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By Christine Everett, Carolyn Thorpe, Mari Palta, Pascale Carayon, Christie Bartels, and Maureen A. Smith

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Physician Assistants And Nurse Practitioners Perform Effective Roles On Teams Caring For Medicare Patients With Diabetes

Christine Everett (christine.everett@duke.edu) is an assistant professor in the Physician Assistant Program, Department of Community and Family Medicine, Duke University School of Medicine, in Durham, North Carolina.

Carolyn Thorpe is a core investigator at the Center for Health Equity Research and Promotion, Veterans Affairs Pittsburgh Healthcare System, and an assistant professor of pharmacy and therapeutics at the School of Pharmacy, University of Pittsburgh, in Pennsylvania.

Mari Palta is a professor of population health sciences at the University of Wisconsin–Madison.

Pascale Carayon is a professor of industrial and systems engineering at the University of Wisconsin–Madison.

Christie Bartels is an assistant professor in the Department of Medicine at the University of Wisconsin–Madison.

Maureen A. Smith is a professor of population health sciences, family medicine, and surgery at the University of Wisconsin–Madison.

ABSTRACT **One approach to the patient-centered medical home, particularly for patients with chronic illnesses, is to include physician assistants (PAs) and nurse practitioners (NPs) on primary care teams. Using Medicare claims and electronic health record data from a large physician group, we compared outcomes for two groups of adult Medicare patients with diabetes whose conditions were at various levels of complexity: those whose care teams included PAs or NPs in various roles, and those who received care from physicians only. Outcomes were generally equivalent in thirteen comparisons. In four comparisons, outcomes were superior for the patients receiving care from PAs or NPs, but in three other comparisons the outcomes were superior for patients receiving care from physicians only. Specific roles performed by PAs and NPs were associated with different patterns in the measure of the quality of diabetes care and use of health care services. No role was best for all outcomes. Our findings suggest that patient characteristics, as well as patients' and organizations' goals, should be considered when determining when and how to deploy PAs and NPs on primary care teams. Accordingly, training and policy should continue to support role flexibility for these health professionals.**

The implementation of team-based care is considered essential to the redesign of the fragmented and inefficient US health care system.[1] Patients with chronic illnesses are especially likely to experience costly care with suboptimal access and quality.[2] Patient-centered medical homes aim to improve care delivery through coordinated clinician teams with common goals and defined roles.[3,4] Team-based care involving physician assistants (PAs) and nurse practitioners (NPs) is one recommended strategy for improving chronic illness care in the patient-centered medical home.[5]

Evidence is limited regarding the effectiveness of primary care PAs and NPs in managing chronic disease. Studies in this area typically examine patients with diabetes because it is a prevalent condition, the patient population has a range of clinical complexity, and PAs and NPs commonly participate in care delivery for these patients.[5–7]

Three studies have reported that diabetes control is similar for patients treated by PAs or NPs and for those treated by physicians.[8–10] However, other studies have demonstrated improvements in diabetes control when NPs are involved in patient care.[11,12] Hence, the evidence generally supports the involvement of PAs and NPs in diabetes care but provides limited understanding of appropriate team-based roles.

The variation in study findings may be partly explained by the range of roles these professionals perform. It is estimated that they can perform 85–90 percent of the primary care services that

are traditionally provided by physicians.[13] Although PAs and NPs are trained to provide a similar range of primary care services, their individual roles are negotiated with collaborating physicians and, therefore, vary considerably across and within settings.[14,15]

The team roles of primary care PAs and NPs can be defined according to the following three dimensions: level of involvement (usual provider, supplemental provider, or no participation), type of patient care provided (chronic care or other care), and patient complexity (in other words, the number and type of medical conditions for a given patient). How primary care roles for PAs and NPs are implemented may reflect the priorities that each practice gives to different goals.[16]

For example, patient-centered medical homes may employ primary care PAs and NPs to perform a supplemental role, such as chronic disease management,[12] if the practice's highest priority is to improve its quality measures. Although the role of a PA or NP may meet a practice's primary goals, the role may also have unintended consequences for other aspects of care. Thus, it is necessary to understand the impact of team members' roles on a variety of outcomes.

To date, no study has compared the effectiveness of a range of PA and NP roles to the effectiveness of physician-only care for patients with chronic illness. Using data for Medicare patients with diabetes treated in a single multispecialty physician group, we evaluated the impact of primary care roles for PAs and NPs on the quality of diabetes care and the use of health services.

Our findings failed to identify an optimal role for PAs and NPs in the team-based care of diabetes patients. However, the results tend to confirm that there are a variety of potentially effective roles. Determining when and how to place PAs and NPs on teams may require the consideration of situation-specific goals and local factors such as patients' characteristics.

Study Data And Methods

DATA The providers and patients in the study were associated with a large midwestern multispecialty physician group. Organizational policies regarding payment and practice differed across clinicians in 2008, the time of the study. Physicians received salaries with bonuses for increased productivity, but PAs and NPs received only salaries. PAs and NPs shared a single job description and were prohibited from being the named, usual provider of primary care.

Our results are based on visits delivered by 210 attending physicians, 24 physician assistants, 28 nurse practitioners, and 51 resident physicians in thirty-two internal medicine, family practice, and geriatric clinics. Some of the clinics were in urban locations, and others were in rural locations, but they were all in the same county. The Minimal Risk Institutional Review Board approved this study with a waiver of the authorization required by the Health Insurance Portability and Accountability Act (HIPAA) of 1996. (See the online Appendix for full details on all aspects of our data and methods.)[17]

METHODS Medicare data were linked to the provider group's electronic health records. We identified 2,576 Medicare patients ages 23–102 with diabetes managed by the provider group in 2008. We identified patient panels by determining which provider each patient saw most frequently, and we grouped patients according to this "usual" provider (physician, physician assistant, or nurse practitioner).

We measured the quality of diabetes care by the receipt of two or more hemoglobin A1c tests in the year and the mean HbA1c (an indicator of glycemic control). Mean HbA1c was categorized according to clinical guidelines in the following way: good, or less than 7.0 percent (reference group); fair, or 7.0–9.0 percent; and poor, or more than 9.0 percent.

Two outcomes of the use of health services were examined.[18] First, we used a high number of emergency department (ED) visits as an indicator of limited access to primary care and of costly use of services.[19] Second, we used the number of hospitalizations as an indicator of the quality and cost of primary care.[20]

The role of the physician assistant or nurse practitioner was defined according to the following three factors: level of involvement, patient complexity, and whether or not the physician assistant or nurse practitioner delivered chronic care (Exhibit 1). *Highly complex patients* were defined according to the Johns Hopkins Ambulatory Care Group System Predictive Model.[21] This model produces a patient risk score based on previous use and diagnoses to predict the use of health care resources in the future. Panels with PAs or NPs as supplemental providers that provided care to at least one patient with a risk score of 2.0 or greater (that is, twice the average predicted use of services for older patients) were categorized as providing care to highly complex patients.

The roles of PAs and NPs were combined in this study for several reasons. First, the primary care job descriptions were the same for both professions in the physician group under study. Second, in most states the members of both professions were required to work in a team with physicians as collaborators or supervisors.

EXHIBIT 1

The Influence Of Primary Care Physician Assistant (PA) And Nurse Practitioner (NP) Roles On Outcomes Of 2,576 Adult Medicare Patients With Diabetes, 2008

PA or NP role		Patients		Patient outcomes			
Treat highly complex patients?	Deliver chronic care?	Number	Percent	2 or more HbA1c tests	Glycemic control	Number of ED visits	Number of hospitalizations
SUPPLEMENTAL ROLE[a]							
No	Yes	412	16	+	=	=	=
No	No	154	6	=	+	+	=
Yes	Yes	736	29	=	+	=	−
Yes	No	138	5	=	−	=	=
USUAL PROVIDER[b]							
Yes and no[c]	Yes	127	5	=	=	−	=

SOURCE Authors' analysis of physician group electronic health data linked with Medicare claims. **NOTES** The reference category was no role for PAs and NPs, with care provided by physicians only. This category included 1,009 patients (39 percent). The patients were ages 23–102. Results were adjusted for patients' sociodemographic variables (age, race, Medicaid dual eligible status, and disability entitlement), clinical characteristics (Ambulatory Care Group risk score [see Note 21 in text], sixteen medical conditions, and three diabetes complications), use of health care services (number of primary care visits; having one or more endocrinology visits; and, when appropriate, number of emergency department [ED] visits and hospitalizations), and characteristics of patient panel (specialty of the usual provider, number of patients on the panel, and percentage of women on the panel). All results were significant ($p \leq 0.05$). The plus symbol denotes better outcome than physician-only care. The equals symbol denotes equivalent outcome to physician-only care. The minus symbol denotes worse outcome than physician-only care. [a]PAs and NPs provided a minority of primary care. [b]PAs and NPs provided the majority of primary care. [c]When PAs or NPs performed usual provider roles, the majority of the panels (86 percent) did not involve highly complex patients.

Third, PAs and NPs provide similar primary care services.[14,22] Despite differences in their philosophy and training, the scope—although not the distribution—of the services they deliver is similar.[23,24] Observed differences in the distribution of service delivery in national studies may result from differences in geographic location, organizational characteristics, or roles within care teams, instead of differences in professional capacities.[25–27]

To evaluate the relationship between patient outcomes and the roles of PAs and NPs, multivariable regression models were fit with all of the variables described in the notes to Exhibit 1. The type of regression model that we used reflected the outcome variable. Logistic regression was used to examine the receipt of two or more HbA1c tests, multinomial logistic regression was used to examine glycemic control, and negative binomial models were used to examine the number of ED visits and hospitalizations. Ninety-five percent confidence intervals were obtained using a robust estimate of the variance, taking into account clustering within clinics.

LIMITATIONS Our findings were based on a small subset of patients, which affects the interpretation and generalizability of our results. Adult Medicare patients with diabetes do not represent the entire primary care population, or even the entire population of patients with diabetes, and findings for this group may not be generalizable to patients in other groups. Similarly, the patients and providers in our study were from a single organization with unique policies and characteristics, within a small geographic area, and with limited variation in patients' demographic characteristics.

Several methodological issues could affect the validity of the study. The assignment of roles to PAs and NPs was not random. The number of patients receiving care from a PA or NP in some roles was small, and the numbers of patients receiving care from those clinicians in different roles might differ. As a consequence, the results might be biased. Additional characteristics at the provider, team, and clinic levels also likely affected the results but were not considered in the study.

The study included only a sample of the physician group's primary care clinics. However, there are reasons to believe that the sampled clinics served a large and representative majority of the group's patients who would have met study inclusion criteria. The number of ED visits was used as a measure of access to primary care. However, that figure included all visits, not just those for reasons that could have been addressed in a primary care clinic during normal business hours. (See the Limitations section of the Appendix for a fuller discussion of limitations.)[17]

Study Results

Data were available on 2,576 patients with a mean age of seventy-two. Ninety-one percent

were white, and 55 percent were female (Exhibit 2). The mean risk score was 1.5, indicating a 50 percent higher predicted use of health care services than that of the average older patient (Appendix Exhibit 1).[17]

There were 261 primary care panels. Fifty-five percent of them had PAs or NPs providing care, and in these panels an average of 24 percent of visits were to these clinicians. For 39 percent of patients, only physicians provided care (Exhibit 1). For only 5 percent of patients was the usual provider a PA or NP. Sixty-two percent of patients received two or more HbA1c tests, and 50 percent had good glycemic control. The mean number of ED visits and hospitalizations was less than one (Appendix Exhibit 2).[17]

Patients received different quality of diabetes care depending on whether they received care from a physician only or also from a PA or NP (Exhibit 1). Compared to patients who received care from a physician only, patients with supplemental PAs or NPs who did not treat highly complex patients but who did provide chronic care were more likely to receive two or more outpatient HbA1c tests (odds ratio: 1.4; 95% confidence interval: 1.05, 1.82) (Appendix Exhibit 3).[17]

The associations between PA or NP role and glycemic control demonstrated a different pattern. Compared to patients who received care from physicians only, patients with supplemental PAs or NPs who did not treat highly complex patients and did not deliver chronic care had only 0.46 times the odds (95% CI: 0.22, 0.97) of having poor versus good glycemic control. Patients with supplemental PAs or NPs who did treat highly complex patients but did not deliver chronic care had 1.8 times the odds (95% CI: 1.21, 2.67) of having poor versus good glycemic control. Patients with supplemental PAs or NPs who both treated highly complex patients and delivered chronic care had 0.70 times the odds (95% CI: 0.59, 0.84) of having fair compared to good glycemic control (Appendix Exhibit 4).[17]

The association between the role of PAs and NPs and use of health care services demonstrated yet another pattern (Exhibit 1). Compared to patients receiving physician-only care, patients with supplemental PAs or NPs who did not treat highly complex patients and did not deliver chronic care experienced a 0.7 times lower rate of ED visits (95% CI: 0.56, 0.93). In contrast, patients with PAs or NPs in usual provider roles experienced a 1.5 times higher rate (95% CI: 1.06, 2.03) (Appendix Exhibit 5).[17] Patients with supplemental PAs or NPs who both treated highly complex patients and delivered chronic care experienced higher hospitalization rates (incidence rate ratio: 1.2; 95% CI: 1.05, 1.47) (Appendix Exhibit 6).[17]

Overall, the comparisons of outcomes for patients whose care teams included PAs or NPs in any role and outcomes for patients receiving care only from physicians revealed equivalent results in thirteen out of twenty cases (Exhibit 1). PA or NP roles were associated with better outcomes than physician-only care in four cases and with worse outcomes in three cases.

Discussion

Findings from this and previous studies offer evidence that PAs and NPs can fill a range of

EXHIBIT 2

Characteristics Of 2,576 Adult Medicare Patients With Diabetes, 2008

Characteristic	Percent
Medicaid	16.1
Entitlement due to disability	19.3
AGE (YEARS)[a]	
Less than 50	5.0
50–59	7.2
60–69	20.7
70–79	41.4
80 or older	25.8
RACE OR ETHNICITY	
White	91.3
Black	5.1
Other	3.7
SEX	
Female	54.9
COMORBID CONDITIONS	
Ambulatory Care Group risk score, mean[b]	1.5
Ambulatory Care Group chronic condition count, mean[c]	5.2
Cardiovascular disease	
None	47.2
Ischemic heart disease only	23.5
Congestive heart failure	29.3
Hypertension	82.5
Chronic kidney disease or end-stage renal disease	22.7
Stroke or transient ischemic attack	8.3
Obesity	21.6
Depression	22.3
Dementia	8.7
DIABETES COMPLICATIONS	
Ulcers	11.9
Amputation	1.5
Eye disease	21.6
Peripheral vascular disease	36.6

SOURCE Authors' analysis of physician group electronic health data linked with Medicare claims. **NOTES** The patients were ages 23–102. Percentages may not sum to 100 because of rounding. Ambulatory Care Group is the Johns Hopkins Adjusted Clinical Groups case-mix system (see Note 21 in text). [a]Mean age: 72. Standard deviation: 11. [b]Standard deviation: 1.0. The risk score is relative to the average predicted use of older adult populations. Values can range from numbers approaching zero (healthy people without diagnosed diseases) to 20 or higher (patients with many diagnosed diseases). A risk score of 1.5 represents a 50 percent increase in predicted use compared to that of the average older adult population. [c]Standard deviation: 3.2.

roles on primary care teams, even for older patients with clinically challenging conditions such as diabetes.[8–12,28] However, selecting an appropriate role for these clinicians may require consideration of context-specific factors. In particular, organizations may need to prioritize patient and organization goals, as well as consider the characteristics of the population served. Therefore, implementing primary care teams and evaluating their impact on outcomes may require a nuanced understanding and balancing of a range of local factors.

Including PAs and NPs in a variety of roles on primary care teams within a single organization resulted in encouraging outcomes more often than not. Adult patients with diabetes on panels with PAs or NPs in any role did the same or better on most outcome measurements than patients receiving physician-only care (Exhibit 1). They did worse on only a few measurements. Given the anticipated increase in demand for services and the expected shortage of primary care physicians, findings from this and past studies suggest that primary care teams including PAs or NPs could be designed to meet at least some goals for improving the quality and cost of care or access to it.

Overall, the findings suggest that local factors, including the characteristics of patients served and which goals are a high priority, may be important considerations when selecting roles for PAs and NPs. No single role was consistently associated with the best outcomes on all measures (Exhibit 1). The complexity of the patients served appeared to influence the patterns of patients' outcomes.

This may explain some of the variation in findings across previous studies of the effectiveness of PAs and NPs in diabetes care. Patients with supplemental PAs or NPs who did not treat highly complex patients consistently experienced similar or better outcomes, compared to patients receiving physician-only care. In contrast, patients with supplemental PAs or NPs who did treat highly complex patients experienced several worse outcomes, again compared to patients receiving physician-only care.

This raises the question of whether a team approach that divides primary care delivery between clinicians would work for all patient populations, particularly the most clinically complex patients. Such patients may be best served through a continuous relationship with a single primary care clinician.[29]

The selection of a role for PAs and NPs on a primary care team may also require the prioritization of goals, as noted above.[16] Improving quality and access while reducing costs is important, but it may not be feasible for a single feature of a practice redesign to accomplish all three goals. For example, if the primary goal is more frequent testing of glycemic control, then the addition of supplemental PAs or NPs who do not treat highly complex patients but who do deliver care for chronic conditions might be appropriate. However, such a design might not reduce ED visits, at least in the short term.

Alternatively, an organization might have rural clinics that are faced with a shortage of physicians. In such cases, including a PA or NP on the primary care team as a usual provider could alleviate that shortage, but it also has the potential to indirectly increase costs through greater use of the ED. To be able to weigh the costs and benefits of each potential approach, organizations need population-based evaluations of multiple outcomes.

Perhaps the most important contribution of this study is to suggest that determining the best roles and primary care team designs will require an even more nuanced approach than that taken in the current analysis. The present study, which examined a single organization, could not evaluate a variety of potentially important factors that tend to vary among organizations and populations.[30]

One organizational policy example is the influence of clinician payment practices.[31] The organization in the study paid physicians based on the volume of services they delivered, and it paid PAs and NPs a salary. Such differences and others may influence how patients and services are divided across provider types, and ultimately they may also influence access to and the quality and cost of care. In the absence of multi-organization studies, each organization must make its own evidence-based decisions about the implementation of primary care teams. This also suggests that it will be challenging to determine on the national level what is the optimal workforce to deliver care within a team setting.

Policy Implications

This attempt to meet the challenge of identifying appropriate roles for primary care team members such as PAs and NPs highlights several points relevant to policy makers. The capacity of these clinicians to fill a variety of roles argues for increased support for new and existing state and federal policies that encourage flexible approaches to provider roles and team design.

Additional funding for programs that encourage generalist training in education programs for PAs and NPs would produce additional clinicians capable of filling a variety of roles. Policies that encouraged novel approaches to reimbursing team-based care and approaches that were

In an era of health system redesign, team-based care is frequently offered as a solution.

applicable to a range of possible professional roles would encourage innovative team designs. Finally, policies encouraging the collection of additional population, organizational, team, and provider information in accountable care and patient-centered medical home demonstrations or evaluations could help identify additional factors that could influence the implementation of roles for primary care team members such as PAs and NPs and, ultimately, could influence patient outcomes.

Conclusion

In an era of health system redesign where the goals are improved access, better quality of care, and reduced costs, team-based care is frequently offered as a solution. Although the results presented here generally support the contention that physician assistants and nurse practitioners can perform a range of effective roles on primary care teams, the findings also indicate that there may be notable exceptions. This suggests that the implementation of roles for primary care team members such as PAs and NPs may require thoughtful consideration of local factors such as the population served and identified goals.

Our findings suggest that policies related to system redesign and to workforce development and deployment should preserve the capacity for flexibility in team implementation and role definition. This would allow for innovative approaches to addressing workforce constraints and provide the opportunity to identify additional factors that might influence team design, role implementation, and the full complement of relevant outcomes. ■

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NOTES

1 Institute of Medicine. Crossing the quality chasm: a new health system for the 21st century. Washington (DC): National Academies Press; 2001.
2 McGlynn EA, Asch SM, Adams J, Keesey J, Hicks J, Decristofaro A, et al. The quality of health care delivered to adults in the United States. N Engl J Med. 2003;348(26):2635–45.
3 Rittenhouse DR, Shortell SM, Fisher ES. Primary care and accountable care—two essential elements of delivery-system reform. N Engl J Med. 2009;361(24):2301–3.
4 Salas E, Cooke NJ, Rosen M. On teams, teamwork, and team performance: discoveries and developments. Hum Factors. 2008;50(3):540–7.
5 Yarnall KS, Østbye T, Krause KM, Pollak KI, Gradison M, Michener JL. Family physicians as team leaders: "time" to share the care. Prev Chronic Dis. 2009;6(2):A59.
6 Centers for Disease Control and Prevention. National diabetes fact sheet, 2011 [Internet]. Atlanta (GA): CDC; 2011 [cited 2013 Oct 7]. Available from: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf
7 Østbye T, Yarnall KS, Krause KM, Pollak KI, Gradison M, Michener JL. Is there time for management of patients with chronic diseases in primary care? Ann Fam Med. 2005;3(3):209–14.
8 Federman DG, Krishnamurthy R, Kancir S, Goulet J, Justice A. Relationship between provider type and the attainment of treatment goals in primary care. Am J Manag Care. 2005;11(9):561–6.
9 Mundinger MO, Kane RL, Lenz ER, Totten AM, Tsai WY, Cleary PD, et al. Primary care outcomes in patients treated by nurse practitioners or physicians: a randomized trial. JAMA. 2000;283(1):59–68.
10 Ohman-Strickland PA, Orzano AJ, Hudson SV, Solberg LI, DiCiccio-Bloom B, O'Malley D, et al. Quality of diabetes care in family medicine practices: influence of nurse-practitioners and physician's assistants. Ann Fam Med. 2008;6(1):14–22.
11 Jackson GL, Lee S-YD, Edelman D, Weinberger M, Yano EM. Employment of mid-level providers

in primary care and control of diabetes. Prim Care Diabetes. 2011; 5(1):25–31.
12 Litaker D, Mion L, Planavsky L, Kippes C, Mehta N, Frolkis J. Physician-nurse practitioner teams in chronic disease management: the impact on costs, clinical effectiveness, and patients' perception of care. J Interprof Care. 2003;17(3): 223–37.
13 Hooker RS, Cawley JF, Leinweber W. Career flexibility of physician assistants and the potential for more primary care. Health Aff (Millwood). 2010;29(5):880–6.
14 Hooker RS, McCaig LF. Use of physician assistants and nurse practitioners in primary care, 1995–1999. Health Aff (Millwood). 2001;20(4): 231–8.
15 Hooker RS, Everett CM. The contributions of physician assistants in primary care systems. Health Soc Care Community. 2012;20(1):20–31.
16 Bosch M, Faber MJ, Cruijsberg J, Voerman GE, Leatherman S, Grol RP, et al. Review article: effectiveness of patient care teams and the role of clinical expertise and coordination: a literature review. Med Care Res Rev. 2009;66(6 Suppl): 5S–35S.
17 To access the Appendix, click on the Appendix link in the box to the right of the article online.
18 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank Q. 2005;83(3):457–502.
19 Oster A, Bindman AB. Emergency department visits for ambulatory care sensitive conditions: insights into preventable hospitalizations. Med Care. 2003;41(2):198–207.
20 Fleming ST. Primary care, avoidable hospitalization, and outcomes of care: a literature review and methodological approach. Med Care Res Rev. 1995;52(1):88–108.
21 Starfield B, Mumford L, Steinwachs D. Ambulatory care groups: a categorization of diagnoses for research and management. Health Serv Res. 1991;26(1):53–74.
22 Hooker RS. Physician assistants and nurse practitioners: the United States experience. Med J Aust. 2006;185(1):4–7.
23 Hing E, Hooker RS, Ashman JJ. Primary health care in community health centers and comparisons with office-based practice. J Community Health. 2011;36(3):406–13.
24 Morgan PA, Shah ND, Kaufman JS, Albanese MA. Impact of physician assistant care on office visit resource use in the United States. Health Serv Res. 2008;43(5 Pt 2):1906–22.
25 Aparasu RR, Hegge M. Autonomous ambulatory care by nurse practitioners and physician assistants in office-based settings. J Allied Health. 2001;30(3):153–9.
26 Mills AC, McSweeney M. Nurse practitioners and physician assistants revisited: do their practice patterns differ in ambulatory care? J Prof Nurs. 2002;18(1):36–46.
27 Everett CM, Thorpe CT, Palta M, Carayon P, Gilchrist VJ, Smith MA. Division of primary care services between physicians, physician assistants, and nurse practitioners for older patients with diabetes. Med Care Res Rev. 2013;70(5):531–41.
28 Lenz ER, Mundinger MO, Hopkins SC, Lin SX, Smolowitz JL. Diabetes care processes and outcomes in patients treated by nurse practitioners or physicians. Diabetes Educ. 2002;28(4):590–8.
29 Grumbach K. Chronic illness, comorbidities, and the need for medical generalism. Ann Fam Med. 2003;1(1):4–7.
30 Campion MA, Medsker GJ, Higgs AC. Relations between work group characteristics and effectiveness: implications for designing effective work groups. Pers Psychol. 1993; 46(4):823–47.
31 Chaix-Couturier C, Durand-Zaleski I, Jolly D, Durieux P. Effects of financial incentives on medical practice: results from a systematic review of the literature and methodological issues. Int J Qual Health Care. 2000;12(2):133–42.