Does Diabetes Care Compete With the Provision of Women's Preventive Care Services?

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OBJECTIVE — Care for chronic diseases may compete with preventive health care. To test this hypothesis, we examined the association between diabetes-related processes of care and preventive care in women.

RESEARCH DESIGN AND METHODS — Using data from a prospective cohort study of diabetes care in managed care settings, we reviewed the care 540 diabetic women received from 355 primary care providers within 14 provider groups from one health plan. Of the 540 women, 278 were eligible to receive mammograms and 314 were eligible to receive Pap smears. Mammography performance was measured as at least one mammogram over a 2-year period and Pap performance was measured as at least one Pap smear over a 3-year period. To assess the association between diabetes-related processes of care and preventive services, we used hierarchical logistic regression models, accounted for clustering within provider groups, and adjusted for patient age, race, income and education level, diabetes treatment and duration, and health status, as well as physician age, sex, years of practice, and specialty. Diabetes-related processes of care were defined as dilated retinal examinations, urine microalbumin/protein testing, foot examinations, lipid and HbA_{1c} testing, recommendations to take aspirin, and influenza vaccinations received over a 1-year period.

RESULTS — In this cohort, 73% of eligible women received mammograms and 56% received Pap smears. After adjustment of models, better diabetes-related processes of care, better health status, and non-Medicaid insurance were associated with mammography performance. Better diabetes-related processes of care, younger patient age, and any visit to a gynecologist were associated with Pap performance.

CONCLUSIONS — Better processes of diabetes care were associated with better women's preventive health care. Diabetes management did not compete with sex-specific screening.

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In the U.S., diabetes affects >9 million women over age 20 years (1). Many of these women receive suboptimal preventive care (2). Although there are many reasons for this deficiency, one unexplored explanation is that the provision of diabetes care interferes with preventive health care services. More specifically, the large number of diabetes-related services that need to be provided during a health care visit may compete for resources, and the demands of diabetes care may decrease the time available for preventive services (3). Some studies (4,5) have suggested that diabetic women may undergo sex-specific cancer screening (i.e., mammogram and Pap smear) less frequently than nondiabetic women. Suboptimal sex-specific screening in diabetic women may have serious implications in light of the increased risk for breast cancer in diabetic women (6) and the increased risk for breast and cervical cancer in overweight women (7).

The characteristics associated with the performance of mammograms and Pap smears among diabetic women have not been well studied. Also, to our knowledge, no studies have examined the association between diabetes quality of care and the provision of other domains of preventive care, particularly sex-specific care. Therefore, using data from a prospective cohort study of diabetes care in managed care settings, we examined the association between diabetes-related processes of care and the performance of mammograms and Pap smears as well as other patient and provider factors associated with sex-specific screening.

RESEARCH DESIGN AND METHODS

— The Translating Research Into Action for Diabetes (TRIAD) study has been previously described in detail (8). Briefly, TRIAD is a multicenter, prospective, cohort study of diabetes care in managed care settings. TRIAD includes six translational research centers collaborating with 10 managed care health plans and 68 provider groups that serve ~180,000 people with diabetes. The TRIAD population consists of a stratified, random sample of adults with diabetes. Patients were sampled from managed care provider groups that had at least 50 diabetic patients. Patients were eligible to participate if they were age ≥18 years, lived in the community, spoke English or Spanish, had been continuously enrolled in a health plan for ≥18 months, were not pregnant, and had had one or more claims for health services during the previous 18 months. The patient's primary care physician (PCP) was identified by the health plan. To be included in this analysis, the patient had to have at least one contact with the PCP of record over the study period. The study protocol was reviewed and approved by the institutional review boards at all six translational research centers. All participants provided informed consent. Subject recruitment was completed in September 2001.

For this study, we used data from the Michigan site of TRIAD. Of the total 676

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Abbreviations: PCP, primary care physician; TRIAD, Translating Research Into Action for Diabetes.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

eligible women, 540 enrolled in TRIAD. Eligible women were cared for by 355 PCPs within 14 provider groups and one health plan. The mean number of TRIAD patients per PCP was 3.8 (median 2.0, range 1–24). For analysis of mammography performance, we included women age 40–70 years who had no history of breast cancer and were continuously enrolled in the health plan for ≥2 years. For analysis of Pap performance, we included women age 21–70 years with no history of uterine cancer, cervical cancer, or hysterectomy for benign or cancerous reasons who were continuously enrolled in the health plan for ≥3 years. Continuous enrollment in the health plan was defined as having no gap in enrollment ≥3 months. Using these criteria, 278 women were eligible for mammograms and 314 women were eligible for Pap smears.

Patient data were obtained by computer-assisted telephone interview or written survey, medical record review, and review of health plan administrative data (8). Survey questions assessed demographic characteristics, services received, and general health status. The medical record review assessed diabetes-related processes of care and comorbid conditions. Administrative data included inpatient and outpatient claims, pharmacy services, and laboratory tests as well as information on the PCP of record, provider visits, the performance of mammograms between 2000 and 2001, and the performance of Pap smears between 2000 and 2002.

Outcome measures

The main outcome measures were the performance of mammograms and Pap smears as assessed by administrative data. Mammography performance was measured as at least one mammogram over a 2-year period (9); Pap smear performance was measured as at least one Pap smear over a 3-year period (10). The primary independent variable was the summary measure of diabetes-related processes of care. The quality of diabetes care was measured using indicators from the Diabetes Quality Improvement Project measurement set (10) based on the receipt of the following processes of care over a 12-month period (yes/no): dilated retinal exam, urine protein screening, in-office foot examination, lipid panel, HbA_{1c} measurement, recommendation to take aspirin or aspirin use, and influenza vaccination. For the dilated retinal examination, recommendation to take aspirin or aspirin use, and foot examination, either medical record documentation or participant report was accepted as an indication of service receipt. Other measures required explicit documentation in the medical record. Factor analysis showed that these seven processes of care were not highly correlated with each other, and models examining the association between patient covariates and each of the processes of care separately did not differ from models examining the association between patient covariates and groups of processes of care (results not shown). Therefore, to categorize diabetes-related processes of care, we examined the unweighted sum of these seven process measures as an overall indicator of the quality and intensity of diabetes care received. The variable ranged in value from 0 (no services) to 7 (all services received).

Candidates for patient covariates in the multivariate models included age (40–49, 50–59, or 60–70 years for mammography and 21–39, 40–49, or 50–70 years for Pap smear), race (white/nonwhite), insurance type (Medicaid versus non-Medicaid), education levels (less than high school, high school, some college, or ≥4 years of college), annual household income (<$15,000, $15,000–39,999, $40,000–75,000, or >$75,000), self-reported health status (excellent, very good, good, fair, or poor), duration of diabetes (<10 or ≥10 years), treatment of diabetes (diet, oral medication, insulin, or insulin plus oral medication), Charlson comorbidity score (0–2, 3–4, or >4) (11), total number of outpatient visits (1–10, 11–20, or >20), and any visit to a gynecologist within the study period. Candidate provider factors were age (years), sex, specialty (internist versus family physician), and years of practice. No endocrinologists or obstetrician/gynecologists served as PCPs.

Statistical analysis

Descriptive statistics were obtained using means ± SE for continuous variables and frequencies and proportions for categorical variables. Bivariate logistic regression analyses were performed to examine the association between patient and provider factors and the performance of mammograms and Pap smears. Hierarchical multivariate logistic regression analyses using the SAS GLIMMIX Macro were performed to examine the association among diabetes-related processes of care and the performance of mammograms and Pap smears, adjusted for patient and provider factors and accounting for the clustering of patients and providers within provider groups (12). Separate hierarchical models were constructed for mammograms and Pap smears. Only statistically significant covariates in bivariate analyses were entered into multivariate models. Multicollinearity was assessed using the Pearson correlation coefficient statistic. No variables were collinear with $r > 0.6$. The significance of the variables in the models was assessed by the Wald χ^2 test, odds ratios (ORs), and 95% CIs. The fit of the models were assessed by the Hosmer-Lemeshow goodness-of-fit test (13). $P < 0.05$ was defined as the level of statistical significance. In a sensitivity analysis, we examined the performance of diabetes-related processes of care and sex-specific screening by provider group but did not find a significant association (results not shown). All statistical analyses were performed using SAS software, Version 8.2 (SAS Institute, Cary, NC).

RESULTS — Patient characteristics, stratified by whether patients received mammograms and Pap smears, are presented in Table 1. Overall, 73% of women received a mammogram at least once over 2 years and 56% received a Pap smear at least once over 3 years. The characteristics of the women who received mammograms and Pap smears were very similar. The mean age for PCPs was 48 years, 29% of PCPs were female and 51% were internists, and the mean length of practice was 21 years. The mean summary measure of diabetes-related processes of care was 5.2 and the median (25–75% interquartile range) was 5 (4–6 for women who received mammograms and Pap smears).

Table 2 presents the bivariate and multivariate associations among patient and provider characteristics and mammography performance. In unadjusted analyses, better diabetes quality of care, higher patient income, better health status, fewer comorbid conditions, non-Medicaid insurance, and any gynecologist visit were significantly associated with the performance of mammography. In unadjusted analyses, younger provider age, female sex of the provider, and fewer years of practice were also associated with the performance of mammography. In fully adjusted multilevel hierarchical logistic regression models accounting for clustering of patients and providers within provider groups, better diabetes quality of care (OR 1.33 [95% CI 1.05–1.71]), better health status (reference = excellent;

Table 1—*Patient characteristics and the performance of mammography and Pap smears*

	Eligible for mammography (n = 278)			Eligible for Pap (n = 314)		
	Screened	Not screened	*P*	Screened	Not screened	*P*
n	203 (73)	75 (27)	—	175 (56)	139 (44)	—
Age (years)	58 ± 0.6	58 ± 0.9	0.87	54 ± 0.9	58 ± 0.9	<0.001
White race	74	68	0.32	71	74	0.60
Education	—	—	0.93	—	—	0.08
Some high school	17	16	—	11	20	—
High school/GED	32	33	—	28	33	—
Some college	31	33	—	37	27	—
≥4 years of college	20	18	—	24	20	—
Annual income	—	—	<0.001	—	—	<0.001
<$15,000	22	44	—	18	38	—
$15,000–39,000	39	24	—	36	31	—
$40,000–75,000	26	16	—	27	19	—
>$75,000	13	16	—	19	12	—
Self-reported health status	—	—	0.11	—	—	<0.001
Excellent	3	4	—	3	3	—
Very good	20	12	—	24	14	—
Good	38	35	—	37	42	—
Fair	31	31	—	31	27	—
Poor	8	18	—	5	15	—
Diabetes duration (years)	15 ± 0.8	16 ± 1.6	0.78	14 ± 0.9	16 ± 0.9	0.20
Duration <10 years	45	47	—	49	42	—
Duration ≥10 years	55	53	—	51	58	—
Diabetes treatment	—	—	0.25	—	—	0.33
Diet	5	0	—	3	1	—
Oral medication	51	52	—	49	50	—
Insulin	25	29	—	33	28	—
Insulin + oral medication	19	19	—	14	20	—
Charlson comorbidity index*	2.2 ± 0.1	2.7 ± 0.2	0.03	2.1 ± 0.1	2.6 ± 0.2	0.03
0–2	73	56	—	72	62	—
3–4	19	34	—	23	26	—
>4	8	10	—	5	13	—
Diabetes process/quality of care	5.3 ± 0.1	4.9 ± 0.1	0.04	5.4 ± 0.1	5.0 ± 0.1	<0.02
Dilated retinal exam	83	67	0.008	87	72	0.003
Urine protein screen	76	80	0.53	80	75	0.41
Foot exam	84	86	0.69	86	86	0.96
Lipid panel	73	52	0.005	73	59	0.02
HbA_{1c}	92	79	0.006	94	83	0.002
Aspirin use	58	71	0.08	52	65	0.04
Influenza vaccination	66	56	0.17	66	61	0.43
Medicaid insurance	2	11	0.004	3	6	0.21
Gynecologist visit	14	7	0.10	15	4	<0.001
Total outpatient visits	19 ± 0.8	18 ± 1.0	0.71	19 ± 0.9	18 ± 0.8	0.65
1–10	23	24	—	22	25	—
11–20	41	36	—	42	40	—
>20	36	40	—	36	35	—

Data are percent, *n* (%), or means ± SE. Screened for mammography means the performance of one mammography over a 2-year period; screened for Pap smear means the performance of one Pap smear over a 3-year period. *Charlson comorbidity index is based on the mean number of comorbid diseases per patient; scores range from 0 to 13 (0 = no; 1–2 = low; 3–4 = medium; and ≥5 = high comorbidity index).

0.69 [0.48–0.99], 0.48 [0.23–0.98], 0.33 [0.11–0.97], and 0.23 [0.05–0.96] for very good, good, fair, and poor health status, respectively), and non-Medicaid insurance (3.86 [1.01–8.86]) were significantly associated with performance of mammography (Table 2). No provider characteristics were significantly associated with performance of mammography in multivariate analyses.

Table 3 presents the bivariate and multivariate associations among patient and provider characteristics and Pap performance. In unadjusted analyses, better diabetes quality of care, younger patient age, higher education level, higher income, better health status, fewer comorbid conditions, non-Medicaid insurance, and having made a gynecologist visit were significantly associated with the performance of Pap smears. In unadjusted anal-

Table 2—*Bivariate and multivariate associations among patient and provider factors and the performance of mammography*

	Bivariate analysis	Multivariate analysis
Patient factors		
Age (ref. = 40–49 years)	—	NI
50–59	1.09 (0.78–1.52)	—
60–70	1.19 (0.61–2.31)	—
Nonwhite race (ref. = white)	0.75 (0.42–1.34)	NI
Education (ref. = <high school)	—	NI
High school/GED	1.01 (0.78–1.33)	—
Some college	1.02 (0.61–1.77)	—
≥4 years of college	1.03 (0.47–2.35)	—
Income (ref. = <$15,000)*		
$15,000–39,000	1.30 (1.01–1.71)	1.00 (0.70–1.44)
$40,000–75,000	1.69 (1.02–2.92)	1.02 (0.49–2.07)
>$75,000	2.20 (1.03–5.00)	1.03 (0.34–2.99)
Self reported health status (ref. = excellent)*†		
Very good	0.75 (0.57–0.96)	0.69 (0.48–0.99)
Good	0.56 (0.32–0.92)	0.48 (0.23–0.98)
Fair	0.42 (0.19–0.88)	0.33 (0.11–0.97)
Poor	0.32 (0.11–0.85)	0.23 (0.05–0.96)
Diabetes duration (ref. = <10 years)	1.07 (0.63–1.83)	NI
Diabetes treatment (ref. = diet)	—	NI
Oral medication	0.88 (0.63–1.21)	—
Insulin	0.77 (0.40–1.46)	—
Insulin + oral medication	0.68 (0.25–1.77)	—
Charlson comorbidity score (ref. = 0–2)*		
3–4	0.82 (0.68–0.98)	0.92 (0.72–1.16)
>4	0.67 (0.46–0.96)	0.85 (0.52–1.35)
Diabetes process/quality of care (continuous)*†	1.25 (1.01–1.57)	1.33 (1.05–1.71)
Insurance type (ref. = Medicaid)*†	4.73 (1.49–8.80)	3.86 (1.01–8.86)
Any visit to a gynecologist (ref. = 0)	2.24 (0.83–6.04)	NI
Total outpatient visits (ref. = 1–10)	—	NI
11–20	0.96 (0.67–1.35)	—
>20	0.92 (0.45–1.82)	—
Provider factors		
Age (continuous)*	0.97 (0.95–0.99)	0.97 (0.93–1.15)
Sex (ref. = male)*	1.36 (1.29–2.33)	1.37 (0.60–3.14)
Specialty (ref. = family/general practice)	1.34 (0.78–2.29)	NI
Years of practice (continuous)*	0.97 (0.95–0.99)	0.95 (0.84–1.06)

Data are OR (95% CI). *Statistically significant association; †statistically significant multivariate association. NI, not included in multivariate analysis because variable was not significant in bivariate analysis.

yses, female sex of the provider was associated with the performance of Pap smears. In fully adjusted multilevel hierarchical logistic regression models accounting for clustering of patients and providers within provider groups, better diabetes quality of care (OR 1.40 [95% CI 1.10–1.78]), younger patient age (reference = 21–39 years; 0.97 [0.94–0.99] and 0.94 [0.88–0.98] for age-groups 40–49 and 50–70 years, respectively), and having made a visit to a gynecologist (3.27 [1.05–10.19]) were significantly associated with the performance of Pap smears. No provider characteristics were significantly associated with the performance of Pap smears in multivariate analyses.

CONCLUSIONS — In this prospective cohort study of patients with diabetes in managed care settings, we found that better diabetes quality of care, better health status, and non-Medicaid insurance were associated with higher odds of mammography performance and that better diabetes quality of care, younger age, and having made a visit to a gynecologist were associated with higher odds of Pap smear performance. The results of our study suggest that better diabetes-related processes of care are associated with greater odds of mammograms and Pap smears being performed. Chronic disease management for diabetes does not compete with sex-specific screening.

Previous studies have suggested that diabetes management may interfere with women's preventive health care. A case-control study matching diabetic and non-diabetic women found that diabetes, nonwhite race, and lack of health insurance were independently associated with decreased mammography rates (4). Another study examining a cohort of women living in rural communities found that the presence of diabetes was inversely associated with mammography performance after adjusting for age, education, supplemental insurance, and health status (14). However, it was unclear if factors leading to decreased mammography rates also contributed to diabetes or if diabetes care itself contributed to decreased sex-specific screening. Indeed, other factors such as poor health status and lower socioeconomic status have been found to be associated with lower rates of both mammography and Pap smears (14–16) as well as increased rates of diabetes (5,17). In our study, we found that once diabetes severity and quality of care were considered, education, income, and race were no longer associated with the performance of sex-specific screening. However, health status did remain an independent predictor of mammography performance. It is possible that in addition to health status, other patient factors such as beliefs regarding screening and preventive services may influence rates of mammography and Pap smears. We may have obtained different results from other studies as we examined a population seen in the managed care setting. In uninsured populations, race and socioeconomic status may have greater predictive value (13,18). Supporting this explanation is our finding that non-Medicaid insurance was predictive of mammography screening, although the same association did not exist for Pap smears.

Previous studies have suggested that provider factors play a role in both sex-specific screening and diabetes care (19–21). However, it is unclear to what extent provider factors contribute to the quality of care in either domain after adjusting for clustering within health systems and patient characteristics. When these adjustments are performed, the association between provider characteristics and

Table 3—*Bivariate and multivariate associations among patient factors and provider factors and the performance of Pap smears*

	Bivariate analysis	Multivariate analysis
Patient factors		
Age (ref. = 21–39 years)*†		
40–49	0.65 (0.46–0.92)	0.97 (0.94–0.99)
50–70	0.42 (0.21–0.85)	0.94 (0.88–0.98)
Nonwhite race (ref. = white)	1.14 (0.69–1.89)	NI
Education (ref. = <high school)*		
High school/GED	1.29 (1.03–1.62)	1.01 (0.70–1.46)
Some college	1.66 (1.06–2.62)	1.02 (0.49–2.13)
≥4 years of college	2.15 (1.09–4.25)	1.03 (0.34–3.11)
Income (ref. = <$15,000)*		
$15,000–39,000	1.50 (1.19–1.88)	1.19 (0.82–1.73)
$40,000–75,000	2.25 (1.42–3.53)	1.42 (0.67–2.99)
>$75,000	3.38 (1.68–6.64)	1.68 (0.55–5.18)
Self-reported health status (ref. = excellent)*		
Very good	0.74 (0.58–0.93)	1.00 (0.71–1.40)
Good	0.55 (0.34–0.86)	0.98 (0.50–1.96)
Fair	0.41 (0.20–0.80)	0.97 (0.36–2.74)
Poor	0.30 (0.11–0.75)	0.96 (0.25–3.84)
Diabetes duration (ref. = <10 years)	0.78 (0.50–1.22)	NI
Diabetes treatment (ref. = diet)	—	NI
Oral medication	0.87 (0.66–1.16)	—
Insulin	0.76 (0.44–1.34)	—
Insulin + oral medication	0.66 (0.29–1.56)	—
Charlson comorbidity score (ref. = 0–2)*		
3–4	0.64 (0.43–0.95)	0.87 (0.70–1.08)
>4	0.41 (0.18–0.90)	0.76 (0.49–1.17)
Diabetes process/quality of care (continuous)*†	1.23 (1.02–1.49)	1.40 (1.10–1.78)
Insurance type (ref. = Medicaid)	1.95 (0.68–5.62)	NI
Any visit to a gynecologist (ref. = 0)*†	3.86 (1.54–9.68)	3.27 (1.05–10.19)
Total outpatient visits (ref. = 1–10)	—	NI
11–20	1.09 (0.81–1.46)	—
>20	1.19 (0.66–2.13)	—
Provider factors		
Age (continuous)*	0.99 (0.97–1.00)	1.00 (0.97–1.03)
Sex (ref. = male)*	1.48 (1.09–2.42)	1.04 (0.53–2.01)
Specialty (ref. = family/general practice)	0.99 (0.63–1.58)	NI
Years of practice (continuous)	0.99 (0.97–1.02)	NI

Data are OR (95% CI). *Statistically significant bivariate association; †statistically significant multivariate association. NI, not included in multivariate analysis because variable was not significant in bivariate analysis.

quality of care may be reduced (12,22, 23). This may be because physicians in the same practice tend to see similar patients or because physicians in different medical groups may have different access to health care resources (12,22,23). After such adjustment, provider factors such as these and provider sex may play a less prominent role (24). In this study, after adjusting for patient covariates and clustering, we found no association between provider characteristics and the performance of mammography and Pap smears. Our findings are consistent with those of other investigations that have shown that differences in mammography rates across provider practices are more strongly associated with patient characteristics than with provider characteristics (25).

Our study has several implications. The factors that lead to better care in one domain of health may also lead to better care in other domains. Such factors may include better health status or more highly organized systems of care; the latter may include electronic reminder systems, disease management programs, and other information technology–based factors (26). Both chronic disease management and preventive care share the need to alter reactive acute care–oriented practice to accommodate the proactive, planned, patient-oriented longitudinal care required for both chronic care and prevention. Our study findings also suggest that the PCP's specialty may not be as strong a predictor of preventive services as is adequate access to specialists who regularly perform these services, as is the case with gynecologists and Pap smears.

The strengths of our study include our ability to adjust for detailed patient characteristics and our ability to measure a range of generally accepted quality of diabetes care measures. The limitations included our inability to examine nondiabetic women or more detailed physician characteristics. Finally, our findings are applicable to diabetes care and preventive care in a population seen in managed care settings and may not extend to other chronic illnesses or to the fee-for-service environment.

In conclusion, a higher quality of diabetes care is associated with greater odds mammography and Pap performance. Chronic disease management for diabetes does not compete with sex-specific screening, and provider factors have minimal impact on the performance of sex-specific screening after adjusting for patient characteristics and clustering within health plans. Interventions aimed at sex-specific screening could potentially use infrastructure designed for diabetes care. Future research should examine the association of other chronic illnesses, sex-specific screening, and common factors influencing quality of care across disease domains. In particular, the impact of reporting and for chronic disease quality measures should be assessed across multiple disease domains, including sex-specific screening.

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