Examining the association of medical-dental integration with closure of medical care gaps among the elderly population

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Abstract

Background.—The integration of medical and dental care in the dental setting offers a unique opportunity to close medical care gaps, such as providing immunizations and laboratory-based tests, compared with traditional nonintegrated settings.

Methods.—We used a matched cohort study design among patients 65 years or older (n = 2,578) with an index dental visit to the Kaiser Permanente Northwest medical-dental integration (MDI) program from June 1, 2018, through December 31, 2019. MDI patients were matched 1:1 to non-MDI controls (n = 2,578) on 14 characteristics. The Kaiser Permanente Northwest MDI program focuses on closing 23 preventive (for example, flu vaccines) and disease management care gaps (for example, glycated hemoglobin testing) within the dental setting. The closure of all care gaps

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(yes versus no) was the outcome for the analysis. Multivariable logistic regression was used to evaluate the association between exposure to the MDI program and level of office integration (least, moderate, and most integration) with closure of care gaps. All data were obtained through Kaiser Permanente Northwest's electronic health record.

Results.—MDI patients had significantly higher odds (odds ratio [OR], 1.46, 95% confidence interval [CI], 1.29 to 1.65) of closing all medical care gaps than non-MDI patients. Greater MDI integration was associated with significantly higher odds of gap closure compared with non-MDI (least integration: OR, 1.18, 95% CI, 1.02 to 1.37; moderate integration: OR, 1.70, 95% CI, 1.36 to 2.12; most integration: OR, 2.08, 95% CI, 1.73 to 2.50).

Conclusions.—Patients receiving dental care in an MDI program had higher odds of closing medical care gaps compared with similar patients receiving dental care in a non-MDI program.

Practical Implications.—MDI is effective at facilitating delivery of preventive and disease management medical services.

Keywords

Medical-dental integration (MDI); medical care gaps; Medicare

Several professional societies recommend ongoing receipt of preventive medical services for adults, such as immunizations (for example, influenza), cancer screening (for example, mammography), and disease management monitoring.[1–3] The benefits of receiving these services have been well documented with reductions in morbidity and mortality. For example, regular receipt of glycated hemoglobin (HbA_{1c}) testing for adults with diabetes mellitus (DM) has been shown to improve cardiovascular outcomes for adults with DM.[4–8] The need for such services is especially important for people 65 years or older, nearly 80% of whom have 2 or more chronic conditions and require routine preventive and disease management care.[9,10]

The dental setting has emerged as a potentially effective venue to provide preventive and disease management services to close medical care gaps. Prior research showed that integration of medical and dental health records within the same health system and using electronic health record (EHR) alerts to inform dental providers when their patients are overdue for preventive and disease management services can reduce emergency department (ED) and hospital use.[11,12] Other studies have also found that better integration between dental and medical care reduces patient barriers to care access, diabetes-specific hospital admissions, and ED use,[11] as well as health care costs and hospital admissions for those with chronic conditions (for example, coronary artery disease) and those who are pregnant.[13] Accordingly, the dental setting may represent a unique opportunity within the health care system for completing screening tests, including identification of cardiovascular risk factors[14,15] and diabetes,[16] as well as for addressing certain unmet medical care needs.

To date, however, no studies have examined the potential benefits of a comprehensive, population-based medical-dental integration (MDI) program on the closure of medical care gaps—defined as completion of recommended preventive medical services for patients who are overdue for these services.[2] Kaiser Permanente Northwest (KPNW) is an ideal setting to

study this because the membership, EHR, and medical and dental services are all contained within the same delivery system. Two studies within KPNW have examined the receipt of dental care (versus nonreceipt) with use[11] and adherence with Healthcare Effectiveness Data Information Set outcomes,[12] although these studies did not isolate the impact of MDI, specifically. Furthermore, little is known about whether the level of integration between medical and dental programs is differentially associated with closure of care gaps for patients 65 years or older who are overdue for these services.

METHODS

Population

We conducted a retrospective matched cohort analysis of KPNW medical and dental members who met all 4 inclusion criteria:

- 65 years or older;

- had a dental visit at a KPNW dental clinic from June 1, 2018, through December 31, 2019;

- had at least 1 medical care gap at the time of their first (index) dental visit during that time period;

- had 12 months of continuous health plan enrollment before an index dental visit.

We included all patients meeting these criteria whose index dental visit occurred at any of the 4 MDI clinics and identified a 1:1 matched sample of patients who met the inclusion criteria and whose index dental visit occurred at 1 of 13 non-MDI dental clinics during the same window. Patients were matched according to sex, care gap type (preventive only, disease management only, or both), age (within 5 years), and dental clinic and index visit date (± 60 days). With respect to dental clinics, the 4 MDI dental clinics were each matched to 3 to 4 non-MDI dental clinics on the basis of total volume of dental staff full-time equivalents and annual volume of dental visits.

Non-MDI patients were further propensity matched to MDI patients based on 7 characteristics: Charlson comorbidity index (0, 1, 2), smoking status (yes versus no), ED use in the previous 12 months (any versus none), hospitalization in previous 12 months (any versus none), presence of any of 5 systemic conditions (DM, rheumatoid arthritis, cardiovascular disease, coronary artery disease, hypertension; yes versus no), periodontal disease status (healthy/early, moderate, advanced), and total number of open care gaps at the index visit (continuous). Data from KPNW's EHR were used for the analysis.

Institutional Review Board Approval

The protocol for this study was approved by the institutional review board within KPNW. The need for individual consent for data use was waived.

Setting

KPNW serves approximately 605,000 medical members and 250,000 dental members in Oregon and Washington. The KPNW MDI program includes 3 distinct model types used in

4 dental clinics. Each model is described as follows: least, moderate, or most integration. The least MDI model was implemented June 1, 2018, while the other 2 models were implemented on August 1, 2018.

Least Integration—One medical and dental office is located in the same building with no medical staff embedded in the dental office. In this model, a dental member assistant (DMA) identifies care gaps at the time of dental visit and coordinates closely with other medical departments located within the building (for example, laboratory, vision, and nurse treatment center for immunizations) to complete overdue care gaps. The DMA also arranges for on-site follow-up with primary care clinicians for care coordination regarding chronic conditions when directed.

Moderate Integration—One stand-alone dental office has embedded medical staff. A licensed practical nurse (LPN) is embedded within the stand-alone dental clinic to address care gaps. The LPN can provide immunizations, collect samples for laboratory-based tests, and provide other basic services (for example, HbA_{1c} test, blood pressure screening, DM foot examinations) directly in the dental setting. The LPN also coordinates all other medical services that require offsite referrals (for example, mammography) or offsite follow-up with primary care (for example, follow-up regarding abnormal HbA_{1c} results).

Most Integration—Two colocated medical and dental offices have embedded medical staff. These 2 dental offices are colocated within a medical office building, and an LPN is embedded within the dental clinic itself. The LPN provides direct services and coordinates with other colocated medical staff members to complete additional services. At both clinics following this model, a single DMA and LPN work closely to identify care gaps before dental visits. The LPN then provides services to close care gaps that can be directly addressed in the dental setting (for example, immunizations and blood pressure screening) and coordinate with other colocated medical departments to address other care gaps after the dental visit (for example, laboratory-based tests and DM retinopathy screening). The LPN also arranges follow-up care as needed with primary care for care coordination regarding chronic conditions.

Non-MDI dental offices do not include embedding of medical staff members to complete on-site care gap closure or enhanced care coordination to complete needed follow-up services. Within the non-MDI clinics, dental staff members use an EHR-based decision support tool (described below) to remind patients of being overdue for evidence-based preventive and disease management services.

Medical Care Gaps

KPNW dental and medical clinics use the Panel Support Tool (PST) to identify patient care gaps. The PST is EHR based and uses an informatics system that tracks care gaps, patient reminders, and follow-up care and has been in use since 2006.[17] The PST lists care gaps for a primary care physician's panel based on current clinical guidelines and evidence for ongoing screening tests and disease management services.[1,2,18]

Patients were included in the sample if they had any of 23 care gaps indicated by the PST. Care gaps are listed in the figure and include gaps in preventive care (that is, immunizations and screening tests) and disease management (that is, laboratory-based tests, screening tests, annual examinations, and smoking cessation resources) for patients with diabetes, coronary artery disease, and hypertension; patients taking certain medications; and active or occasional smokers. The primary outcome measure of this study was closure of all medical care gaps present at the index dental visit. For 18 of the 23 measures, care gap closure was assessed 30 days after the index visit; fecal immunochemical testing, mammography, annual DM examination, retinopathy examination, and smoking cessation were assessed at 60 days after the index visit.

Statistical analyses

We first conducted descriptive analyses of analytic variables to confirm assumptions and as a quality assurance process. To assess the performance of our matching algorithm, we calculated standardized differences of demographic and clinical characteristics between MDI and non-MDI patients. To assess the association between MDI and closure of all care gaps, we used logistic regression models comparing care gap closure between MDI and non-MDI patients. We used the standardized difference as a measure of whether key variables were balanced between groups or should be added to the regression model to control for potential confounding. Larger standardized differences indicate larger differences between groups. Variables with a standardized difference (0.2 after matching) were considered to be meaningfully different between groups[19] and were adjusted for in our models. The threshold of 0.2 has been used previously in observational studies.[20,21]

However, because no differences of 0.2 or higher were found after matching, we did not conduct further adjustment. To assess the association between level of MDI integration and closure of all care gaps, we conducted a separate analysis with logistic regression and a categorical independent variable consisting of non-MDI population (reference group) and the 3 levels of MDI integration: least integration, moderate integration, and most integration.

RESULTS

Population characteristics

The patients in the MDI and non-MDI groups were well-balanced for gap type, age, sex, and most clinical and demographic variables after matching (Table 1). In both groups, average age was 70.9 years, 40.3% of patients were male, and the mean total number of open care gaps at the index visit was 1.8. Groups differed significantly in comorbidities at baseline (patients in MDI clinics were more likely to have no comorbidities at baseline) and previous hospitalizations (MDI clinic patients were less likely to have been hospitalized in the past 12 months). However, no standardized differences greater than 0.2 between the MDI and non-MDI groups were found.

Care gap closure

Patients treated at MDI clinics had significantly higher odds (odds ratio [OR], 1.46, 95% confidence interval [CI], 1.29 to 1.65) of closing all medical care gaps than the non-MDI

population. Each integration model was associated with significantly higher levels of care gap closure than the non-MDI population, with ORs increasing as level of embedding increased (Table 2); least integration (OR, 1.18, 95% CI, 1.02 to 1.37), more integration (OR, 1.70, 95% CI, 1.36 to 2.12), and most integration (OR, 2.08, 95% CI, 1.73 to 2.50).

DISCUSSION

Patients 65 years or older who received dental care at an MDI clinic were nearly 1.5 times as likely to close all care gaps than patients who received dental care at a usual care clinic. The care gap closure effect was significant for dental clinics at all 3 levels of integration. We also found that higher levels of MDI were associated with higher levels of care gaps closures. These findings suggest that MDI is an effective way to facilitate use of preventive and disease management health services.

To our knowledge, these results are the first of which we are aware to evaluate the independent effect of MDI with higher care gap closure among patients 65 years or older. Moreover, this study is the first of which we are aware to examine the "dose response" of higher levels of MDI with care gap closure. These findings were consistent with previous research conducted within KPNW, which found that the receipt of dental care was associated with higher use of Healthcare Effectiveness Data Information Set–level preventive services[12] and lower DM-specific use.[11] Similarly, other research outside of KPNW found the dental setting could promote preventive health. Greenberg and colleagues[14] found that by screening patients at an academic dental clinic, previously unidentified cardiovascular risk factors could be identified. In addition, Jontell and Glick[15] found that oral health care professionals can screen and identify patients not aware of their risk of developing serious complications from cardiovascular disease and advise these patients to seek medical care. Similarly, a 2014 systematic review[22] found that screening for dysglycemia in dental offices effectively identified high-risk patients who required triage for glycemic management. However, our study is the first to isolate the association of MDI with outcomes, using rigorous study methods.

The observation that all 3 integration models improved rates of care gap closure is encouraging, as it suggests that relatively small changes, such as colocating a dental office within a medical building or embedding a single medical staff member within a dental office, can have a real impact on care gap closure when coupled with EHR tools integrating medical and dental records. A key challenge in extending this model to other systems is the typical nonintegration of medical and health care in distinct insurance plans and service networks. However, our study findings do have broad applicability to general dentistry within the United States. In particular, many federally qualified health centers (FQHCs) have care delivery systems that are organized similarly to Kaiser Permanente; dental care is provided at FQHCs with colocated medical staff. Thus, FQHCs could be early adopters of this model. Indeed, some dental FQHCs have already developed similar programs focused on early child medical and dental examinations. Furthermore, our finding of care gap closure with MDI in stand-alone dental offices (the moderate integration group) suggests this model could be implemented in stand-alone dental care delivery settings, where most dental care is provided in the United States. Although barriers persist in implementing this model in

solo and small group dental practices, the evidence from this study of the effectiveness in closing medical care gaps in the dental setting suggests that changes in billing and coding of medical and dental procedures to make integration more feasible could lead to long-term cost savings.

The findings from our research have clear policy significance. Medicare does not pay for dental services, except if the care is related to hospitalization. Because of the clear benefit in promoting use of preventive and disease management services among the Medicare population, our results suggest there may be benefits in the Medicare program offering dental insurance coverage to recipients 65 years or older.

We recognize several potential limitations associated with this study. First, use of data from 1 health care system may limit generalizability to other more diverse populations. However, the KPNW membership reflects the underlying population of the area.[23,24] Compared with the US population, the total KPNW membership is slightly less white and has a higher proportion of members older than 65 years.[25] Another limitation is that the retrospective cohort design uses information from the EHR, which does not enable us to assess causality. However, we think this limitation is reduced owing to a strong retrospective, propensity-score matched design reducing the affect of confounders on the proposed analysis. Lastly, the study did not address the cost-effectiveness of closing care gaps.

Future research should examine the use of LPNs and other medical staff members in smaller, more traditional stand-alone dental offices to understand whether adding such staff members is cost-effective, owing to increasing use of preventive and disease management services. Such studies could inform whether further expansion of MDI services in more traditional dental offices is feasible and effective. Second, future research is needed to evaluate the long-term impact of ongoing use in the MDI program with improvements in long-term health outcomes, reductions in health care use, and potential reductions in health care costs. However, further research is needed to test this specifically. The long-term effects of these MDI programs are a vital question for future study. Given the high level of care gaps among older people and the critical need for screening and disease management among this population, our study focused on patients 65 years or older. However, future research should identify the effectiveness of MDI on younger age groups as well.

CONCLUSIONS

Our data indicate that integrating medical and dental care can effectively close care gaps among older adults and may be an effective, relatively low-cost way to improve health outcomes for this population. More research is needed regarding the long-term health effects of these programs, as well as potential cost and health care use reductions and how such programs can be applied to other dental and health care settings.

Acknowledgments

ABBREVIATION KEY

DM	Diabetes mellitus
DMA	Dental member assistant
ED	Emergency department
EHR	Electronic health record
KPNW	Kaiser Permanente Northwest
FQHC	Federally qualified heath center
HbA$_{1c}$	Glycated hemoglobin
LPN	Licensed practical nurse
MDI	Medical-dental integration
PST	Panel Support Tool

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CARE GAP TYPE	WHEN ADDRESSED	GAPS ADDRESSED
Preventive	Same Day	**Immunizations:** Tetanus, diphtheria, pertussis; pneumococcal conjugate; shingles; influenza; meningococcal ACWY; meningococcal B; *Haemophilus influenzae* type b; varicella. **Screening tests:** Fecal immunochemical testing for colorectal cancer, cholesterol for patients without diabetes or cardiovascular disease, glycated hemoglobin for patients without diabetes mellitus (DM).
Preventive	Follow-up	Mammography (for breast cancer screening).
Disease Management	Same Day	**Laboratory-based tests:** Glycated hemoglobin for patients with DM, microalbumin urine testing for patients with DM, cholesterol for patients with diabetes or coronary artery disease, thyroid-stimulating hormone screening for patients receiving thyroid replacement therapy, potassium screening for patients taking angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker medications, creatine for patients taking angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker medications. **Screening tests:** Blood pressure for patients with hypertension, for examinations for patients with DM.
Disease Management	Follow-up	Annual clinical examinations for patients with DM, retinopathy screening for patients with DM, provision of smoking cessation resources for patients who are active smokers or reported occasional smoking in the previous 3 months.

Figure.
Description of care gaps.

Table 1.

Population characteristics.[*]

CHARACTERISTICS	MDI[†] CLINICS (N = 2,578), NO. (%)	NON-MDI CLINICS (N = 2,578), NO. (%)	P VALUE	STANDARD DIFFERENCE
Exact-Matched Variables				
Baseline gap type			Not applicable	
Preventive alone	1,611 (62.5%)	1,611 (62.5%)		0.00
Disease management alone	538 (20.9%)	538 (20.9%)		0.00
Both types	429 (16.6%)	429 (16.6%)		0.00
Age, mean (SD[‡]) matched within 5 years	70.9 (5.0)	71.1 (5.1)	.13	0.04
Sex (exact match)				
Male (versus female)	1,040 (40.3%)	1,040 (40.3%)	Not applicable	0.00
Propensity-Matched Variables			.02	
CCI[§] 0	1,351 (52.4%)	1,268 (49.2%)		0.04
CCI 1	450 (17.5%)	517 (20.1%)		0.04
CCI ≥ 2	777 (30.1%)	793 (30.8%)		0.01
Current smoker				
Yes (versus no)	158 (6.1%)	151 (5.9%)	.68	0.01
Emergency department use in previous 12 months				
Yes (versus no)	398 (15.4%)	434 (16.8%)	.17	0.03
Hospitalization in previous 12 months				
Yes (versus no)	166 (6.4%)	202 (7.8%)	.05	0.04
Systemic conditions (% yes)				
Diabetes mellitus	707 (27.4%)	719 (27.9%)	.71	0.01
Rheumatoid arthritis	37 (1.4%)	37 (1.4%)	Not applicable	0.00
Cardiovascular disease	263 (10.2%)	304 (11.8%)	.07	0.03
Cardiovascular disease	309 (12.0%)	327 (12.7%)	.45	0.01
Hypertension	1,365 (52.9%)	1,385 (53.7%)	.58	0.01
Periodontal disease status			.84	
Healthy/early	1,917 (74.4%)	1,936 (75.1%)		0.01
Moderate	451 (17.5%)	430 (16.7%)		0.01
Advanced	82 (3.2%)	78 (3.0%)		0.01
Missing	128 (5.0%)	134 (5.2%)		0.01
Total open gaps at index visit, mean (SD)	1.8 (1.2)	1.8 (1.2)	.84	0.01
Non – Propensity-Matched Variables				
Socioeconomic Status: Area Deprivation Index, mean (SD)	4.6 (2.4)	4.5 (2.6)	.36	0.03

[*] Population includes population of Medicare patients 65 years or older with 1 or more care gaps at baseline. P value from t test for age, count of open gaps at baseline, and Area Deprivation Index state rank; P value from χ^2 for all other variables.

[†] MDI: Medical-dental integration.

[‡] SD: Standard deviation.

§CCI: Charlson comorbidity index.

Table 2.

Logistic regression analysis of medical care gap closure,[*] by total MDI[†] population and MDI model type.

MDI POPULATION CHARACTERISTICS	ODDS RATIO	95% CONFIDENCE INTERVAL	p VALUE
Total MDI Population			
MDI population	1.46	1.29–1.65	< .0001
Non-MDI population	1.00	NA[‡]	NA
MDI Model Type, Dental Clinic			
Least integration: Colocated medical and dental office, nonembedded medical staff. Salmon Creek	1.18	1.02–1.37	< .0007
Moderate integration: Stand-alone dental office, embedded medical staff. Glisan	1.70	1.36–2.12	< .0346
Most integration: Colocated medical and dental office, embedded medical staff. Beaverton, Cedar Hills	2.08	1.73–2.50	< .0001
Non-MDI population	1.00	NA	NA

[*] Population includes patients enrolled in Medicare who were patients 65 years or older with 1 or more care gaps at baseline. All care gap closure assessed at 30 days after index visit, except for fecal immunochemical testing, mammography, annual diabetes mellitus examination, retinopathy examination, and smoking cessation, which was assessed at 60 days after index visit. *P* value from logistic regression analysis.

[†] MDI: Medical-dental integration.

[‡] NA: Not applicable.