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Atraumatic Restorative Treatment (ART) in Pediatric Dentistry Residency Programs: A Survey of Program Directors

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Abstract: Purpose: The purpose of this study was to investigate the extent of clinical training on atraumatic restorative treatment (ART) among pediatric dentistry residency programs and assess program directors' attitudes toward ART. **Methods:** All U.S. Pediatric Dentistry residency programs' directors were asked to complete a web-based survey. Sixty-one of the 76 directors (80 percent) completed the survey, with no significant response bias. **Results:** Eighty-nine percent of the responding programs provided clinical instruction on ART. Of these, 30 percent provided ART training often/very often. ART was used mostly in single-surface cavities (43 percent) and as an interim treatment in primary teeth (57 percent). Factors associated with ART clinical training included not placing amalgams in primary teeth ($P < .03$) and having directors with positive attitudes toward ART ($P < .001$). Factors associated with directors' positive attitudes included believing that child's caries risk ($P < .006$), professional guidelines ($P < .003$), and patient insurance status ($P < .04$) were all important in selecting restorative treatment. **Conclusions:** Atraumatic restorative therapy appears to be underused in pediatric dentistry residency programs in the United States. Residency directors' attitudes were highly predictive of the amount of clinical training provided, suggesting that directors need to be better informed about the use of ART. (*Pediatr Dent* 2013;35:500-5) Received February 15, 2012 | Last Revision January 28, 2013 | Accepted January 29, 2013

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Access to oral care is still problematic for certain populations in the United States. Among the factors that limit access are the limited availability of services and inability to pay for services. To address such problems, strategies to make services more efficient, affordable, and less traumatic have been suggested. Atraumatic restorative treatment (ART) was proposed as one solution to achieve those goals. ART was developed in the 1980s as an affordable, patient-friendly caries management procedure that does not need extensive operator training or special skills.

A recent meta-analysis in 2010 showed that survival of ART restorations was 93 percent over two years in single-surface restorations and 62 percent in multiple surface restorations in primary teeth.¹ In permanent teeth, survival was 80 percent over five years in single-surface restorations and 86 percent over one year in multiple-surface restorations.¹ Another systematic review in 2011 showed that, when compared with amalgam, there was no significant difference between the two restorations after 12 and 24 months in primary teeth.² In permanent teeth, ART restorations survived better than amalgam for up to 6.3 years, but survival was site-dependent; occlusal restorations had a higher survival rate than occluso-proximal restorations.² Those survival rates qualified ART to meet the American Dental Association (ADA) specification for quality restorations, especially for single-surface restorations.³

Although the ART approach was initially developed to provide preventive and restorative care to people in low-income countries, the use of ART is no longer restricted to underprivileged nations. The World Health Organization and International Dental Federation recognize ART as part of the basic package of oral care for all communities around the world.^{4,5} They view ART as an innovative highly effective approach suitable for populations at all levels of economic development. They also believe that ART fits modern concepts of preventive and restorative oral care, with a focus on prevention and minimally invasive restorative care.

Few studies reported the use of ART in economically developed countries; in England and Scotland, only 10 percent of general dentists had adopted ART to treat children.⁶ In the Netherlands, ART was used by 26 percent of general dentists.⁷ The authors of the previous studies thought those results might be due to some dentists viewing ART as inferior care⁶ or the lack of economic incentives, as many reimbursement systems do not recognize Minimally Invasive Dentistry (MID) procedures such as ART.⁸

The use of ART in the United States is not as well-established or well-studied. In the 2011 revision of its policy statements, the American Academy of Pediatric Dentistry (AAPD) considered ART to be a definitive treatment used with populations that have little access to traditional dental care.⁹ At the same time, the AAPD recognized another type of ART: interim therapeutic restorations (ITRs), which are similar to ART in technique but differ in therapeutic goals. Both scoop out dental caries using hand instruments and place glass ionomer (GI) to restore the resultant cavity; however, ITRs were recommended as an interim treatment prior to definitive restoration of the teeth.⁹ At a public health level and in its most recent initiative to prevent early childhood caries, the Indian Health Service promoted the use of ART to reduce the need for children having to go to the operating room to receive dental treatment.¹⁰

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While recent recommendations and policy statements have advocated the use of ITR and ART, knowledge and use of these techniques may be lacking. For example, in a national sample that represented 43 percent of pediatric dentists in 2001, 51 percent “cleaned caries by spoon and placed glass ionomer” when they were asked about the most frequent caries management techniques they usually used with children younger than three years old.¹¹ In a similar study among general dentists, 44 percent of dentists often used ART as a restorative procedure to treat children; however, 38 percent of the same sample knew nothing about ART, and 32 percent thought that further training on ART was “not desirable.”¹²

Given the strong evidence of the great impact of dental education and training on future dentists’ attitudes and behaviors,¹³⁻¹⁶ the under use of ART may reflect that little attention is given to ART in dental education in general and in pediatric dentistry training programs in particular. However, very little is known about ART-related training in U.S. dental education.

Therefore, the purposes of this study were to: (1) assess factors related to the attitude of pediatric dentistry residency program directors toward atraumatic restorative treatment; and (2) assess factors related to the level of clinical training on ART in pediatric dentistry residency programs in the United States.

Methods

The Institutional Review Board of the University of Iowa, Iowa City, Iowa, approved all aspects of this study. This was a cross-sectional study of pediatric dentistry residency program directors in the United States using a pretested web-based questionnaire with 51 items. The survey was pretested for content validity using cognitive analysis (by consulting and pretesting the instrument with experts) by six faculty members from the Department of Preventive and Community Dentistry, four faculty members from the Department of Pediatric Dentistry, and one faculty member from the Department of Operative Dentistry at the University of Iowa in the spring of 2010. Pilot testing for face validity was conducted by two pediatric dentistry senior residents and two dental public health senior residents.

Program directors of all 76 pediatric dentistry residency programs identified by the AAPD and accredited by the ADA as of May 2010 were invited to participate in this survey. Eligible programs included hospital-based, dental school-based, and combined programs.

An invitation letter, signed by the principal investigator, research chairperson, and two members of the research team, was mailed to all program directors in early May 2010. After seven days, an e-mail, including a cover letter that described confidentiality safeguards, the link to the web survey, and a unique identification number, was sent to all directors. Two reminder e-mails with the web survey link and the unique identifier number were sent again two and four weeks after the original e-mail to those who did not submit the completed survey or did not opt out.

The questionnaire was divided into five sections: (1) program directors’ characteristics; (2) residency program characteristics; (3) the characteristics of the patient population served by the program; (4) the attitude of program directors toward ART; and (5) the level and format of clinical instruction on ART.

Besides the demographic characteristics of the program and the program director, section two included questions about the use of behavior management techniques in the program (two questions) and the use of different MID techniques in the program (11 questions). Those questions were used as key independent variables in

this study. In addition, the program director’s attitude toward ART (composite variable, described next) was used as an intermediate variable (acted as both predictor and outcome variable). Figure 1 shows the conceptual framework of the variables in this study.

The composite variable (the use of MID techniques) included 11 MID procedures that were agreed on during the cognitive analysis phase of questionnaire development. The scale was the sum of responses to the 11 questions, each measured on a 5-point frequency scale (never=1, rarely=2, sometimes=3, often=4, most often=5). The internal consistency of this scale was measured by Cronbach’s alpha, which was 0.7, suggesting a high level of consistency. The scale was used as a predictor variable in this model and had a mean of 38 (SD±6) in the study sample. For this scale, a respondent who scored “never” all the time would have a total score of 11, and the respondent who scored “most often” all the time would have a total score of 55.

The composite variable regarding program directors’ attitudes toward ART was used as an intermediate variable in this model. The agreement or disagreement of program directors with 10 statements about ART was measured on a 5-point Likert scale. The scale summed the scores for each subquestion, ranging from 1=strongly disagree to 5=strongly agree. Therefore, the most negative attitude would be 10 and the most positive attitude would score 50 on this scale. The scale had a Cronbach’s alpha coefficient score of 0.8, and the mean for the study sample was 37 (±7).

The level of clinical training provided on ART was measured by the question: “How often do pediatric dentistry residents use ART as a caries management technique for their patients?” Responses were measured on a 5-point frequency scale (never=0 to very often=5). For this survey, ART was defined as “a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material.”¹⁷

Statistical analysis. The statistical analysis was carried out using SPSS 18.0 software (SPSS Inc, Chicago, Ill., USA).¹⁸ Bivariate analyses were conducted to consider associations between outcome variables (dependent variables) and each potential predictor variable (independent variables) and to develop the most parsimonious multivariable models. Multiple linear regression, stepwise and backward, was used for “the level of clinical training

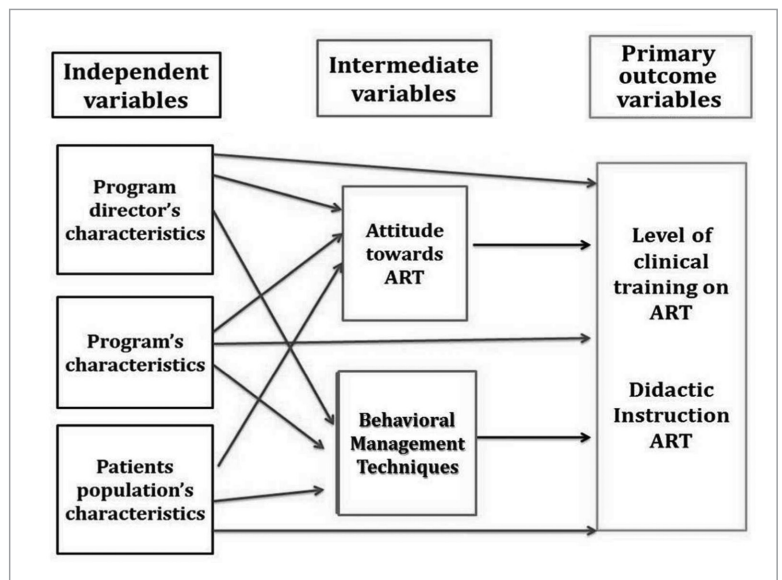


Figure 1. Conceptual model of the study.

on ART” and the “attitude of program directors toward ART” outcome variables. Additionally, possible statistical interactions between the predictor variables were examined. All tests were assessed at a 0.05 level of statistical significance.

Results

The overall response rate for this study was 80 percent, with 61 programs out of 76 responding. Respondent and nonrespondent programs were compared in a descriptive way, according to variables obtained from the AAPD programs’ profile including number of students and faculty and level of stipends provided. No response bias was detected based on these comparisons.

Program directors’ characteristics. Sixty-one percent of respondents were male. Eighty-seven percent had graduated from a U.S. dental training program, and 60 percent completed their training in hospital-based programs. Ninety percent of the program directors who responded to this survey were board certified, and 49 percent had other post DMD/DDS training or degrees. Study sample characteristics are provided in Table 1.

When discussing restorative treatment options with their residents, 99 percent of program directors cited children’s caries risk as “very important” or “important,” 77 percent cited parental preference as “very important” or “important,” and only 38 percent cited patient insurance status or source of payment as “very important” or “important.”

Approximately 97 percent of the sample reported that professional guidelines were “very influential” or “influential” on their knowledge regarding different restorative options, 92 percent cited continuing education, and 84 percent cited post-doctoral training as a “very influential” or “influential” source.

Program characteristics. Thirty respondent programs were dental school-based, 30 were hospital-based, and one was based in a public health or community center. Fifty-two programs were located in urban areas, with 39 programs located in inner cities.

Seventy-nine percent of the programs used general anesthesia “very often” or “often” with children three years old or younger, and 52 percent used it “very often” or “often” with children older than three years.

Patient population served by the program characteristics. A mean of 74 percent (± 13 percent) of the patient population served by respondent programs was at high caries risk, and 20 percent (± 11 percent) was at low caries risk. Approximately 77 percent (± 20 percent) of respondent programs’ patients were covered by Medicaid and other public insurance, 11 percent (± 10 percent) were covered by private insurance, and 10 percent (± 11 percent) had no insurance. Twenty-one percent (± 13 percent) of respondent programs treated children with intellectual and developmental disabilities.

Attitudes of program directors toward ART. For this sample of 61 program directors, the scores of the “attitudes of program directors toward ART” scale ranged from 10 to 49. The scale distribution was skewed toward a more positive attitude, with only four program directors scoring less than 27, and 22 directors scored between 40 and 50 on the same scale. However, the results showed 38 directors scored between 10 and 40 on the attitude scale, which indicates that most of the directors were more neutral toward ART.

In the final regression model of the outcome variable “attitude toward ART,” five variables, shown in Table 2, were significant and explained 45 percent of the variation of program directors’ attitudes. The variables that were significant predictors for positive attitudes toward ART included program directors who thought a child’s caries risk, professional guidelines and standards of care, and patient insurance status were very important factors

in determining restorative options to be used with children and those who disagreed that “definitive restorations should be the treatment of choice regardless of other factors.” On the contrary, programs that used amalgam in primary teeth more often were associated with a negative attitude toward ART.

Level of clinical training provided on ART. Although 89 percent (N=45) of program directors stated that they provide clinical instruction on ART for their residents, only 30 percent used this technique “very often” or “often” as a caries management technique for their pediatric patients. Specifically, ART was reported to be used more often in anterior primary teeth, in single-surface cavities, and as an interim treatment. Table 3 presents some of the types of ART used by those programs.

In multiple linear regression, four predictor variables remained significant in the final model (Table 4): (1) the attitude toward ART composite variable; (2) the use of MID composite

Table 1. STUDY SAMPLE CHARACTERISTICS

Program director characteristics	Mean \pm (SD)	Median	Minimum	Maximum
Age (yrs)	53 \pm 12	54	32	75
<i>No. of years spent in the following settings before becoming a program director</i>				
Private practice	8 \pm 10	3	-	40
Academics (full-time faculty)	8 \pm 8	5	-	35
Public Health Service	1 \pm 3	-	-	20
Military dental corps	0.41 \pm 3.00	-	-	20
<i>Percent of time per week spent in each of the following in the past 12 months</i>				
Research	9 \pm 11	5	-	60
Administration	30 \pm 17	30	5	100
Direct patient care	21 \pm 19	20	-	95
Teaching/student supervision	41 \pm 21	40	-	100

Table 2. RESULTS OF MULTIPLE LINEAR REGRESSION OF THE ATTITUDE OF PROGRAM DIRECTORS TOWARD ATRAUMATIC RESTORATIVE TREATMENT COMPOSITE VARIABLE

Predictor variable	Beta coefficient	P-value
Directors who think child’s caries risk is a very important factor when discussing different treatment options with their residents	.32	.006
Directors who strongly disagree with the statement “definitive restorations should be the treatment of choice, regardless of other factors”	.33	.003
Directors who think that patient insurance status is a very important factor when discussing different treatment options with their residents	.22	.04
Directors who think that professional guidelines and standards of care are very important factors when discussing different treatment options with their residents	.35	.003
Programs that place amalgam in primary teeth more often	-.29	>.01

*R square =0.45; F=6.7, P>.01 (using the stepwise method and confirming the results with forward and backward regression).

Table 3. RESULTS OF THE FREQUENCY OF USE OF DIFFERENT TYPES OF ATRAUMATIC RESTORATIVE TREATMENT (ART) AMONG 54 PEDIATRIC RESIDENCY PROGRAMS (89% OF OUR SAMPLE) WHO ANSWERED YES TO PROVIDING CLINICAL TRAINING ON ART

Types of ART used in pediatric dentistry residency programs	Never N (%)	Rarely N (%)	Sometimes N (%)	Often N (%)	Very often N (%)	Total N (%)
ART in anterior primary teeth	0 (0)	3 (5)	15 (25)	17 (27)	18 (30)	53 (98)
ART in posterior primary teeth	1 (2)	12 (20)	25 (41)	8 (13)	6 (10)	52 (96)
ART in posterior permanent teeth	10 (16)	27 (44)	14 (24)	2 (3)	0 (0)	53 (98)
ART in single-surface cavities in primary teeth	1 (2)	5 (8)	24 (39)	13 (22)	10 (16)	53 (98)
ART in a single-surface cavities in permanent teeth	9 (15)	23 (38)	19 (31)	2 (3)	0 (0)	53 (98)
ART as an interim treatment in primary teeth	0 (0)	4 (7)	19 (31)	17 (28)	13 (21)	53 (98)
ART as an interim treatment in permanent teeth	6 (10)	11 (18)	25 (41)	6 (10)	4 (7)	52 (96)
ART as a definitive treatment in primary teeth	20 (12)	25 (15)	21 (13)	18 (11)	3 (2)	53 (98)
ART as a definitive treatment in permanent teeth	27 (44)	19 (31)	6 (10)	1 (2)	0 (0)	53 (98)

variable; (3) frequency of the use of general anesthesia with children three years old or younger; and (4) placing amalgam in primary teeth more often. Those variables explained 50 percent of the variation in the level of clinical training provided in those programs.

Among the 12 percent who answered “no” to the question “does your program provide clinical instruction on ART, as defined above,” five percent cited “residents should learn ideal restorations first” as a reason for not including ART in their training programs. Other reasons cited were: “no special ADA code exists to reimburse ART restorations” (three percent); “ART is a sub-optimum treatment” (three percent); and “insufficient scientific evidence that supports the use of ART” (three percent).

Discussion

The response rate for this study (80 percent) is considered to be high, suggesting that the findings may be generalized to all training programs. Moreover, no response bias was found between respondent and nonrespondent programs, which further suggest that our sample was representative of all pediatric dentistry residency programs in the United States. The results of the “attitude of program directors toward ART” scale appears to be in line

with two recent U.S. studies in which the results showed more positive attitudes toward MID in general and toward ART in particular among civilian, federal, and public health dentists.¹⁹⁻²¹

Professional guidelines were rated in our study and in different surveys of pediatric dentists as an important source of knowledge about different treatment modalities.^{11,21} Despite the fact that the AAPD guidelines gave ART another name and endorsed it only as an interim restoration, the AAPD encourages the use of ART with very young, uncooperative, and high caries-risk children.⁸ This may explain how professional guidelines predicted a more positive attitude toward ART in our multivariable model.

As in the present study, patients’ insurance status has been identified previously as an important factor in selecting a restorative treatment option for children.^{11,12,21} However, in our study it was identified also as a strong predictor for a positive attitude toward ART. In a 2001 survey of a national sample of pediatric dentists, respondents indicated that certain restorative modalities are more effective with Medicaid patients than others.¹¹ Thus, the fact that a program has most of its population covered by a particular insurance status may influence the attitude of the program directors toward certain procedures that may be more feasible with certain payment types.

The use of general anesthesia as a behavior management technique with children younger than three was a significant predictor for the level of clinical training on ART provided in those programs. This could be explained by two reasons. First, programs that use GA more often with very young children seem to operate within a high caries-risk population, which, in turn encourages the use of ART. Or, second, programs may use ART as a caries stabilization technique until young children can be admitted to the operating room.

In addition, programs that placed amalgam restorations in primary teeth more often also used ART less often as a caries management technique with children. This agrees with results from a 2001 national survey, where 96 percent of pediatric dentists used definitive treatments such as amalgam and stainless steel crowns for all types of lesions, while only 30 percent used GI for the same lesions.¹¹

Finally, after controlling for other variables, attitude toward ART alone explained 35 percent of the level of clinical training on ART. This was expected within the frame of the well-known influence of attitude on behavior and training provided to students, as cited in other literature.²²

Table 4. RESULTS OF MULTIPLE LINEAR REGRESSION OF THE VARIABLE CLINICAL TRAINING ON ATRAUMATIC RESTORATIVE TREATMENT PROVIDED TO RESIDENTS IN PEDIATRIC DENTISTRY RESIDENCY PROGRAMS

Predictor variable	Beta coefficient	P-value
Programs with directors who had more positive attitudes toward ART	.346	.001
Programs that use minimally invasive techniques more often	.283	.009
Programs that use general anesthesia as a behavioral management technique for children three years old or younger more often	.285	.006
Programs that place amalgam in primary teeth more often	-.229	>.03

* R square=0.50; F=4.83, P<.03 (using the stepwise method and confirmed by backward and forward regression).

Our results suggest that, in spite of strong evidence that supports ART's effectiveness, this technique still faces some resistance among dental educators and practitioners, as evidenced by the relatively small proportion (30 percent) that used ART often or very often. This resistance occurs mainly due to the lack of knowledge about ART technique and the concept of minimal intervention in general. Advanced pediatric dentistry training programs are very important sources for dentists, particularly pediatric dentists, to learn about ART, and the AAPD guidelines are a very influential factor that prompts educators and practitioners to use ART. Thus, it is logical to think that professional organizations should be at the forefront of efforts to promote the use of ART in the United States.

From the current study, it is evident that U.S. practitioners use ART in ways that differ somewhat from its original therapeutic goals. Globally, ART was developed²³⁻²⁷ mainly to serve as a definitive treatment in permanent teeth; however, the present study showed that ART was used mainly in anterior primary teeth and as interim treatment in post-doctoral pediatric dentistry programs in the U.S. This fits with the AAPD guidelines on the use of ART and ITR and reflects how program directors view the use of ART differently than is the case in the rest of the world. Thirty-one percent of pediatric dentistry residency program directors in our study "strongly agreed" or "somewhat agreed" that ART should be modified to conform to the oral health standards in the United States.

This study was the first of its kind to survey program directors about their attitudes toward ART and the clinical instruction about ART provided to residents in pediatric dentistry residency programs in the United States. Although we had a high response rate, the small size for this population posed some difficulties in statistical analysis.

Another limitation of this study was the inability to survey all pediatric dentistry faculty members in the program; program directors may not be fully aware of the curriculum details and what happens in the clinics on a daily basis. However, including more faculty members from the same institution would complicate the analysis, because the independence of observations would become an issue.

Although we placed questions about ART near the end of the survey to avoid arousing certain attitudes or prejudgment about ART, social desirability cannot be excluded as a factor that may under- or overestimate the level of training and instruction provided.

Conclusions

Based on this study's results, the following conclusions can be made:

1. Eighty percent of pediatric dentistry residency programs in the United States provided clinical training on atraumatic restorative treatment.
2. Pediatric dentistry residency programs used ART mainly in primary, anterior, single-surface cavities and as an interim treatment.
3. Pediatric dentistry residency programs underuse ART, as evidenced by only 30 percent of programs in this study using it "often" or "very often" as a caries management technique.
4. The attitude of program directors toward ART was a strong predictor of clinical training provided on ART.
5. The directors' perceived importance of professional guidelines in making treatment decisions was very predictive of a positive attitude toward ART.

6. Given the underuse of ART, it appears that American Academy of Pediatric Dentistry guidelines need to be tailored to better inform pediatric dentistry residency program directors about ART.

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Abstract of the Scientific Literature

A serial cross-sectional study of pediatric inpatient hospitalizations for non-traumatic dental conditions

The aim of this study was to examine trends of non-traumatic dental conditions (NTDCs)-related hospitalization in the United States and identify the relationship between complex chronic condition (CCCs) and NTDC-related inpatient hospitalizations. Investigators analyzed the data from U.S. Nationwide Inpatient Samples from 2000-2010 for children ages three to 17 years ($N=3,030,970$). The predictor variable were the number of CCCs (0/1/2+) and the outcome variable was whether the child had a NTDC-related hospitalization (yes/no). Descriptive statistics was generated and covariate-adjusted multi-variable logistic regression models were done to estimate prevalence odds ratios (PORs). There were less than one percent of NTDC-related hospitalizations of all hospital admissions, with a slightly increased trend (not statistically significant) from year 2000 to 2010. There was no difference in odds of NTDCs for children with zero or one CCCs, but there was a significant increase for children with 2+ CCCs, non-white, publicly insured and lower income. Post hoc analyses revealed the average total charge for children with a NTDC-related hospitalization was \$25,211 compared with \$18,061 for a non-NTDC-related hospitalization.

Comments: This study is the first published study to look at the non-traumatic dental conditions in pediatric inpatient hospitalizations. Although the prevalence is low (averaging 0.59 percent from 2000 to 2010), the findings from this analysis are still valuable. It also supports that patients with special health care need are indeed at higher risk of dental caries as stated in AAPD Caries-risk Assessment Guideline. In addition, the cost of a NTDC-related hospitalization was much higher than a non-NTDC-related hospitalization, which should encourage the focus on prevention for the children at higher risk in order to ultimately reduce the high cost associated with hospitalization. It would be interesting to see the findings from each state which were not included in this study. **KLH**

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28 references