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Journal of Health Care for the Poor and Underserved, Volume 32, Number 2, May 2021 Supplement, pp. 366-382 (Article)

Published by Johns Hopkins University Press

DOI: <https://doi.org/10.1353/hpu.2021.0068>

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Implementation of Care Coordination and Technology in the Dental Setting to Address High-risk Patient Needs

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Abstract: Poor oral health, and biological impact of oral disease, affects a person's general health and well-being. Using electronic dental health record data to identify high-risk dental caries patients coupled with a new oral health team member, the dental care advocate (DCA) facilitated the dental organization's ability to create TechQuity by enabling outreach to the patients in need of the most care, the high-risk dental caries patient. Conclusions: $N = 86,025$, patients with at least one DCA contact were significantly associated with an increased odds of patients scheduling an appointment compared with those who had no DCA contact, adjusting for other factors in the model (odds ratio [OR] = 2.41 (95% CI: 2.31, 2.51)). Patients with any DCA interactions are significantly associated with increased odds of attending an appointment, compared with those who had no DCA interactions, adjusting for other factors in the model [OR] = 2.31 (95% CI: 2.22, 2.34).

Key words: Care coordination, health equity, oral health, health care technology.

When patients receive different types of care in terms of the provider, the location, and timeliness, variations of care exist in the U.S. health care system. The Institutes of Medicine's (IOM) 2001 report, *Crossing the Quality Chasm*, posits that improving health care quality requires changing the health care system's design.¹ Decades later, digital technology has opened the doors for measuring and analyzing health care data at the individual and population levels,² transforming health care operations, policy, and system redesign. Most importantly, digital technology has enabled a coordinating

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mechanism between the provider and the patient.^{3,4,5} Leveraging digital information in a coordinated way opens the door for the rapid dissemination of data into clinical and operational implementation, thereby improving the health care delivery system. Dentistry, a health care system component, is slowly adopting a digital patient chart called an electronic dental record (EDR).^{6,7} However, of the dental practices employing EDRs, the extraction of standardized patient data in a structured way, to target quality improvements, reduce disparities, and target vulnerable populations, is in its infancy.^{8,9}

Dental caries is both a highly prevalent disease and serves as a marker of health disparities along racial/ethnic, age, ability, and socioeconomic status groups. This study extracted EDR data from appointment-scheduling and dental appointment attendance for patients at high risk for dental caries. The patient's caries risk level is determined by the balance and severity of protective factors such as fluorides, and pathological factors, such as high fermentable-carbohydrate consumption. This targeted risk group of dental patients needs interventions from the provider teams to arrest and prevent carious lesions' development and progression.¹⁰ To accomplish a positive oral health impact for the high-risk caries patient, the coordination of the care to include follow-up aftercare and scheduling an appointment is one way to provide equity of oral health resources for the most vulnerable.

This study is significant for those seeking to understand high-risk caries patients of all ages using the data recorded in the EDR. Studies have not been conducted using structured data from the patients' EDR and scheduling and attendance as fostered by a dental care coordinator role. This study aimed to measure the care coordinators' efforts with the identified high-risk caries patients. The relational coordination framework used conceptually to guide this study indicates that well-designed job structures and positive intra-organization relationships will lead to care outcomes that positively benefit the patient. The study's data enables the dental organization to understand the impacts of care coordination efforts on high-risk caries patients, who are disproportionately vulnerable across several demographic domains, as one type of patient outcome measure of dental care. This type of patient outcome measure in dentistry is missing in care coordination and leverages technology advance health equity through technology, also known as *TechQuity*.

Background. Role of the dental care advocate. The purpose of the dental care advocate (DCA), a care coordination role, is to oversee patient flow and coordinate effective communication between patients, dentists, practice managers, and clinical staff. The dental care advocate acts as a liaison to foster patient oral health improvement initiatives and engagement with the patient. The DCA training program is built on the 70 –20 –10 model of learning. Seventy percent of the teaching takes place on the job through experiential learning. Twenty percent of the education takes place through coaching, mentoring, and interaction with peers in a standard format. Lastly, 10% of the instruction occurs in a formally structured way to include instructor-led and online courses along with self-directed experiences. All DCAs go through a certification process evaluated by the lead dentists at the practice. The organization has an enterprise peer, the dental care advocate development specialist, to sustain the certification process, continued growth, and learning and instruction.

Dental caries. Mostly preventable, dental caries and periodontal diseases are the

two most prevalent and among the common chronic diseases in the United States.^{11,12} Education efforts promoting the importance of disease prevention are vital to raising awareness to stop or prevent disease progression. At the same time, Accountable Care Organizations (ACOs) were created to improve health by holding the health systems responsible for the cost, quality, and outcomes of care for the population they serve.¹³ Care coordination efforts, documenting the patient and provider's responsiveness from a dental care delivery standpoint, is one way to deliver high-performance outcomes to reduce the dental disease burden in a population.¹⁴ However, studies of the intervention efforts using care coordinator type roles and follow-up of the patient's dental care are limited. For instance, in a study published in 2010, Binkley, Garrett, and Johnson sampled 10,000 Medicaid-insured children ages four to 15 in West Louisville, Kentucky, to assess the effects of a dental care coordinator intervention among Medicaid-eligible children.¹⁵ Findings from the study determined utilization was higher in the intervention group (43%) than in the control group (26.5%); $P = .047$ (95% CI 1.0–4.25). The intervention consisted of telephone calls and a 45–60 minute in-person home visit.

Risk assessment: Dental disease. In dentistry, the two common oral diseases are dental caries (tooth decay) and periodontal diseases (gum disease). Science has evolved to attribute the risk of caries to “physical, biological, environmental, behavioral, and lifestyle factors such as high numbers of cariogenic bacteria, inadequate saliva flow, insufficient fluoride exposure, poor oral hygiene, inappropriate methods of feeding infants, and poverty.”^{16[p.51]} Periodontal disease can be attributed to non-modifiable risk factors, such as genetics, and modifiable risk factors, such as pathogenic microorganisms.¹⁷ By looking at the elements in each of the oral diseases, caries and periodontal, risk profiles can be created to determine the patient's risk level from a low range, attributed to minimal factors, to high, with significant factors intensifying the disease.

The sizeable dental organization has developed and standardized risk assessment tools for each oral disease, caries (caries management by risk assessment, CAMBRA), and periodontal (periodontal management by risk assessment, PEMBRA) support treatment and outreach efforts to patients. Both risk assessment tools operate in the EDR, enhancing clinical decision support to measure the completion of the risk assessment profile by the primary care dentist of record for each patient. Risk profiles are reviewed and updated at each regular dental examination visit. The risk assessment profile determines the level of risk from low to the extreme range for the patient. With the risk assessment profile complete, the variables generated go into an individualized prevention and treatment summary given to the patient, called the proactive dental care plan (PDCP).¹⁸

The electronic dental record: axiUm. The large dental care organization adopted an electronic dental record across 53 offices in Oregon, Washington, and Idaho in 2013. The EDR, axiUm, can leverage specified forms and structured data specifically for the DCA. Two types of forms in the EDR are designed for DCA use in high-risk patients' care coordination; these are the follow-up form and patient contact notes. When a high-risk caries patient is identified, needing an intervention for treatment or home preventions support, the DCA is trained to use motivational interviewing techniques in coordination with the follow-up form while discussing follow-up treatment plan-

ning and scheduling. The objective is to engage the patient in fostering a partnership with their continuing care.

The contact note is a central area of axiUm where the DCA and other operational personnel can leave notes about attempts to contact the patient, voicemails, automated appointment reminder data, patient grievance activities, and insurance information. There are over 35 different note types in the contact notes. The DCA can use each of the note types within the EDR.

In the same way, a follow-up form is designed for use by the DCA. The form is used when a DCA places an intervention call. The sections comprise a set of standardized questions, a field to record the patient's response, and date. A free text field is added to the form to record any other information resulting from the interaction the DCA has with the patient. The form allows the DCA to track each high-risk patient and their customized treatment plan, understanding that the DCA follows the progress of multiple high-risk caries patients over an extended period. The follow-up form is attached to the patient's electronic dental record and is accessible to the DCA through a module in the EDR that retains assigned forms. The DCA can review the form anytime they are connected to the EDR-axiUm. Updates and any additional information happen each time a conversation is encountered (an intervention), with patients moving from high or extreme-risk to moderate-risk or low caries risk.

Lastly, the impact of DCA-patient coordination efforts to improve the patient's adherence to care can be measured using data collected in these DCA interactions. A DCA intervention is measured as communication between the DCA and the patient and is recorded in the EDR as either a contact note or a follow-up form. To evaluate the overall outcome of improvement in the patient's disease assessment, a critical appraisal of the interaction the DCA has with the patient to influence behavior is essential. This study uses care coordination at the appointment and attendance level as a proxy for adherence to risk-reduction efforts to improve the risk profile of the high-risk caries patient.

Relational coordination (RC) theory. Relational coordination theory provides a lens to understand the relational importance of job groups to affect care coordination for the patient.¹⁹ Gittell asserts that relational coordination differs from other approaches to coordination along three specific relationship dimensions needed for effective coordination.²⁰ Gittell states:

These dimensions—shared knowledge, shared goals, and mutual respect—can be seen as characteristics of the relationships between participants in a work process that influence and are [sic] influenced by the nature of their communication. Shared knowledge situates participants cognitively, shared goals situate participants motivationally, and mutual respect situates participants socially vis-à-vis other participants in the work process.^[p.302]

The relational coordination theory posits improved efficiencies, quality, and safety outcomes when employee jobs are supported with vital communication attributes among teams and cohesive relationships across team members.^{21,22,23,24,25} To illustrate, the care coordination function is embedded in the ACO dental organization through a defined role of the dental care advocate (DCA) with the commencement of a job design built

to share knowledge, share goals, and foster communication between the dental team and the patient. In theory, when these components are in place, the patient-to-provider performance improves. The outputs of the redesigned organizational structure and improved relationships through the DCA's job design may influence the outcomes of patient care.

This paper investigates the DCA's interaction activities (a measure of care coordination efforts), compared with uncoordinated care, as measured by the absence of interaction by the DCA on all high-risk dental caries patients.

Methods

The research methods for this study used a retrospective correlational design to determine whether the dental care advocate interaction (contacting the patient and recording the efforts in the EDR) resulted in a scheduled and attended appointment, using archival data from the EDR, longitudinally over three years—2016, 2017, and 2018.

Research hypotheses.

H_{o1} : Dental care coordinators do not affect high-risk caries patients scheduling an appointment.

H_{a1} : Dental care coordinators affect high-risk caries patients scheduling an appointment.

H_{o2} : Dental care coordinators do not affect high-risk caries patients attending an appointment.

H_{a2} : Dental care coordinators affect high-risk caries patients attending an appointment.

Design. The research design uses the DCA coordination activities, called an interaction, as the independent variable (IV) and the patient's behavior (the individual scheduling and attending an appointment) as the dependent variable (DV). The design includes general scheduling and attendance during 2016, 2017, and 2018 for patients without the DCA interaction. Specifically, all of the patients identified as high-risk caries patients seen in the dental office in 2016, 2017, and 2018 are divided into two groups A and B (Figure 1). In the A group, the patient has at least one interaction with the DCA; in the B group, the patient does not interact with the DCA. Both the A and B groups follow the same analysis plan listed in the section covering the analysis structure. The analysis determines the impact (negative or positive) of the DCA's care coordination efforts on the scheduling and attending a dental appointment in high-risk caries dental patients.

Participants. A de-identified participant list ($n = 86,025$) provided from archival data, including all high or extreme-risk caries patients of all ages and genders, who were assigned to one accountable care insurance group, and who had a dental exam that included a risk profile in the EDR within six months of the DCA intervention during 2016, 2017, and 2018.

Materials. Upon Institutional Review Board (IRB) approval from Pacific University, de-identified Excel spreadsheets were provided to the principal investigator. Included

Figure 1. The workflow of research variables of the dental care advocates interaction with a high-risk caries patient

Note:
The DCAC interaction includes contact notes and follow-up forms reported in axiUm.

in the spreadsheets are all patients of high-risk caries attending a new patient appointment or a return (recall) appointment (called *continuing care*). The spreadsheet contains descriptive variables, including the number of caries (decayed surfaces), the patient's age, and gender (Appendix A). The Excel data report the DCA interaction as the number of contact and follow-up notes recorded by the DCA within six months of the exam visit. Exam visits are identified by procedure codes provided by the American Dental Association Code on Dental Procedures and Nomenclature (CDT) 2019; dental procedure codes D0150 (new patient exam) and D0120 (continuing patient exam) were used to generate the *N* of participants for the study as shown in Figure 2.²⁶

Moderate and low-risk caries patients with D0150 and D0120 CDT procedure codes were excluded from the sample. All the study data were from the EDR and extracted from the scheduling system to identify the type, date, and time of an appointment scheduled and attendance (show or no-show) of the patient.

Procedure. Scheduling and contact data from January 2016 through to December 2018, extracted from axiUm, were used in the analysis of the DCA's involvement in care coordination, as identified by the interaction of the DCA with a patient (IV), and if this influenced a patient to schedule a dental appointment and attend a scheduled dental appointment (DV). An interaction is defined as a call or oral communication between the DCA and the high-risk patient or responsible party recorded in the EDR. Two groups were assigned; Group (A) were the patients with whom a DCA had interacted, as listed in the EDR. Group (B) were the patients who met the inclusion criteria but did

D0120	Periodic Oral Evaluation—Established Patient
	An evaluation performed on a patient of record to determine any changes in the patient's dental and medical health status since a previous comprehensive or periodic evaluation. This includes an oral cancer evaluation and periodontal screening where indicated and may require interpretation of information acquired through additional diagnostic procedures. Report additional diagnostic procedures separately.
D0150	Comprehensive Oral Evaluation—New or Established Patient
	Used by a general dentist and/or specialist when evaluating a patient comprehensively. This applies to new patients; established patients who have had a significant change in health conditions or other unusual circumstances, by report, or established patients who have been absent from active treatment for three or more years. It is a thorough evaluation and recording of the extraoral and intraoral hard and soft tissues. It may require interpretation of information acquired through additional diagnostic procedures. Additional diagnostic procedures should be reported separately.

Figure 2. CDT 2019 Dental Procedure Codes Definitions

Note:
American Dental Association (ADA). CDT 2019 now available to aid accurate coding. Chicago, IL: ADA, 2019. Available at: <https://www.ada.org/en/publications/ada-news/2018-archive/august/cdt-2019-now-available-to-aid-accurate-coding>.

not have a DCA interaction recorded in the EDR. The analysis adjusts for descriptive elements such as the patient's age, gender, and the number of caries for each patient.

The analysis plan does not compare insurance-employer groups; the study is designed to consider all the accountable-care plan types within the three years and investigate the potential relationships of gender, age, or decayed surfaces. All patients, regardless of socioeconomic status or geography, are included in the study if they have an accountable care plan.

Calculation of the variables. A calculated aggregate *N* of high caries-risk, accountable care dental insurance patients seen for an exam is identified in the EDR (Table 1). High-risk patients are typically scheduled for exams at no more than six-month intervals. Each qualifying exam visit is included in the *N*. For each of the qualifying exam visits, the following elements from the EDR were extracted to a Microsoft (MS) Excel spreadsheet for initial analysis: Exam Date, Exam Type (new patient or continuing care exam), Caries Risk Level (High or Extreme only included), Oral Health Level (measured as "Phase"), number of decayed surfaces, patient age, patient gender, patient home address/ZIP code, rural/urban, health literacy level, race, and number of DCA interactions within six months after the exam, number of appointments scheduled within six months after the exam, and number of appointments attended within six months after the exam. The patient cases are grouped as either no DCA interaction or

Appendix A.

THE DCA INTERVENTION DATA—MICROSOFT EXCEL SPREADSHEET

Year	Patients in Study	DCA contact	Appt Scheduled AY	% with Appt AY%	Appt No- showed AYN	% with No- show AYN%	Appt Attended AYY	% with Appt Attended AYY%	No DCA Contact B	Appt Scheduled BY	% with Appt BY%	Appt No- showed BYN	% with No- show BYN%	Appt Attended BYY	% with Appt Attended BYY%	% with DCAC that Attended AYY2%	% w/o DCAC that Attended BYY2%
Care Advocate Followup Only																	
2016	26930	148	127	86%	28	22%	124	98%	26782	16797	63%	2583	15%	16157	96%	84%	60%
2017	27738	1364	975	71%	172	18%	943	97%	26374	16711	63%	2774	17%	15915	95%	69%	60%
2018	31324	931	706	76%	134	19%	682	97%	30393	20313	67%	3719	18%	19216	95%	73%	63%
Care Advocate Followup or Care Advocate Contact Note																	
2016	26930	498	449	90%	95	21%	441	98%	26432	16475	62%	2516	15%	15840	96%	89%	60%
2017	27738	6307	4982	79%	954	19%	4814	97%	21431	12704	59%	1992	16%	12044	95%	76%	56%
2018	31324	10358	8377	81%	1779	21%	8044	96%	20966	12642	60%	2074	16%	11854	94%	78%	57%
Variable	Criteria	Explanation										Used for					
N	Patient with an exam and is high CRA	This is our set of distinct patients to work with															
A	Patient has a DCA follow-up form within 6 months of exam	DCA form found in EHR															
AY	Patient had an appointment scheduled within 6 months of exam	DCA and appointment scheduled															
AYN	Patient failed at least 1 appointment (no-showed)	DCA, appt, no-showed															
AYY	Patient attended at least 1 appointment	DCA, appt, showed															
B	Patients with no DCA follow-up form within 6 months of exam	DCA form not found in EHR (= N - A)															
BY	Patient had an appointment scheduled within 6 months of exam	No DCA and appointment scheduled															
AYN	Patient failed at least 1 appointment (no-showed)	No DCA, appt, no-showed															
BYY	Patient attended at least 1 appointment	No DCA, appt, showed															
AY%	% of patients with DCA followup and appt scheduled	DCA, appt scheduled (as % of A)															
AYN%	% of patients with DCA followup and appt scheduled that no-showed	DCA, appt, no-showed (as % of AY)															
AYY%	% of patients with DCA followup and appt scheduled that attended appt	DCA, appt, showed (as % of AY)															
AYY2%	% of patients with DCA followup that attended appointment	DCA, showed for appt (as % of A)															

Note:
The spreadsheet of all qualifying exam visits in the three years (2016–2018).

Table 1.

THE PERCENTAGES OF ALL HIGH-RISK CARIES DENTAL PATIENTS IN THE COMPARISON GROUPS FOR 2016, 2017, AND 2018

Year	2016	2017	2018
Number of Pt Exams (N)	26941	27750	31334
DCA Interaction (A)	498 (2%)	6312 (23%)	10361 (33%)
(At least one DCA contact)			
Scheduled Appt (AY)	449 (90%)	4987 (79%)	8379 (81%)
Attended (AYY)	441 (89%)	4819 (76%)	8046 (78%)
No-showed (AYN)	8 (2%)	168 (3%)	333 (4%)
(as a percentage of AY)			
No DCA Interaction (B)	26443 (98%)	21438 (77%)	20973 (67%)
Scheduled Appt (BY)	16480 (62%)	12708 (59%)	12646 (60%)
Attended (BYY)	15844 (60%)	12048 (56%)	11858 (57%)
Non-attendance (BYN)	636 (4%)	660 (5%)	788 (6%)
(as a percentage of BY)			
Overall no-attendance Rate	35604 (5.5%)	44554 (6.3%)	51532 (6.6%)
(entire organization)			

Note:

Data retrieved from axiUm.

DCA interaction based on the presence of at least one contact note or follow-up form indicating a DCA interaction occurred.

The data analysis includes two independent samples for proportions tests. The first analysis is the percentage of patients scheduling for at least one appointment (AY vs. BY). The second is the percentage of patients attending at least one appointment (AYY vs. BYY). A Wilcoxon signed-rank test is used to test for normal distribution of the data. A binary logistic regression is used to model the binary dependent variable's scheduling and attendance. The analysis adjusts for baseline covariates, including the number of decayed surfaces, patient age, patient gender, rural/urban home address, health literacy level, race, gender, and age. Lastly, an odds ratio established the strength of the association between contact with a DCA and scheduling and attendance behavior.

All analyses performed using a standard significance level of .05 ($\alpha = .05$). All study data are stored in an Oracle database, and analysis employs a combination of SQL (Standard Query Language), Microsoft Excel spreadsheets (version 16.0.12624.20348), R Statistics (version 6.3.1).^{27,28,29}

Table 2.
DESCRIPTIVE STATISTICS FOR VARIABLES COLLECTED

Patient Exams (N = 86,025)	No DCA Interaction (N = 68,854)	DCA Interaction (N = 17,171)	Test	p-value
Gender				
Female	49.4% (34,028)	5.0% (8,591)	-.99 (z)	.32
Male	5.5% (34,790)	49.9% (8,568)	.99 (z)	.32
Age				
Mean	33.4	36.3	-18.05 (t)	< .0001
Median	32	35		
Range	1-97	1-95		
Standard deviation	18.8	18.2		
Decayed Surfaces				
Mean	5.2	7.3	-26.21 (t)	< .0001
Median	3	4		
Range	0-128	0-128		
Standard deviation	7.4	9.9		
Rural/Urban				
Rural	1.8% (7,418)	11.3% (1,937)	-.6287	.5295
Urban	89.0% (61,296)	88.6% (15,206)	1.4066	.1595
Unknown	.2% (140)	.2% (28)	—	—
Race				
White	67.5% (46,740)	67.2% (11,536)	.6158	.538
Non-white	19.7% (13,580)	21.5% (3,695)	-2.4214	.0115
Unknown	12.8% (8,804)	11.3% (1,940)	1.8066	.0708
Need Help With Instructional Material				
Never need help	64.3% (44,252)	67.0% (11,509)	-5.4049	<.0001
Rarely need help	17.4% (11,966)	17.7% (3,036)	-.3889	.6974
Sometimes need help	6.3% (4,328)	5.8% (994)	.5892	.5557
Often need help	2.3% (1,578)	1.8% (306)	.5434	.5868
Always need help	9.5% (6,510)	7.4% (1,263)	2.3679	.0179
Unknown	.3% (220)	.4% (63)	-.1235	.9017

Note:
Microsoft Excel spreadsheets (version 16..12624.20348)

Results

There were $N = 86,025$ patient exams in the cohort. Females represented 49.5% (42,619) of the high-risk assessed examinations, 50.4% (43,358) were male, and 0.1% (48) did not identify as male or female. Patients ranged in age from 1 to 97 years, with an average age of 34. The patients' number of decayed surfaces ranged from 0 to 128, with an average of 5.6 decayed surfaces (Table 2).

Table 3.

LOGISTIC REGRESSION MODELING THE ODDS OF A SCHEDULED APPOINTMENT OF A HIGH-RISK CARIES PATIENT WITH AN INTERACTION FROM THE DENTAL CARE ADVOCATE

Appointment Scheduled	Odds Ratio	Std. Err.	Z	p-value	95% Conf. Interval
Any Interaction (N = 86,025)	2.41	.05	41.56	< .0001	2.31
Gender					
Male	—	—	—	—	—
Female	1.06	.02	3.89	< .0001	1.03
Patient Age	1.02	.00	33.16	< .0001	1.01
Rural/Urban					
Urban	—	—	—	—	—
Rural	.85	.02	-7.01	< .0001	.81
Unknown	.94	.23	-.28	.78	.58
Need Help With Instructional Material					
Never	—	—	—	—	—
Rarely	1.11	.02	4.98	< .0001	1.06
Sometimes	1.11	.03	3.20	< .0001	1.04
Often	1.04	.05	.77	.44	.94
Always	1.07	.03	2.55	.01	1.02
Race					
White	—	—	—	—	—
Non-White	1.12	.02	5.85	< .0001	1.08
Unknown	.76	.02	-12.65	< .0001	.72
Decayed Surfaces	1.05	.00	36.91	< .0001	1.05
Constant	.73	.02	-14.11	< .0001	.70

Note:

Microsoft Excel spreadsheets (version 16.12624.20348)

There were two primary outcomes of interest measured as binary variables: appointments scheduled and appointments attended. A multivariate logistic regression method was used to determine whether there was an association between DCA contacts and the appointments scheduled/attended. Each model adjusted for gender, age, decayed surfaces, race, health literacy level, rural/urban home address, and reported the odds ratio along with the corresponding 95% confidence intervals.

Table 3 shows the results of logistic regression models of the odds of scheduling an appointment. Patients with at least one DCA contact were significantly associated with an increased odds of patients scheduling an appointment compared with those who had no DCA contact to schedule an appointment, adjusting for other factors in the model

(odds ratio [OR] = 2.41 (95% CI: 2.31, 2.51). Further of the descriptive variables of patients that were contacted by the DCA, female patients were significantly more likely than male patients to schedule an appointment [OR] = 1.06 (95% CI: 1.03, 1.09). As well as increasing patient age [OR] = 1.02 (95% CI: 1.01, 1.02) was significantly associated with scheduling an appointment. As for geographical location, patients living in rural areas were significantly less likely to schedule an appointment than those living in urban areas [OR] = 0.85 (95% CI: 0.81, 0.89). Of the patients who need help with instructional material; rarely needing help with instructional materials [OR] = 1.11 (95% CI: 1.06, 1.15); sometimes needing help with instructional materials [OR] = 1.11 (95% CI: 1.04, 1.18); always needing help with instructional materials [OR] = 1.07

Table 4.

LOGISTIC REGRESSION MODELING THE ODDS OF AN ATTENDED APPOINTMENT OF A HIGH-RISK CARIES PATIENT WITH AN INTERACTION FROM THE DENTAL CARE ADVOCATE

Appointment Attended	Odds Ratio	Std.	Err.	Z	p-value	95% Conf. Interval
Any Interaction (N = 86,025)	2.306	.047	41.24	< .0001	2.216	2.399
Gender						
Male	—	—	—	—	—	—
Female	1.083	.016	5.48	< .0001	1.053	1.115
Patient Age	1.017	.000	38.31	< .0001	1.016	1.018
Rural/Urban						
Urban	—	—	—	—	—	—
Rural	.867	.020	-6.15	< .0001	.829	.907
Unknown	.955	.226	-.2	.845	.600	1.519
Need Help With Instructional Material						
Never	—	—	—	—	—	—
Rarely	1.127	.022	6.03	< .0001	1.084	1.171
Sometimes	1.153	.036	4.58	< .0001	1.085	1.225
Often	1.124	.056	2.36	.018	1.020	1.239
Always	1.193	.033	6.38	< .0001	1.130	1.260
Race						
White	—	—	—	—	—	—
Non-White	1.071	.020	3.69	< .0001	1.033	1.111
Unknown	.726	.016	-14.6	< .0001	.695	.758
Decayed Surfaces	1.041	.001	32.6	< .0001	1.039	1.044
Constant	.613	.014	-21.97	< .0001	.587	.640

Note:
Microsoft Excel spreadsheets (version 16.12624.20348)

(95% CI: 1.02, 1.13) were statistically more likely to schedule an appointment than those not needing help with instructional material. Non-White patients had increased odds of scheduling an appointment than White patients [OR] 1.07 (95% CI: 1.03, 1.11). Decayed surfaces were associated with an increased odds of scheduling a dental appointment [OR] = 1.05 (95% CI: 1.05, 1.05).

Table 4 shows the results of logistic regression models of the odds of attending an appointment. Patients with any DCA interactions are significantly associated with increased odds of attending an appointment, compared with those who had no DCA interactions, adjusting for other factors in the model [OR] = 2.31 (95% CI: 2.22, 2.34). Further, female patients were significantly more likely to attend an appointment than male patients [OR] = 1.08 (95% CI: 1.05, 1.12). Older patients had increased odds of attending an appointment than younger patients [OR] = 1.02 (95% CI: 1.02, 1.02). Patients living in rural areas were significantly less likely to attend an appointment than those living in urban areas [OR] = 0.87 (95% CI: 0.83, 0.91). Of the patients who reported needing help with instructional material; rarely needing help with instructional materials [OR] = 1.13 (95% CI: 1.08, 1.17); sometimes needing help with instructional materials [OR] = 1.15 (95% CI: 1.08, 1.23); always needing help with instructional materials were [OR] = 1.07 (95% CI: 1.02, 1.13) were statistically more likely to attend a dental appointment. Non-White patients had increased odds of attending an appointment [OR] = 1.07 (95% CI: 1.03, 1.11). Decayed surfaces were associated with increased odds of attending a dental appointment [OR] = 1.04 (95% CI: 1.04, 1.04).

Discussion

This quantitative investigation has shown the effects of DCA contact on high-risk patients' scheduling and attending a dental appointment ($n = 17,171$), and patient scheduling and attendance with no DCA contact ($n = 68,854$). Studies have found that regular dental appointment attendance by patients results in better oral health.³⁰ While age, gender, race, health literacy level, rural/urban home address, and the number of decayed surfaces each had some level of significance, the study's overall focus is on the DCA's impact on the scheduling and attendance of the patient to continue care. Additional studies investigating attendance and scheduling patterns with an outcome of disease-decay reduction at the tooth level within a patient population are needed in dentistry.

Findings from this study indicate that patients with a DCA interaction are more than twice as likely to schedule and attend a dental appointment than those in the non-interaction DCA group. Year-over-year data indicate an increasing rate of patients having contact with the DCA role. Several factors may influence this. The 2016 data are included in the analysis as a baseline measurement year and included in the analysis to mark the role's inauguration. The investigator included 20 days of data in the analysis to reflect the year the role officially started. The widely dispersed sites within the dental organization may have influenced the slow dissemination of the interaction expectations of the DCA as the forms and contact notes were not measured or monitored for performance. More DCA interactions of the high-risk patients occurred through

enhancements in the EDR and the introduction and sharing of quality measurement within the dental organization.

Additionally, the advent of accountable care health care payment reform and measurement has driven enhanced targeted dental benefits for those patients who have been identified as high-risk. As the organization is compensated for the additional benefit, the the strength of the outreach interventions may be influenced by the change in the dental benefit design. As dental plan benefits are typically deployed on a year-to-year basis, this may have affected the focus of the DCA interaction.

Overall, of the high-risk dental patients who had an interaction with the DCA, 80% scheduled, and over 75% attended an appointment within their risk-appropriate interval. The high-risk patient's positive direction to schedule and attend dental treatment is in alignment with the disease prevention strategies to delay or avoid future extensive dental trauma. However, with the current dental payment system that focuses on payment for procedures rather than diagnosis, treatment, and outcome measures, the profession is at odds with embedding disease mitigation efforts into the mainstream of dental practice due to the financial cost. The cost of a DCA to do the interaction versus automation of the interaction process via patient portals may influence the adoption rate from an employee expense side.

The high-risk assessed caries patients and those with more help needed are more likely to make appointments, holding the DCA interaction constant. Qualitative data would be helpful to understand more about the approach by the risk that is engaging the high-risk patients.

While any interaction strategy may produce positive results, there are several limitations to this study. The systematic review of McLean et al. studied appointment reminder systems and found the accuracy of the patient record is often out of date, lacking current phone numbers or contact information, indicating the intervention is mitigated by information in the health record.³¹ To improve advocacy for the patient, updates to the data are critical. This can influence the likelihood of scheduling and attendance interaction efforts by the DCA. The ramifications to the patient who is not contacted by the DCA are that they must schedule their care independently.

Another cause for the lack of scheduling and attendance maybe lie with the lack of understanding of the need for continued care by the dental patient. Socioeconomic status data were not available for analysis as a covariate. Such analyses might provide insight into the scheduling and attendance patterns of a capitated insurance plan with the large accountable care dental organization.

Future work will be critical to measure human contact versus the available technology to connect the patient through a digital space such as a patient portal offering online support and personal connectedness with the provider. These types of systems may be leveraged in ways to increase scheduling and attendance patterns in the future by providing direct access to a provider and patient. However, one point of future study must compare the cost of automated systems versus a DCA staff member, as well as the extent to which the difference is offset by the possible advantage of more patients scheduling and attending appointments when they have experienced direct human contact.

The DCA is a useful initiative to improve scheduling and attendance of high-risk

dental caries patients, but would not be possible without the technology-enabled risk assessments, and EHR follow up and contact notes. Dental care advocates play a vital role in care coordination by assisting the patient in scheduling and improving patient attendance. For dental care organizations seeking to improve the scheduling and attendance of their patients and their patients' health, dental care advocates play a vital role in coordinating patient care. With increased patient appointment attendance for our highest-risk patients, health outcomes will improve, and care costs will decrease.

Acknowledgments

This paper and the research behind it would not have been possible without the exceptional support of Willamette Dental Group. Dr. Eugene Skourtes, knowledge and vision, have been an inspiration and kept my work on track to advance oral health care systems that deliver proactive patient care through a partnership with our patients to stop the disease repair cycle through evidence-based prevention and treatment.

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