Geographic and health system correlates of interprofessional oral health practice

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Abstract

Objective: This study explores geographic, system, and organizational constructs that predict medical care teams’ willingness to administer fluoride varnish and conduct oral health risk assessments.

Methods: A cross-sectional survey of voluntary health professionals attending trainings on interprofessional oral health practice was completed at ten meetings across the United States from April through September, 2016. Bivariate and multivariate analyses were used to examine unknown correlates of oral health prevention and intervention at geographic, organizational, and system levels relating to the impact of referral mechanisms and systems as well as health information technology on fluoride varnish administration and risk-based oral evaluations.

Results: A convenience cohort (n=560) from 44 states was examined. Most (68.7%, n=385) agreed with the dependent variable “medical providers at our site, or part of our network, are administering fluoride varnish and identifying oral health risk factors in the majority of patients seen.” In bivariate analysis, organization type (P=0.0067), having successful referral systems (P<0.0001), and electronic health record (EHR) utility (P<0.0001) were associated with the dependent variable. No geographic indicators were significant. All referral system indicators were significant in multivariate analysis. Dependable referrals (P<0.0001), EHR utility (P=0.0054), and type of referral (P=0.0009) were predictors of the dependent variable. The odds of those reporting a dependable referral system and dependent variable agreement were 4.5 times greater than for those who lacked dependable referral systems (odds ratio 4.54, confidence interval 2.79–7.39). The odds of those who had dependable EHRs and dependent variable agreement were 2.4 times greater than for those who lacked useful EHRs (odds ratio 2.4, confidence interval 1.29–4.37).

Conclusion: The dependability of medical-to-dental referral systems and processes impacts the administration of fluoride varnish and identification of oral health risk factors by motivated primary care teams. Additionally, the ease of EHR use and the availability of electronic information exchange were found to impact primary care oral health practice.

Keywords: Oral health; referral management; risk-based care; population health; coordinated care

Significance statement: Caries activity is one of the most common diseases of childhood, and prevention/intervention by primary care teams can positively impact patient results. This analysis examined unknown correlates of oral health prevention and intervention at geographic, organizational, and system levels relating to the impact of referral mechanisms and systems as well as health information technology on fluoride varnish administration and risk-based oral evaluations.
Introduction
The case for interprofessional oral health care to address the epidemic of early childhood caries has been well litigated. The evidence supports the clinical and cost-effectiveness of primary care–based oral health risk assessments and fluoride varnish applications [1]. Many studies have demonstrated the successful adoption of interprofessional oral health practices at the clinic, system [2], and state [3, 4] levels. While the personal attributes and opinions of individual physicians and pediatricians have been explored [5, 6], few studies have examined the organization and system characteristics that enable or facilitate use of fluoride varnish or oral health risk assessments. Physicians have communicated they are more likely to provide fluoride varnish if they have proper training, have access to patient data to determine eligibility, have access to dentists to whom they can refer patients, and are engaged by leadership in the decision to provide the services [7]. The business case for oral health interprofessional practice was presented in a single state study that demonstrated its cost-efficiency albeit with diminishing returns depending on reimbursement levels [8]. Given the depth of knowledge of individual provider motivation, we examined correlates of interprofessional oral health practice at organizational and health system levels, including geographic characteristics. We specifically asked the following research questions: What are the geographic and organizational attributes of practices that provide oral health interprofessional care (fluoride varnish and risk assessment)? Are they more likely to have established referral systems for dental care and if so, how are they managed?

Materials and methods
The research design centered on a cross-sectional survey of health care professionals, including clinical, administrative, and support team members from medical and dental disciplines. Respondents attended a training program on interprofessional oral health practice delivered by the Director of the DentaQuest Institute’s Office of Interprofessional Practice at ten meetings across the United States from April through September, 2016. Training was conducted at conference-style venues, and not in clinical settings. Those in attendance were trained on the definition of interprofessional oral health practice, examples of how it is practiced, and effective implementation approaches. The training was voluntary, and continuing education credits were made available for most health professions. The anonymous survey was administered at the training sites at the conclusion of the program and submitted as the participants exited the venue. Participation was voluntary, and no personal or clinic-identifying information was collected. Thus this represents a convenience cohort of participants in a training program on interprofessional oral health practice and most likely captures health providers most interested and excited to engage in oral health activities.

The survey was developed by the Office of Interprofessional Practice at the DentaQuest Institute and piloted with an eight-member national content expert panel. The panel assisted with operationalizing constructs and survey items to explore the organization and system characteristics that positively encouraged the adoption of interprofessional oral health care practice. The survey asked participants whether physicians in their “networks or systems [place of primary employment/service] routinely apply fluoride varnish and conduct oral health risk assessments” (dependent variable).

Additional survey questions were asked to capture recommended independent variables, which were organized along geographic and organizational domains. Respondents indicated their organization type such as federally qualified health centers or private practices. Included in the list of organization options was dental service organization, which is a growing trend whereby an entity contracts with dental practices to manage the business-related functions. They also indicated the states in which the practices they primarily worked were located. We operationalized the state variable as the census region of the country (Northeast, South, Midwest, and West). Respondents self-reported if the practices they worked in primarily were in rural, suburban, or urban communities. Respondents represented a wide array of professionals, which created impracticality in adjusting the data for specific provider type. Therefore two provider attributes were used: primary system of employment (medical/dental) and primary role (clinical/leadership/support). System variables were collected through questions that asked respondents’ agreement using a five-item Likert scale (strongly agree, agree, neutral, disagree, strongly disagree) that were operationalized as the following: medical-to-dental referral success; directionality of interprofessional referrals (medical
to dental only, bidirectional, and none); and referral method. The referral method was operationalized as electronic transfer/information exchange, warm handoff, all other methods, and no method. Likert responses were organized as agree (strongly agree and agree) or disagree (strongly disagree, disagree, and neutral). Warm handoff has become health care lexicon for ensuring patients get to the right level of care at the right time [9]. The study was approved by the Institutional Review Board of the Medical University of South Carolina.

Survey data were examined through bivariate analyses using chi-square tests comparing the dependent variable and each independent variable. Multivariate logistic regression models were used that included all variables that were in the bivariate analysis, and we adjusted the data for a variety of characteristics to determine the effect of specific variables, holding all other variables constant.

Adjusted odds ratios were estimated to identify characteristics associated with a higher likelihood of agreeing with the statement that “networks or systems routinely apply fluoride varnish and conduct oral health risk assessments” were provided by medical professionals in the respondents’ sites or networks. SAS version 9.4 was used for all statistical analyses [10].

Results

A total of 673 training attendees, which included clinical, administrative, and support health care team members, volunteered to complete the survey. One hundred and thirteen were volunteered to complete the survey. One hundred and thirteen were eliminated because of incomplete responses or undecipherable writing. Respondents who indicated they practiced clinically in the military were also excluded. Our original intention was to keep them in the analysis as a subpopulation but we received too few responses from military personnel to include them in the analysis (n < 5). Anyone not responding to the survey question that captured data for the dependent variable was excluded. Our convenience cohort resulted in 560 completed surveys. Because attendance was not taken, no denominator is available to calculate a response rate, although we speculate most of the attendees completed surveys. In descriptive analysis, most (68.7%) agreed with the following statement: “Medical providers at our site, or part of our network, are administering fluoride varnish and identifying oral health risk factors in the majority of patients seen.” A description of our cohort is presented in Table 1 along with results from our descriptive analysis that delineates our cohort’s attributes along independent variables.

Geographically, our study cohort represented 44 states. Table 1 delineates characteristics of respondents and the organizations where they are employed or practice. We had a reasonable representation from each of the four census regions (South [31.7%], Northeast [31.3%], West [20.6%], Midwest [16.4%]) and three levels of rurality (rural [42.9%], suburban [32.1%], urban [25.0%]).

Participants were asked to select the organizational type that best described their current work situation; most of our cohort represented federally qualified health centers and private practices. All organizational types had majority agreement with the statement that medical providers at their site or in their network are administering fluoride varnish and identifying oral health risk factors in the majority of patients seen (68.7%, n = 385). Respondents’ referral system attributes are delineated in Table 2. Of note, a minority of respondents used electronic means for referral facilitation, while the majority disagreed that their electronic health record (EHR) made referral management easy.

In bivariate analysis, organization type (P = 0.0067), having a successful medical-to-dental referral system (P < 0.0001), referral method (P < 0.0001), and EHR ease of use for referrals (P < 0.0001) all had significant relationships with the dependent variable. Table 3 shows a summary of all bivariate comparisons.

No geographic indicators (census region or rurality) were significant in the multivariate analysis. All referral system indicators were significant. Dependable medical-to-dental referrals (P < 0.0001), ease of EHR use in making dental referrals (P = 0.0054), and how referrals were made (P = 0.0009) were all predictors of the dependent variable. The odds of those who agreed with having a dependable medical-to-dental referral system and also agreed with the dependent variable were 4.5 times greater than for those who disagreed about having a dependable medical-to-dental referral system (odds ratio 4.54, confidence interval 2.79–7.39). Respondents who agreed/strongly agreed that they had a successful network for medical-to-dental referrals had 4.54 times greater odds of agreeing that most medical providers deliver fluoride varnish and complete risk-based oral health assessments than respondents.
Table 1. Results from descriptive analyses of the survey respondents attending interprofessional oral health training

| Respondents characteristics* | Proportion of respondents (%) | Number of respondents |
|------------------------------|------------------------------|-----------------------|
| Dependent variable           |                              |                       |
| Agreement with the following statement: “Medical providers at our site, or part of our network, are administering fluoride varnish and identifying oral health risk factors in the majority of patients seen.” |                              |                       |
| Disagree                     | 31.3                         | 175                   |
| Agree                        | 68.7                         | 385                   |
| Geographic indicators        |                              |                       |
| Geographic region of practice/employment |                              |                       |
| Midwest                      | 16.4                         | 92                    |
| Northeast                    | 31.3                         | 175                   |
| South                        | 31.7                         | 178                   |
| West                         | 20.6                         | 115                   |
| Self-reported rurality of organization |                              |                       |
| Rural                        | 42.9                         | 240                   |
| Suburban                     | 32.1                         | 180                   |
| Urban                        | 25.0                         | 140                   |
| Organization indicators      |                              |                       |
| Type of organization         |                              |                       |
| Accountable care organization/coordinating care organization | 9.5                          | 53                    |
| Dental service organization  | 6.6                          | 37                    |
| Federally qualified health center | 40.4                      | 226                   |
| Rural health clinic          | 6.4                          | 36                    |
| Non–rural health clinic private practice | 37.1                      | 208                   |
| Person-level indicators      |                              |                       |
| Professional orientation/primary system of employment |                              |                       |
| Dental                       | 61.0                         | 325                   |
| Medical                      | 39.0                         | 208                   |
| Primary role in organization |                              |                       |
| Clinical care                | 30.2                         | 169                   |
| Leadership                   | 12.7                         | 71                    |
| Support staff                | 57.1                         | 320                   |

*There were 560 respondents for each of the dependent and independent variables, with the exception of professional orientation/primary system of employment (n=533). We were unable to assign 27 respondents to either medical or dental.

who disagreed/strongly disagreed with that statement (odds ratio 2.4, confidence interval 1.29–4.37). Table 4 summarizes logistical regression and adjusted odds ratio findings.

Discussion

In a previous analysis completed by the American Dental Association’s Health Policy Institute, it was reported that a key component of physician dissatisfaction was a lack of adequate sources for dental care referrals [11]. Our results corroborate these findings and those of Bernstein et al. [12] that physicians are more likely to facilitate interprofessional oral health practice through fluoride varnish applications when an established medical-to-dental referral system is in place. While the importance of treating dental referrals the same as any other specialty referral is explained by the US Department of Health and Human Services in its guidance around interprofessional
Table 2. Results from the descriptive analyses of the study cohort’s referral system or network

| Respondents’ referral system/network characteristics | Proportion of respondents (%) | Number of respondents |
|------------------------------------------------------|------------------------------|-----------------------|
| Directionality of interprofessional referral system ($n=560$) |                              |                       |
| No referral system currently in place                 | 33.4                         | 187                   |
| Bidirectional (medical to dental and dental to medical) | 40.7                         | 228                   |
| Medical-to-dental referrals only                      | 25.9                         | 145                   |
| Referral method (respondents could check all that apply) ($n=854$) |                              |                       |
| Electronic transfer                                   | 14.0                         | 119                   |
| Direct delivery (warm handoff, internal mail)         | 19.5                         | 167                   |
| All other methods                                     | 45.8                         | 391                   |
| Answered “no referral system currently in place”      | 20.7                         | 177                   |
| Agreement with the following statement: “Our electronic health record (EHR) makes medical-to-dental referrals easy” ($n=559$) |                              |                       |
| Disagree                                             | 76.6                         | 428                   |
| Agree                                                | 23.4                         | 131                   |
| Respondents’ self-reported status of having a dependable medical-to-dental system/network ($n=559$) |                              |                       |
| Disagree                                             | 51.3                         | 287                   |
| Agree                                                | 48.7                         | 272                   |

oral health practice [13], difficulties with achieving this level of referral between medical and dental care teams are frequently reported [14, 15].

Respondents who reported EHR ease of use were 2.4 times more likely to administer fluoride varnish and conduct risk assessments. A recent report from a multistate interprofessional practice collaborative found that when a risk assessment template was embedded within a site’s EHR, risk-based oral evaluations by medical providers increased [14]. A second analysis found that adding oral health provider prompts within an EHR system assisted in standardization and decreasing variation between multiple providers during well child care [2]. In an additional analysis of medical care providers’ perspectives on dental information needs in EHRs, the authors reported that respondents recommended “user-friendly access” to dental information communication was crucial to the delivery of holistic care [15].

While the type of referral system used by our respondents varied, use of electronic health information and referral transmission processes for interprofessional practice-related communication was positively related to the administration of fluoride varnish and oral health risk assessment evaluations. Respondents with interprofessional electronic transfer capabilities were nearly two times more likely to administer fluoride varnish and risk assessments. Although their impact on workflow processes, return on investment, and ability for interoperability need further examination, the benefits of electronic referral tools with EHR systems have been reported to result in more timely and improved communications as well as to provide better triage opportunities for provider teams [16, 17]. A lack of electronic information and referral exchange capability has been associated with oral health referral dissatisfaction by physicians [11, 14].

While our study identified organizational- and system-level correlates for the adoption of certain interprofessional oral health practice, it does have limitations. The quality of referrals and patient outcomes were not explored. Respondents provided perceptions and descriptions of interprofessional oral health practices. Our dependent variable was defined with two elements: fluoride varnish and risk assessment. It is possible some respondents operationalized their response to only one of the two-part construct. Participants were not given the opportunity to report the age of their patient populations, and survey questions were not designed to isolate information about the application of fluoride varnish in adult or pediatric care. Given that fluoride varnish application is most often associated with the well-child visit, a missed opportunity to gain knowledge of providers administering oral health care to nonpediatric populations may have occurred. In addition, it did not confirm the impact these practices had on the patients they serve. Data were collected anonymously from respondents who voluntarily
### Table 3. Results from bivariate analysis of dependent and independent variables

| Independent variables                              | Dependent variable: “Medical providers at our site, or part of our network, are administering fluoride varnish and identifying oral health risk factors in the majority of patients seen” | $P$ value |
|----------------------------------------------------|------------------------------------------------------------------------------------------------|-----------|
|                                                    | Disagree ($n$)* | Agree ($n$)                             |           |
| **Geographic variable: Region of practice/employment** | | | 0.0575 |
| Midwest                                            | 25 (27.2%) | 67 (72.8%)                               |           |
| Northeast                                          | 59 (33.7%) | 116 (66.3%)                              |           |
| South                                              | 65 (36.5%) | 113 (63.5%)                              |           |
| West                                               | 26 (22.6%) | 89 (77.4%)                               |           |
| **Geographic variable: Rurality level of organization** | | | 0.8535 |
| Rural                                              | 78 (32.5%) | 162 (67.5%)                              |           |
| Suburban                                           | 55 (30.6%) | 125 (69.4%)                              |           |
| Urban                                               | 42 (30.0%) | 98 (70.0%)                               |           |
| **Organization variable: Type of organization**     | | | 0.0067 |
| ACO/CCO                                            | 6 (11.3%)  | 47 (88.7%)                               |           |
| DSO                                                | 12 (32.4%) | 25 (67.6%)                               |           |
| FQHC                                               | 84 (37.2%) | 142 (62.8%)                              |           |
| RHC                                                | 9 (25.0%)  | 27 (75.0%)                               |           |
| PP                                                 | 64 (30.8%) | 144 (69.2%)                              |           |
| **Our organization/site has successfully implemented a dependable medical-to-dental referral system/network** | | | <0.0001 |
| Agree                                              | 41 (15.1%) | 231 (84.9%)                              |           |
| Disagree                                           | 133 (46.3%) | 154 (53.7%)                             |           |
| **Referral system variable: System/network directionality** | | | 0.4122 |
| No system                                          | 65 (34.8%) | 122 (65.2%)                              |           |
| Bidirectional                                      | 69 (30.3%) | 159 (69.7%)                              |           |
| Medical to dental only                             | 41 (28.3%) | 104 (71.7%)                              |           |
| **Referral method**                                | | | <0.0001 |
| Electronic transfer                                | 16 (13.5%) | 103 (86.5%)                              |           |
| Direct delivery (warm handoff, internal mail)      | 56 (33.7%) | 110 (66.3%)                              |           |
| All other methods                                  | 123 (31.5%) | 267 (68.5%)                             |           |
| Answered “no referral system currently in place”   | 62 (35.0%) | 115 (65.0%)                              |           |
| **Referral system variable: Type of agreement with the following statement: “Our electronic health record makes medical-to-dental referrals easy”** | | | <0.0001 |
| Agree                                              | 19 (14.5%) | 112 (85.5%)                              |           |
| Disagree                                           | 156 (36.4%) | 272 (63.6%)                             |           |

ACO, Accountable care organization; CCO, coordinating care organization; DSO, dental service organization; FQHC, federally qualified health center; RHC, rural health clinic; PP, private practice.

‘All responses of “neutral” on the five-point scale were grouped with “disagree” and “strongly disagree.”
participated in the study. As such, we were unable to identify
the number of individual practices represented; therefore it is
possible that multiple people from a single practice participated
in the survey. Given that we collected data across 44 states, we
anticipate potential clustering to be minimized.

**Conclusion**

This analysis demonstrated, in this motivated study popula-
tion, the importance of a dependable medical-to-dental refer-
ral systems and processes for fluoride varnish administration
and identification of oral health risk factors during primary
health care. In addition, the ease of EHR use and the avail-
ability of electronic referral mechanisms were found to impact
primary care oral health prevention and intervention. Given
the findings, further research is warranted to understand the
limitations and importance with participation in interprofes-
sional care by dental care providers. More detailed analysis on
how interprofessional processes may reduce oral health risk
and new cavitation, as well as the actual and perceived impact
on patient populations, may also be warranted.

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Table 4. Results from adjusted odds ratio estimates*

| Domains                        | Independent variables                                                                 | Adjusted odds ratio | Confidence interval | Covariate P from the model |
|--------------------------------|---------------------------------------------------------------------------------------|---------------------|---------------------|-----------------------------|
| Geographic indicators          | Census region (West as referent group)                                                 | 0.99                | 0.50–1.97           | 0.4497                      |
|                                | North                                                                                 | 0.94                | 0.38–1.78           |                             |
|                                | South                                                                                 | 1.54                | 0.73–3.24           |                             |
| Rurality (urban as referent group) | Rural                                                                               | 0.82                | 0.48–1.40           | 0.7560                      |
|                                | Suburban                                                                              | 0.86                | 0.50–1.50           |                             |
| Organizational type            | Organization type (rural health clinic as referent group)                              |                     |                     | 0.1211                      |
|                                | Accountable care organization                                                          | 0.59                | 0.16–2.22           |                             |
|                                | Dental service organization                                                           | 0.47                | 0.13–1.68           |                             |
|                                | Federally qualified health center                                                      | 0.33                | 0.12–0.86           |                             |
|                                | Private practice                                                                      | 0.53                | 0.19–1.50           |                             |
| Referral system attributes     | Has a successful network for medical-to-dental referrals (disagree/strongly disagree as referent group) |                     |                     | <0.0001                     |
|                                | Agree/strongly agree                                                                  | 4.54                | 2.79–7.39           |                             |
|                                | Referral directionality (one directional, medical to dental only as referent group)   |                     |                     | 0.7826                      |
|                                | No referral system                                                                    | 0.65                | 0.18–2.39           |                             |
|                                | Bidirectional                                                                         | 0.91                | 0.50–1.63           |                             |
|                                | Referral method (electronic health record as referent group)                          |                     |                     | 0.0009                      |
|                                | Warm handoff                                                                          | 0.22                | 0.10–0.51           |                             |
|                                | All other methods                                                                     | 0.26                | 0.12–0.54           |                             |
|                                | No method                                                                             | 0.54                | 0.13–2.29           |                             |
|                                | Ease of electronic health record use for making dental referral (disagree/strongly disagree as referent group) |                     |                     | 0.0054                      |
|                                | Agree/strongly agree                                                                  | 2.37                | 1.29–4.37           |                             |

*All responses of “neutral” on the five-point scale were grouped with “disagree” and “strongly disagree.”
Author contributions
Sean G. Boyens conceptualized and designed the study and survey instrument, collected primary data, and drafted the initial manuscript. Abigail Lauer designed the statistical analysis, performed the statistical analysis, and reviewed and revised the manuscript. Amy Martin developed the study framework, supervised the statistical analysis, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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