased markedly. Recent data indicate that approximately 90% of caries in permanent teeth of children occur in tooth surfaces with pits and fissures, and approximately two thirds are on the chewing surfaces alone (4,7,10).

Each year, oral (mouth) and pharyngeal (throat) cancers, which are mainly squamous cell carcinomas, are diagnosed in approximately 30,000 U.S. residents, and approximately 8,000 persons die of these diseases (7,11,12). Oral and pharyngeal cancers are the fourth, seventh, and fourteenth most common cancers among African-American men, white men, and all women, respectively (11). They are most often diagnosed at late stages and treated by methods (e.g., surgery, radiation, and chemotherapy) that can be disfiguring and costly (13). Overall relative 5-year survival rates are approximately 54%, and mortality is nearly twice as high among certain minorities (especially African-American men) as among whites (11,12).

Epidemiologic studies indicate that approximately one third of all dental injuries and approximately 19% of head and face injuries are sports-related (7,8,14–16). During 1997–1998, persons aged 5–24 years accounted for 2.6 million (70%) of the 3.7 million emergency department visits per year for sports-related injuries among persons of all ages. Approximately 22% of the average annual estimate of visits were for craniofacial injuries to the brain and skull, face, scalp, and neck (14).

More widespread use of effective population-based interventions could help reduce the morbidity, mortality, and economic burden associated with dental caries, oral cancers, and sports-related craniofacial injuries. This report and other related publications provide guidance from the Task Force on Community Preventive Services (the Task Force) to decision makers in state and local health departments, managed care organizations, purchasers of health care, persons responsible for funding public health programs, and others who have interest in or responsibility for improving oral and related general health in all segments of the population.

## INTRODUCTION

The Task Force is developing the *Guide to Community Preventive Services* (the *Community Guide*) with support from CDC, the U.S. Department of Health and Human Services (DHHS), other federal agencies, and other public and private partners. The recommendations presented in this report were developed by the Task Force and are not necessarily the recommendations of CDC, DHHS, or other participating organizations.

This *MMWR* report is one in a series of reports on systematic reviews conducted for the *Community Guide*, a resource that will include multiple systematic reviews, each focusing on population-based opportunities to promote health and prevent disease or injury. This report provides an overview of the process used to select and review evidence and summarizes the Task Force's recommendations on community interventions to reduce dental caries, oral cancers, and sports-related craniofacial injuries. A full presentation of the recommendations, supporting evidence (i.e., discussions of applicability, additional benefits, potential harms, and barriers to implementation), economic evaluations of recommended interventions (when available), and remaining research questions will be published in the *American Journal of Preventive Medicine* in 2002. More information regarding this *MMWR* report is available from CDC's Division of Oral Health, National Center for Chronic Disease Prevention and Health Promotion at (770) 488-5301. Copies of this report are available electronically at <<http://www.thecommunityguide.org>>.

## METHODS

Detailed methods used to conduct systematic reviews and link evidence to recommendations for the *Community Guide* have been described elsewhere (17). In brief, for each *Community Guide* topic, a multidisciplinary development team conducts a review by

- developing an approach to organizing, grouping, and selecting the interventions for review;
- systematically searching for and retrieving evidence;
- assessing the quality of and summarizing the strength of the body of evidence of effectiveness;
- summarizing information regarding other evidence (e.g., applicability of the intervention to different populations and settings, additional benefits, potential harms, barriers to implementation, and economic evaluations); and
- identifying and summarizing research gaps.

The coordination and consultation\* teams generated a comprehensive list of strategies and created a priority list of interventions for review based on their perceptions of the importance of each intervention and the extent to which the interventions were practiced in the United States. These teams focused on interventions to prevent and control dental caries (including community water fluoridation, school-based or school-linked pit and fissure sealant delivery programs, and communitywide sealant promotion programs), oral cancers, and sports-related craniofacial injury because these important health problems contribute substantially to annual dental care expenditures, serve as selected indicators of the need for preventive services, and address several *Healthy People 2010* objectives (Table 1).

To be included in the review of effectiveness of an intervention, a study had to a) involve primary investigation of an intervention selected for evaluation;<sup>†</sup> b) be published in English on or before December 31, 2000; c) be conducted in established

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<sup>†</sup> Studies of the effectiveness of school-based programs that require use of protective sports equipment were reviewed as part of population-based interventions to encourage use of helmets, facemasks, and mouthguards to reduce oral-facial trauma. Available studies of educational interventions were reviewed if they involved the five interventions described in Table 2.

**TABLE 1. Selected oral health objectives from *Healthy People 2010*\***

Targeted condition	Age of population (yrs)	Percentage of population or other units or observation		
		Baseline (yrs) <sup>†</sup>		2010 objective
<b>Dental Caries</b>				
Dental caries experience (i.e., lifetime number of decayed, missing, or filled teeth measured at a single point in time) in primary or permanent teeth	2-4	18%	(1988-1994)	11%
	6-8	52%	(1988-1994)	42%
	15	61%	(1988-1994)	51%
Untreated dental decay	2-4	16%	(1988-1994)	9%
	6-8	29%	(1988-1994)	21%
	15	20%	(1988-1994)	15%
	35-44	27%	(1988-1994)	15%
Never had a permanent tooth extracted because of dental caries or periodontal disease	35-44	31%	(1988-1994)	42%
Have had all their natural teeth extracted	65-74	26% <sup>‡</sup>	(1997)	20%
Proportion of children who have received dental sealants on their molar teeth	8	23%	(1988-1994)	50%
	14	15%	(1988-1994)	50%
Proportion of the U.S. population served by community water systems with optimally fluoridated water	All ages	62%	(1992)	75%
<b>Oral and Pharyngeal Cancers</b>				
Proportion of oral and pharyngeal cancers detected at the earliest stage (stage 1, localized)	All ages	35%	(1990-1995)	50%
Proportion of adults who, in the past 12 months, report having had an examination to detect oral and pharyngeal cancer	>40	13%	(1998)	20%
<b>Sports-Related Craniofacial Injuries</b>				
(Developmental) Increase the proportion of public and private schools that require use of appropriate head, face, eye, and mouth protection for students participating in school-sponsored physical activities	School ages (unspecified)	Unknown		

\* US Department of Health and Human Services. *Healthy People 2010*, vols I and II. 2nd ed. Washington, DC: US Government Printing Office, November 2000.

<sup>†</sup> Years indicate when the data were analyzed to establish baseline estimates. Certain estimates were age-adjusted to the year 2000 standard population.

<sup>‡</sup> Based on self-report, National Health Interview Survey, 1998 (National Center for Health Statistics).

market economies\* (unless such studies were unavailable or scarce, in which case, relevant studies conducted in other countries were included); and d) compare outcomes among groups of persons exposed to the intervention with outcomes among groups of persons not exposed or less exposed to the intervention.

Time and resource constraints precluded review of certain candidate interventions. Examples include a) school-based programs that deliver health education, fluoride rinse and tablets, or oral examinations and referral, either as single- or multicomponent interventions; b) programs to prevent early childhood caries; c) public, professional, and school-based education; and d) multicomponent interventions that target  $\geq 2$  health outcomes.

For each intervention reviewed, the team developed an analytic framework indicating possible causal links between the intervention under study and predefined outcomes of interest. These outcomes included dental caries, oral cancers or precancers, and sports-related craniofacial injuries. These conditions were selected because they are common, sometimes life-threatening, costly in terms of resources and quality of life, or preventable by strategies already in widespread use. Moreover, promoting oral health is a fundamental concern of public health practice, not exclusively of dental health practitioners. Prevention of other important craniofacial health conditions (e.g., periodontal diseases, developmental anomalies) has been reviewed elsewhere (8).

Studies that met the inclusion criteria also had to meet the quality criteria. Each study was evaluated using a standardized abstraction form and assessed for suitability of the study design and threats to validity. On the basis of the number of threats to validity, studies were characterized as having good, fair, or limited execution (17). The strength of the body of evidence of effectiveness was characterized as strong, sufficient, or insufficient on the basis of the number of available studies, the suitability of study designs for evaluating effectiveness, the quality of execution of the studies, the consistency of the results, and the effect size<sup>†</sup> (17).

The *Community Guide* systematically links evidence to recommendations (17). The strength of evidence of effectiveness corresponds directly to the strength of recommendations (e.g., strong evidence of effectiveness corresponds to an intervention being strongly recommended, and sufficient evidence corresponds to an intervention being recommended). Other types of evidence also can affect a recommendation. For example, evidence of harms resulting from an intervention might lead to a recommendation that the intervention not be used, even if it is effective in improving certain outcomes.

A finding of insufficient evidence of effectiveness does not result in recommendations for or against an intervention's use but is important for identifying areas of uncertainty and continuing research needs. In contrast, sufficient or strong evidence of ineffectiveness leads to a recommendation that the intervention not be used. Although the option exists, the Task Force has yet to use economic information to modify recommendations.

\*Established market economies as defined by the World Bank are Andorra, Australia, Austria, Belgium, Bermuda, Canada, Channel Islands, Denmark, Faeroe Islands, Finland, France, Former Federal Republic of Germany, Germany, Gibraltar, Greece, Greenland, Holy See, Iceland, Ireland, Isle of Man, Italy, Japan, Liechtenstein, Luxembourg, Monaco, The Netherlands, New Zealand, Norway, Portugal, San Marino, Spain, St. Pierre and Miquelon, Sweden, Switzerland, the United Kingdom, and the United States.

<sup>†</sup> Studies qualified for the final summary estimates of effectiveness if they provided sufficient detail to support quality scoring, had an acceptably small number of limitations in execution or design, and provided an appropriate measure for summarizing (e.g., median and range) the effectiveness of the intervention on a single scale.

## RESULTS

A systematic search of the Medline database\* (1966 through December 2000) yielded approximately 4,000 journal article citations potentially relevant to the review. In addition, members of the development team manually searched reference lists and consulted with specialists in the field to identify other relevant citations, including reports on studies of the economics of the interventions being examined. Of all citations considered, 130 studies met the inclusion criteria and were abstracted; 94 of these were excluded because of limitations in their execution or design and were not considered further. The remaining 36 studies were considered qualifying studies.

The assessment of effectiveness for the five interventions discussed in this report was based on the systematic review and evaluation of the 36 qualifying studies, all of which had good or fair quality of execution (citations and details available at <<http://www.thecommunityguide.org>>). Based on the evidence of effectiveness, the Task Force strongly recommended community water fluoridation and school-based or school-linked pit and fissure sealant delivery programs (i.e., those that also involve a private dental practice or public dental clinic) but did not make a recommendation for or against the other three interventions because of insufficient evidence of effectiveness or ineffectiveness (Table 2). The available evidence also did not permit the Task Force to render a judgment on the relative effectiveness of school-based versus school-linked sealant delivery programs.

## USING THESE RECOMMENDATIONS IN COMMUNITIES AND HEALTH-CARE SYSTEMS

Given that oral health conditions cause considerable morbidity and even mortality, and that activities to promote oral health are ongoing throughout the United States, the recommendations in this report should be relevant to most communities. Communities, school systems, health-care systems, and oral health practitioners should consider starting program planning and implementation cycles by

- assessing their goals in light of national goals and objectives (7);
- assessing the current burden of oral health conditions in their populations;
- reviewing the current status and history of intervention activities; and
- identifying opportunities for improving intervention effectiveness and oral health status.

To decide which combination of interventions is most likely to meet local objectives, decision makers should consider state and local laws and regulations, resource availability, administrative structures, and economic and social environments of implementing organizations and practitioners. They should also consider recommendations and evidence provided in this and other reports, including those of the U.S. Surgeon General (8); National Health Service Centre for Reviews and Dissemination, University

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\*Available at <<http://www.ncbi.nlm.nih.gov/PubMed>> (accessed October 17, 2001).

**TABLE 2. Recommendations from the Task Force on Community Preventive Services regarding selected interventions to improve oral health**

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Intervention (No. of qualifying studies)	Task Force recommendation for use	Intervention description	Key findings
<b>Interventions to prevent or control dental caries</b>			
Community water fluoridation (CWF) (n = 21; 9 in analysis group A;* 7 in analysis group B;† and 5 in analysis group C <sup>§</sup> )	Strongly recommended	Adding (or removing), monitoring, and adjusting fluoride in water supplies to reach optimal fluoride concentrations <sup>§</sup> in community drinking water. Situations in which ongoing CWF was stopped were also reviewed.	<ul style="list-style-type: none"> <li>• Starting or continuing CWF effectively prevents dental caries in communities at varying levels of baseline caries prevalence (i.e., caries measured in children aged 4–17 years of varying socioeconomic status).               <ul style="list-style-type: none"> <li>— 29.1% median decrease in dental caries associated with starting or continuing CWF (range: 110.5% decrease to 66.8% increase); 7 group A studies* (21 measures).</li> <li>— 50.7% median decrease in dental caries associated with starting or continuing CWF (range: 22.3% to 68.8% decrease); 7 group B studies† (20 measures).</li> </ul> </li> <li>• Stopping CWF is associated with increases in dental caries in some communities.               <ul style="list-style-type: none"> <li>— 17.9% median increase in dental caries associated with stopping CWF (range: 42.2% decrease to 31.7% increase); 3 group A studies* (5 measures).</li> <li>— 59.5% increase in dental caries associated with stopping CWF; 1 group B study† (1 measure).</li> </ul> </li> </ul>

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**TABLE 2. (Continued) Recommendations from the Task Force on Community Preventive Services regarding selected interventions to improve oral health**

<b>Intervention (No. of qualifying studies)</b>	<b>Task Force recommendation for use</b>	<b>Intervention description</b>	<b>Key findings</b>
School-based or school-linked pit and fissure sealant delivery programs (n = 10)	Strongly recommended	Direct delivery of dental sealants to children in school-based or school-linked (i.e., involving a private dental practice or public dental clinic) settings.	Effectively reduces dental caries among children aged 6–17 years of varying socioeconomic status and baseline caries experience levels.  Median percent decrease in occlusal caries in posterior teeth associated with the intervention: 60% (range: 5%–93%); 10 studies (22 measures).
Statewide or communitywide sealant promotion programs (n = 1)	Insufficient evidence**	Statewide sealant promotion program that included public service announcements, news releases, billboards, professional education (e.g., articles, continuing education, videos, posters), increased support for school-based programs, and third-party reimbursement (e.g., Medicaid) for sealant placement.	One study with a before-after evaluation design reported a 12.4% increase (from 79.4% in 1989) in sealant use reported by dentists after 3 years. Because of limitations in design and execution, this study provided insufficient evidence of effectiveness in increasing observed sealant use (among children or adults) or decreasing dental caries.
<b>Interventions to prevent or control oral and pharyngeal cancers</b>			
Population-based interventions for early detection of precancers and cancers (n = 7)	Insufficient evidence**	Communitywide, coordinated public education, professional education and training, professional examination of persons at high risk in various settings (e.g., home, health fairs, field clinics, usual source of care), and referral of persons with suspicious lesions (e.g., erythroplakia, leukoplakia, lichen planus, submucous fibrosis, and oral cancer) for follow-up and treatment.	No studies met the minimum quality criteria for assessing effectiveness in increasing early detection of cancers and precancers, improving health status, or reducing mortality.  The 7 qualifying studies, conducted in India, Japan, Sri Lanka, and the United Kingdom during 1981–1996, used community health workers or dentists as test oral examiners and dentists, physicians, oral pathologists, or oral cancer specialists as “gold standard” examiners. Suspicious lesions (precancers or cancers) were detected at a median percent yield of 4.2% (range: 1.3%–5.7%).

**TABLE 2. (Continued) Recommendations from the Task Force on Community Preventive Services regarding selected interventions to improve oral health**

Intervention (No. of qualifying studies)	Task Force recommendation for use	Intervention description	Key findings
			<p>The studies also provided information on the median of sensitivity, specificity, and predictive value positive in detecting suspicious lesions for follow-up and treatment as follows:</p> <ul style="list-style-type: none"> <li>• sensitivity = 74% (range: 59%–95%); 7 studies</li> <li>• specificity = 98% (range: 69%–99%); 7 studies</li> <li>• predictive value positive = 73.5% (range: 31%–87%); 6 studies</li> </ul>
<b>Interventions to prevent or control craniofacial injuries in contact sports</b>			
Population-based interventions to encourage use of helmets, facemasks, and mouthguards in contact sports (n = 4)	Insufficient evidence**	Coordinated education and promotion of use of helmets, facemasks, and mouthguards to prevent sports-related traumatic injuries to the head, face, and mouth directed to both players and the public.	Four studies of fair quality yielded 12 measures of effectiveness that failed to produce a body of evidence (considered separately or together) sufficient to meet minimum requirements for a Task Force recommendation regarding use of helmets, face shields, goggles, or mouthguards. <sup>††</sup>

\* Analysis group A (n = 9 studies) included studies that reported before and after measures of tooth-level caries in concurrent comparison groups. Effectiveness of CWF (i.e., percent change in caries because of CWF) was estimated as follows:  $(F_{pre} - F_{post}) - (NoF_{pre} - NoF_{post}) / NoF_{pre}$ , where  $F_{pre}$  = dental caries prevalence in fluoridated community before fluoridation (or at baseline during ongoing fluoridation),  $F_{post}$  = dental caries prevalence in fluoridated community after fluoridation (or at follow-up during ongoing fluoridation),  $NoF_{pre}$  = dental caries prevalence in nonfluoridated community before fluoridation (or at baseline during ongoing fluoridation), and  $NoF_{post}$  = dental caries prevalence in nonfluoridated community after fluoridation (or at follow-up during ongoing fluoridation).

<sup>†</sup> Analysis group B (n = 7 studies) included studies that were not in group A and reported postexposure measures of tooth-level caries in concurrent comparison groups. Percentage effectiveness of CWF was estimated as follows:  $(F_{post} - NoF_{post}) / NoF_{post}$ .

<sup>§</sup> Analysis group C (n = 5 studies) included studies that were not in groups A or B and reported measures of caries at various levels (i.e., child, tooth, or surface). Findings indicated no consistent patterns different from those in analysis groups A or B (data not shown).

<sup>¶</sup> Optimal adjusted fluoride concentrations in the United States are 0.7–1.2 parts per million (ppm) (CDC. Engineering and administrative recommendations for water fluoridation, 1995. *MMWR* 1995;44[No. RR-13]:1–40).

\*\* A determination that evidence of effectiveness is insufficient to support a Task Force recommendation for or against use of an intervention should not be seen as evidence of ineffectiveness. A determination of insufficient evidence helps identify areas of uncertainty regarding effectiveness of an intervention and continuing research needs. In contrast, evidence of ineffectiveness leads to a recommendation that the intervention not be used. The Task Force's decision to make no recommendation for or against use of this intervention does not prevent readers from making judgments regarding the intervention based on other criteria.

<sup>††</sup> Full supporting evidence for this and all other interventions will be provided in a special supplement to the *American Journal of Preventive Medicine* in 2002.

of York (18); CDC (19,20); Institute of Medicine (21); and Canadian Task Force on Preventive Health Care (22,23).

The Task Force has strongly recommended community water fluoridation and school-based or school-linked pit and fissure sealant delivery programs. Although the Task Force has not used economic information to modify recommendations, this information, when available, can help local policy makers in the decision-making process. If local goals and resources permit, the use of these interventions should be initiated or increased. In addition, these interventions should be considered in the context of other communitywide, provider-based, and individual strategies for preventing or controlling dental caries in communities (7,8,19).

The Task Force's decision to make no recommendation for or against the use of three other reviewed interventions at the community level (i.e., statewide or communitywide sealant promotion programs; population-based interventions for early detection of precancers and cancers; and population-based interventions to encourage use of helmets, facemasks, and mouthguards in contact sports) indicates the need for high-quality (as defined previously [17]) research on their effectiveness. Until the results of such research become available, readers can judge the usefulness of these interventions based on other criteria. Although the effectiveness of communitywide sealant promotion programs remains unknown, the clinical safety and effectiveness of sealants have been established (24,25).

Where organized efforts are being considered to reduce the burden of oral cancer, the findings presented here should be considered with recommendations of other groups (8,20,22,26,27). For example, more widespread use of effective strategies to reduce tobacco use, an important cause of oral and pharyngeal cancer (8,27-29), should be encouraged, and clinicians can consider periodic oral examinations of persons who engage in risk behaviors (i.e., tobacco use or excessive alcohol consumption) or manifest suspicious symptoms (8,22).

Although the Task Force did not make a communitywide recommendation regarding use of protective head and face equipment in contact sports, the frequency and severity of head, face, and oral injuries have decreased in certain sports since the use of helmets, facemasks, and mouthguards became mandatory in selected organized contact sports (e.g., football, ice hockey) (30,31).

## **ADDITIONAL INFORMATION REGARDING THE *COMMUNITY GUIDE***

*Community Guide* topics are prepared and released as each is completed. A compilation of the recommendations and supporting evidence for these topics will be published in book form. Upcoming topics in 2001-2002 include the sociocultural environment, cancer, and sexual behavior. The findings from systematic reviews on vaccine-preventable diseases, tobacco use prevention and reduction, motor vehicle occupant injury, and diabetes have been published. Additional information regarding these reports, the Task Force, and the *Community Guide* is available at <<http://www.thecommunityguide.org>>.

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