

Workforce Configurations to Provide High-Quality, Comprehensive Primary Care: a Mixed-Method Exploration of Staffing for Four Types of Primary Care Practices

David Meyers, MD¹, Lisa LeRoy, PhD², Michael Bailit, MBA³, Judith Schaefer, MPH⁴, Edward Wagner, MD⁴, and Chunliu Zhan, PhD¹

¹Agency for Healthcare Research and Quality, Rockville, MD, USA; ²Abt Associates, Boston, MA, USA; ³Bailit Health, Needham, MA, USA; ⁴MacColl Center for Health Care Innovation, Seattle, WA, USA.

BACKGROUND: Broad consensus exists about the value and principles of primary care; however, little is known about the workforce configurations required to deliver it.

OBJECTIVE: The aim of this study was to explore the team configurations and associated costs required to deliver high-quality, comprehensive primary care.

METHODS: We used a mixed-method and consensus-building process to develop staffing models based on data from 73 exemplary practices, findings from 8 site visits, and input from an expert panel. We first defined high-quality, comprehensive primary care and explicated the specific functions needed to deliver it. We translated the functions into full-time-equivalent staffing requirements for a practice serving a panel of 10,000 adults and then revised the models to reflect the divergent needs of practices serving older adults, patients with higher social needs, and a rural community. Finally, we estimated the labor and overhead costs associated with each model.

RESULTS: A primary care practice needs a mix of 37 team members, including 8 primary care providers (PCPs), at a cost of \$45 per patient per month (PPPM), to provide comprehensive primary care to a panel of 10,000 actively managed adults. A practice requires a team of 52 staff (including 12 PCPs) at \$64 PPPM to care for a panel of 10,000 adults with a high proportion of older patients, and 50 staff (with 10 PCPs) at \$56 PPPM for a panel of 10,000 with high social needs. In rural areas, a practice needs 22 team members (with 4 PCPs) at \$46 PPPM to serve a panel of 5000 adults.

CONCLUSIONS: Our estimates provide health care decision-makers with needed guideposts for considering primary care staffing and financing and inform broader discussions on primary care innovations and the necessary resources to provide high-quality, comprehensive primary care in the USA.

KEY WORDS: primary care; workforce; team-based care; health care delivery.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s11606-018-4530-7>) contains supplementary material, which is available to authorized users.

Received January 17, 2018

Revised April 20, 2018

Accepted May 30, 2018

J Gen Intern Med

DOI: 10.1007/s11606-018-4530-7

© Society of General Internal Medicine (This is a U.S. Government work and not under copyright protection in the US; foreign copyright protection may apply) 2018

INTRODUCTION

There is broad consensus with regard to the value and principles of primary care in the USA and around the world^{1–5} As expressed by Starfield,¹ Bodenheimer et al.,² and more recently, the Patient-Centered Primary Care Collaborative,⁶ primary care should be (1) person and family centered, (2) continuous, (3) comprehensive and equitable, (4) team based and collaborative, (5) coordinated and integrated, (6) accessible, and (7) of high value. Health system structures and processes needed to support these aims have also been identified, including meaningful use of information technology, population management, linkage with social services and community resources, and appropriate and adequate financing mechanisms.^{3,4,7–9}

Team-based care is at the core of most strategies aimed at improving primary care.^{4,6–15} Clinicians alone do not have the time and may not be best suited to meet all of the needs of their patients. A primary care team, with each member working collaboratively and performing to the full extent of their training, can more efficiently and effectively serve a practice's patients. Researchers have identified a wide variety of elements necessary to form an effective team, including leadership and culture, team size, staffing ratios, workflow, and communication^{9–12} and called for expanded roles for nurses, medical assistants (MAs) and others on primary care teams.^{12–14} Though not yet definitive, early evidence, especially around patient-centered medical homes (PCMHs), shows that team-based approaches have positive impacts on patient and provider outcomes.^{15–17}

However, there is relatively little data on team compositions in U.S. primary care practices besides the number of physicians per practice.^{18–20} Peikes et al. analyzed staffing patterns of 496 practices participating in the Comprehensive Primary Care initiative in 2012, reporting that 98% of them employed administrative staff, 89% employed MAs, 47% employed licensed practical nurses (LPNs), 36% employed registered

nurses (RNs), and 24% employed care managers, with larger practices having more of these professionals.²¹ Patel et al. examined staffing requirements for practices transitioning to a PCMH by comparing available staffing data and staffing needs to fulfill PCMH functions, and concluded that, to be a successful PCMH, 4.25 full-time-equivalent (FTE) supporting staff members are needed per FTE physician.⁹ No study has attempted to examine optimal workforce configurations in relation to general primary care principles, quality of care, cost of care, or staff experience, due to the lack of data sources to support such examination.

Recognizing this gap and the current lack of empirical data, we combined quantitative and qualitative data with an iterative, deliberative, consensus-building process to develop optimal staffing configurations for four types of hypothetical primary care practices. The resulting workforce models and associated cost estimates are intended to provide reference points for discussion about primary care staffing and inform broader debates on primary care workforce and financing in the USA.

METHODS

We took a four-step process to develop each workforce configuration (see Online Appendix A for more details). First, we defined high-quality, comprehensive care and created a conceptual framework to guide the staffing modeling. Second, the definitions and framework were used to explicate the specific functions needed in a primary care practice. Third, we used a mix of qualitative and quantitative data, expert input, and a deliberative, consensus building process to translate the functions into the number and type of staff needed to care for a hypothetical patient panel. Fourth, the per-patient-per-month (PPPM) cost was estimated using existing data on labor and overhead costs.

Data Sources on Practice Staffing Configurations

We compiled staffing data for 73 primary care practices participating in five primary care innovation programs: (1) Robert Wood Johnson Foundation's Learning from Effective Ambulatory Practices,¹¹ (2) American Board of Internal Medicine Foundation's Finding Joy in Primary Care,¹⁶ (3) Peterson Center's America's Most Valuable Primary Care, (4) University of California at San Francisco Center for Health Professions' Innovative Workforce Models in Health Care, and (5) Agency for Health Research and Quality's Transforming Primary Care grant initiative²² (see Online Appendix B for staffing statistics from the data). We conducted in-depth case studies of eight practices nominated by national experts, focusing on staffing characteristics related to one or more functions highlighted in the conceptual framework (Online Appendix C).

Workforce Model Development

After creating the conceptual framework,²³ analyzing existing staffing data, and distilling the lessons from visits to eight exemplary practices,²⁴ we began our staffing modeling for a practice serving a hypothetical panel of 10,000 actively managed adults. Recognizing the current inconsistencies in defining patient panels,^{8,25,26} we estimated the practice's workload assuming that its patient panel was reflective of the national distribution of health conditions²⁷ and every adult had at least one visit per year to the practice. We then estimated the type and number of FTE staff needed to perform each function identified in the conceptual framework. A steering committee composed of 19 national experts in primary care was consulted on the overall methodology, process, data, and intermediate and final estimates (Online Appendix D). Once the "index" model was established, we then modified it to create three additional workforce configurations for practices with patient panels with a higher concentration of older patients and chronic care needs, with higher behavioral health and social needs, and with locations in sparsely populated rural areas (with a smaller panel of 5000). Key characteristics of the four hypothetical patient panels are described in Online Appendix E.

Workforce Model Costing

We obtained salary data for physicians and other staff types in 2015 dollars from the Bureau of Labor Statistics (BLS)²⁸ and used other sources²⁹⁻³² to estimate salaries for occupations not captured by the BLS. We calculated the median salary for each occupation (shown in Online Appendix F), adjusted the salary cost by 30% to account for benefits,^{9,33} multiplied the adjusted salary by FTEs, and aggregated the salaries for all staff types to yield the total labor cost for a practice in a year. To account for differences in labor rates across the USA, costs were estimated based with low (25th percentile in the national distribution), medium, and high (75th percentile) salary rates. We used data from the Medical Group Management Association to estimate general operating and business operating costs for a primary care practice, including but not limited to rent, utilities, supplies, laboratory and phlebotomy personnel, and the non-clinical time of a medical director.³⁴ These costs were added to the total labor costs to yield the total costs to run the practice for a year. Finally, total annual costs were divided by 12 months and by the panel size to obtain PPPM costs.

RESULTS

Primary Care Practice Staffing Configurations

Table 1 presents the proposed workforce configurations to provide high-quality, comprehensive primary care to four adult populations, listing staffing needs for each of the eight specific primary care practice functions, as well as administrative support and leadership for quality improvement. It

Table 1 Primary Care Team Configurations to Provide High-Quality, Comprehensive Primary Care

	Index model	High geriatric model	High social need model	Rural model
Practice patient panel	10,000 adults	10,000 adults	10,000 adults	5000 Adults
Functions				
Planned, evidence-based primary care (PCP)	6.0 MDs/DOs and 2.0 NPs/PAs	8.0 MDs/DOs and 4.0 NPs/PAs	5.0 MDs/DOs and 5.0 NPs/PAs	2.0 MDs/DOs and 2.0 NPs/PAs
Planned, evidence-based primary care (RN/LPN/LVN)	1.0 RN and 0.5 LPN/LVN	1.5 RN	2.5 RNs	1.0 LPN/LVN
Planned, evidence-based primary care (MA/LPN/LVN)	9.0 MAs	12.0 MAs	10.0 MAs	6.0 MAs
Complex care/transition management	2.5 RNs	3.5 RNs	3.0 RNs	1.5 RN
Behavioral health integration	1.5 LCSW and 1.0 MS-level therapist	3.0 LCSWs	2.0 LCSW, 1.0 psychologist, and 1.0 substance use counselor	1.75 LCSW
Medication management	1.0 pharmacist	1.0 pharmacist and 1.0 pharmacy assistant	1.0 pharmacist and 1.0 pharmacy assistant	0.5 pharmacist
Care coordination/referral management	1.0 MA and 1.0 layperson	2.0 MAs, 1.0 layperson, and 1.0 patient navigator	2.0 MA and laypersons and 2.0 patient navigators	1.0 MA/layperson
Self-management support	1.0 MA and 0.5 RN	1.5 RN and 1.0 MA	1.0 RN and 1.0 MA	1.0 MA/layperson
Community linkages	*	*	2.0 CHWs	1.0 CHW
Population management	0.5 RN	0.5 RN	0.5 RN	0.3 RN
Front desk administration—reception, intake	8.0 clerks	11.0 clerks	10.0 clerks	4.0 clerks
Quality improvement (leadership)	0.3 MD/DO	0.3 MD/DO	0.3 MD/DO	0.2 MD/DO
Total FTEs per year	36.8 FTEs	52.3 FTEs	50.3 FTEs	22.3 FTEs
Individual PCP actively managed adult patients	MD/DO, 1333; NP/PA, 1000	MD/DO, 900; NP/PA, 700	MD/DO, 1100; NP/PA, 900	MD/DO, 1400; NP/PA, 1110

PCP primary care provider; MD medical doctor; DO doctor of osteopathic medicine; NP nurse practitioner; PA physician assistant; RN registered nurse; LPN licensed practical nurse; LVP licensed vocational nurse; MA medical assistant; LCSW licensed community social worker; FTE full-time-equivalent
 *This function is performed by other staff in the model

should be noted that many staff member types (i.e., RN, MA, social worker) provide more than one essential function, and there are multiple ways an individual practice might fulfill the required functions. For example, the 0.5 RN FTE for population health management in the index model could be met wholly by a single nurse who also provides complex care management, or divided between two nurses who each also provides direct care and supervises MAs, or solely by a part-time nurse. The models recognize that team members may perform multiple functions while highlighting that it is critical to account for the staffing to accomplish each function, rather than focusing exclusively on team role. We highlight the salient points about each model below.

The Index Model. To provide high-quality, comprehensive primary care to 10,000 actively managed adults, a primary care practice would need about 37 staff members, including eight primary care professionals (PCPs) (i.e., six physicians and two NPs or PAs). These PCPs would be supported in providing clinical care by 1.5 team nurses and 9 MAs. The team would also include 2.5 RNs providing complex care management for patients with multiple chronic conditions and those newly diagnosed with serious acute or chronic illnesses. In this model, two behavioral health specialists offer scheduled appointments but primarily see patients at the PCPs' request before, during, or after visits on a flexible basis. They offer brief assessments and interventions for patients with mental health, substance use, or behavioral health problems. One pharmacist provides medication therapy management, especially to those with multiple medications or new prescriptions. Referral management is performed by a MA and

a trained lay person. While all direct care staff members are trained in self-management support techniques such as motivational interviewing, additional 1 MA and 0.5 RN are dedicated to this function.

High Geriatric Model. To manage 10,000 adults with a high percentage of older patients and those with multiple chronic conditions, a practice would need 52 staff members, including 12 PCPs. In comparison to the index model, the team needs more staff devoted to complex care management (3.5 versus 2.5 RNs), medication management (2.0 versus 1.0 pharmacy staff), and self-management support (2.5 versus 1.5 staff). Additional non-clinical staff would help with care coordination and the increased administrative needs of complex patients.

High Social Need Model. The model requires 50 staff members, including 10 PCPs. More behavioral health specialists (4.0 versus 1.5 for the index model) are needed, including a psychologist and substance use counselor. Two pharmacy staff (versus 1.0 in the index model) manage physical and behavioral health medications. Similar to the high geriatric model, 4.0 care coordinators are needed. In addition, 2.0 community health workers are needed to link patients with community resources (housing, social support, transportation, etc.) and perform outreach.

Rural Model. The patient panel of 5000 adults reflects the lower population density of a rural area. Despite the smaller patient panel, the model requires 22 staff members, including

4 PCPs, to meet the increased needs for care coordination and self-management support given more limited health and social services in rural communities. Additionally, one community health worker is added to conduct outreach to isolated patients and to maintain relationships with dispersed community resources. Recognizing the challenges of physician recruitment and retention in rural areas, this model utilizes equal numbers of physicians and NPs/PAs.

Costs Associated with Workforce Configurations

Table 2 presents the estimated labor and overhead costs associated with different configurations. The median PPPM costs range from \$45 for the index model to \$64 for the high geriatric model. The PPPM estimates calculated based on low, median, and high salary rates are presented in more details in Online Appendix G.

DISCUSSION

In this study, we evaluated the staffing configurations and associated costs for four hypothetical primary care practices. Our results appear to be consistent with the only comparable previous findings by Patel et al.⁹ who determined that at a fully functional PCMH, a FTE physician needed 4.25 FTE supporting staff members as compared to a ratio of 3.6 FTE supporting team members in our index model and 4.0 FTE supporting team members in our high geriatric or social needs model. We have gone beyond the staffing ratio to configure the entire primary care team capable of providing comprehensive, high-quality primary care to a practice's patient panel. While the models are presented as serving 10,000 active patients (5000 in the rural model), they are intended to be scalable. Scaling the models downward to practices with three or fewer clinicians demonstrates a current real-world challenge of smaller primary care practices—it can be difficult to secure part-time services of skilled team members such as pharmacists and behavioral health counselors. Potential solutions include forming groups with other small primary care practices to share services and contracting with community-based organizations.

Our goal with this study is to spur and inform conversation about the appropriate level of staffing and revenue needed for a practice to provide high-quality, comprehensive primary care in the USA. These models are not numerically precise and are not designed to dictate staffing standards. An individual practice in considering its own staffing composition will need to consider numerous external and internal factors, including the local availability of health care workers and the specific skills and preferences of the practice's individual team members. Our estimates should be viewed, both in terms of their implications and limitations, in light of some key factors, discussed below.

Comprehensive Care

Primary care practices in the USA have limited the comprehensiveness of care they provide over the past decades, partially, if not entirely, driven by the incentives from the fee-for-service payment system.⁴ With reimbursements linked to face-to-face visits by primary care physicians (sometimes also including visits with NPs or PAs), primary care practices have become efficient in increasing the volume of office visits, often through increasing reliance on referrals to support the diagnosis and management of individual problems. This greatly increases the fragmentation of each individual patient's care. The models presented here are built to allow a primary care practice to address the large majority of the needs of its patient panel. This more comprehensive approach includes both returning the breadth of care provided by primary care practices and the depth. It continues to recognize the appropriate use of sub-specialist services necessary to provide high-quality care, while allowing primary care practices to utilize sub-specialists as consultants rather than managers of care. These models also recognize that patient-centered primary care requires the team to provide care coordination and linkage to community resources, health education and self-management support, and care for common behavioral health needs, including both support for behavior change such as smoking cessation and care for basic mental health conditions including depression and anxiety.

Panel Size

The average primary care practice in the USA today utilizes a smaller team of professionals to care for a larger group of patients than recommended by these models.^{18,19,35,36} While commonly cited patient panel sizes are likely over-estimates

Table 2 Median Costs Associated with Four Types of Staff Configurations, in 2015 Dollars

Model	Index model	High geriatric model	High social need model	Rural model
Total staffing cost per year*	\$3,411,000	\$4,795,000	\$4,217,000	\$1,773,000
General operating cost per year [#]	\$1,767,000	\$2,651,000	\$2,209,000	\$884,000
Business operating cost per year [#]	\$188,000	\$282,000	\$235,000	\$94,000
Total cost per year	\$5,366,000	\$7,728,000	\$6,661,000	\$2,751,000
Total cost per patient per month	\$45.00	\$64.00	\$56.00	\$46.00

*Median salary for each staff type calculated based on the salary data from the Bureau of Labor Statistics²⁸ and multiple other sources^{29–32}

[#]Estimates based on the Medical Group Management Association data

due to inclusion of patients who are not seen by the practice and who are seen by multiple practices,^{8,25,26,36} the models presented here propose that in order to provide high-quality, comprehensive primary care, panel sizes need to be smaller and primary care teams larger and more diverse. Our index model, which proposes a patient panel for a primary care physician at 1333, is consistent with the recommendations of Altschuler et al.³⁷ and the findings of Peikes et al. which found that 65.3% of the practices participated in the Comprehensive Primary Care initiative had a physician panel size below 1500 patients.²¹

Not surprisingly, larger teams providing comprehensive care for smaller numbers of patients cost more. The estimated costs of our index model practice of \$45 PPM is higher than what most health insurers currently pay for primary care services.³⁸ Payers will need to financially support primary care practices if they are to sustainably maintain smaller panel sizes and comprehensive teams. However, providing high-quality, comprehensive primary care by expanded teams has the potential not only to improve patient health and experience but also to substantially offset expenditures in other parts of the larger health care system.^{15,17}

Cost, Financing, and Payment for Primary Care

The US spent \$9990 per capita for health care in 2015,³⁹ and the portion of this spent on primary care was unclear. Goroll et al. estimated that primary care patient visits accounted for 6–7% of total health care spending for Medicare beneficiaries in 2007, and suggested that this percentage might be lower for the rest of the population.³³ Bailit et al. estimated that primary care spending accounted for 7.7% total spending in preferred provider organizations plans and 8.6% for Health Maintenance Organizations in 2014.⁴⁰ If one considers that 7% of \$9990 per capita per year is spent on primary care (i.e., \$58 PPM), our estimates suggest that comprehensive primary care delivery is feasible without requiring substantial additional spending at the national level.

However, substantial changes in the payment system are needed. The visit-based, fee-for-service payment system does not incentivize the delivery of team-based, comprehensive primary care. To implement team configurations aimed at providing comprehensive primary care, the payment system must reward care coordination, outreach services, and population management.⁴¹

The Future Primary Care Workforce

Our models may also inform national discussions on broader primary care workforce issues. Many researchers have expressed concerns and proposed various solutions to the primary care workforce shortages in the USA.^{14,42–46} Our workforce models may provide fresh reference points with which to study the global demand and supply for PCPs and other health care professionals. For example, our estimates could be extrapolated to calculate the needed supply of MAs or RNs in order to provide high-quality, comprehensive primary care in the USA.

Limitations

There are important limitations in our methods. Foremost, our study is not based on empirical data; no data exist that allow identification of high-performing primary care practices and their respective team configurations. For this reason, we could not include confidence intervals for our staffing estimates. In addition, we had to make many assumptions on patient panel sizes and characteristics, many of which are debatable. The models do not account for the costs associated with transforming towards this model, including recruitment and training, which can be expected to be substantial. The models also do not account for primary care teams delivering care to hospitalized patients or patients in nursing homes. Future work should consider primary care workforce models that include different assumptions such as smaller practice sizes as well as the care of children, validate the models against real-world data, and explore approaches to achieving the ideal staffing configurations.

CONCLUSION

Our study explored staffing configurations and associated costs for primary care practices to provide high-quality, comprehensive care for four adult patient panels. While not numerically precise, our estimates can serve as guideposts on optimal primary care practice staffing and inform discussions on larger primary care issues such as primary care workforce planning and financing in the USA.

Acknowledgements: *The authors would like to acknowledge the valuable contributions of all participating primary care practices who contributed staffing data, expert panel members who offered critical input in the model development process, and Robert McNellis, Janice Genevro, Theodore Ganiats, and Richard Ricciardi of the Agency for Healthcare Research and Quality (AHRQ) for their valuable comments. Special thanks also to MaryJoan Ladden and the Robert Wood Johnson Foundation for providing access to data and insights from the Learning from Effective Ambulatory Practices project.*

Corresponding Author: David Meyers, MD; Agency for Healthcare Research and Quality, Rockville, MD, USA (e-mail: David.Meyers@ahrq.hhs.gov).

Funders *This manuscript is based on the research conducted by researchers at the Agency for Healthcare Research and Quality (AHRQ) and Abt Associates in partnership with the MacColl Center for Health Care Innovation and Bailit Health, LLC, under an AHRQ contract (Contract Nos. 290-2010-00004-1/290-32009-T). The findings and conclusions in this document are those of the authors, who are responsible for its contents; the findings and conclusions do not necessarily represent the views of AHRQ or the U.S. Department of Health and Human Services.*

Compliance with Ethical Standards:

Prior Presentations: *This work was previously presented partially at the Academy Health Research Meeting in Boston, Massachusetts, on June 2016; at the American Public Health Association meeting in Denver, Colorado, on November 1, 2016; and at the Academy Health Research Meeting in New Orleans, Louisiana, on June 25, 2017.*

Conflict of Interest: The authors declare that they do not have a conflict of interest.

REFERENCES

1. **Starfield B.** Primary Care: Balancing Health Needs, Services, and Technology. New York: Oxford University Press; 1998.
2. **Bodenheimer T, Ghorob A, Willard-Grace R, Grumbach K.** The 10 building blocks of high-performing primary care. *Ann Fam Med.* 2014;12(2):166–71.
3. Institute of Medicine. Primary Care: America's Health in a New Era. Washington, DC: National Academy Press; 1996.
4. **Ellner AL, Phillips RS.** The coming primary care revolution. *J Gen Intern Med.* 2017; 32(4):380–6.
5. World Health Organization. Primary Health Care: Now More Than Ever. Geneva: WHO; 2008.
6. Patient-Centered Primary Care Collaborative. Shared principles of primary care: moving the United States toward a vibrant future of person-centered, team-based, and community aligned primary care. Available at: <https://www.pcpcc.org/about/shared-principles>. Accessed May 11, 2018.
7. **Ghorob A, Bodenheimer T.** Share the care: building teams in primary care practices. *J Am Board Fam Med.* 2012;25(2):143–5.
8. **Grumbach K, Olayiwola JN.** Patient empanelment: the importance of understanding who is at home in the medical home. *J Am Board Fam Med.* 2015;28(2):170–2.
9. **Patel MS, Arron MJ, Sinsky TA, Green EH, Baker DW, Bowen JL, et al.** Estimating the staffing infrastructure for a patient-centered medical home. *Am J Manag Care.* 2013;19(6):509–16.
10. **Friedman A, Hahn KA, Etz R, Rehwinkel-Morfe AM, et al.** A typology of primary care workforce innovations in the United States since 2000. *Med Care.* 2014;52(2):101–11.
11. **Ladden MD, Bodenheimer T, Fishman NW, et al.** The emerging primary care workforce: preliminary observations from the primary care team: learning from effective ambulatory practices project. *Acad Med.* 2013;88(12):1830–4.
12. **Bodenheimer T, Willard-Grace R.** Teamlets in primary care: enhancing the patient and clinician experience. *J Am Board Fam Med.* 2016;29(1):135–8.
13. **Balasa DA.** New roles for the certified medical assistant to enhance quality and effectiveness of care. *J Med Pract Manage.* 2008;23(5):276–8.
14. **Bodenheimer T, Bauer L.** Rethinking the primary care workforce—an expanded role for nurses. *N Engl J Med.* 2016; 375:1015–7.
15. **Reiss-Brennan B, Brunisholz KD, Dredge C, et al.** Association of integrated team-based care with health care quality, utilization, and cost. *JAMA.* 2016;316(8):826–34.
16. **Sinsky CA, Willard-Grace R, Schutzbank AM, et al.** In search of joy in practice: a report of 23 high-functioning primary care practices. *Ann Fam Med.* 2013;11(3):272–8.
17. **Jabbarpour Y, DeMarchis E, Bazemore A, Grundy P.** The impact of primary care practice transformation on cost, quality and utilization: a systematic review of research published in 2016. Available at: <https://www.milbank.org/news/patient-centered-primary-care-collaborative-publishes-new-evidence-report/>. Accessed May 11, 2018.
18. **Bauer MS, Leader D, Un H, Lai Z, Kilbourne AM.** Primary care and behavioral health practice size: the challenge for healthcare reform. *Med Care.* 2012; 50(10): 843–8
19. **Hing E, Burt CW.** Characteristics of office-based physicians and their medical practices: United States, 2005–2006. . National Center for Health Statistics. *Vital Health Stat.* 13(166). 2008.
20. **Lau DT, McCaig LF, Hing E.** Toward a more complete picture of outpatient, office-based health care in the U.S. *Am J Prev Med.* 2016. 51(3):403–9.
21. **Peikes DN, Reid RJ, Day TJ, et al.** Staffing patterns of primary care practices in the comprehensive primary care initiative. *Ann Fam Med.* 2014;12(2):142–9.
22. Agency for Healthcare Research and Quality. Primary care transformation. Available at: <https://www.ahrq.gov/professionals/systems/primary-care/tpc/index.html>. Accessed May 11, 2018.
23. Agency for Healthcare Research and Quality. Redefining primary care for the 21st century. Available at: <https://www.ahrq.gov/professionals/systems/primary-care/workforce-financing/white-paper.html>. Accessed May 11, 2018.
24. Agency for Healthcare Research and Quality. AHRQ new models of primary care workforce and financing. Available at: <https://www.ahrq.gov/ncepcr/primary-care-research/workforce-financing/exec-summary.html>. Accessed May 11, 2018.
25. **Angstman KB, Horn JL, Bernard ME, et al.** Family medicine panel size with care teams: impact on quality. *J Am Board Fam Med.* 2016;29(4):444–51.
26. **Raffoul M, Moore M, Kamerow D, Bazemore A.** A primary care panel size of 2500 is neither accurate nor reasonable. *J Am Board Fam Med.* 2016;29(4):496–9.
27. **Ortman JM, Velkoff VA, Hogan H.** An aging nation: the older population in the United States: population estimates and projections, 2014. Available at: <https://www.census.gov/prod/2014pubs/p25-1140.pdf>. Accessed May 11, 2018.
28. Bureau of Labor Statistics. May 2015 national occupational employment and wage estimates. Available at: http://www.bls.gov/oes/current/oes_nat.htm. Accessed May 14, 2018.
29. **Peckham C.** Physician compensation report 2015. Available at: <http://www.medscape.com/sites/public/physician-comp/2015>. Accessed May 11, 2018.
30. **Peckham C.** Medscape nurse salary report 2015. Available at: <http://www.medscape.com/features/slideshow/public/nurse-salary-report-2015>. Accessed May 11, 2016.
31. **Peckham C.** Clinical and office staff salary report 2015. Available at: <http://www.medscape.com/features/slideshow/public/staff-salary-report-2015#page=1>. Accessed May 11, 2018.
32. **Basu S, Phillips RS, Bitton A, Song Z, Landon BE.** Medicare chronic care management payments and financial returns to primary care practices: a modeling study. *Ann Intern Med.* 2015;163:580–8.
33. **Goroll AH, Bwensson RA, Schoenbaum SC, Gardner LB.** Fundamental reform of payment for adult primary care: comprehensive payment for comprehensive care. *J Gen Intern Med.* 2007; 22(3):410–5.
34. Medical Group Management Association. MGMA Cost Survey for Primary Care Practices: 2014 Report Based on 2013 Data. Glacier Publishing Services, Inc.; 2014.
35. **Muhlestein DB, Smith NJ.** Physician consolidation: rapid movement from small to large group practices, 2013–2015. *Health Aff.* 35(9): 1638–42.
36. **Murray M, Davies M, Boushon B.** Panel size: how many patients can one doctor manage? *Fam Pract Manag.* 2007;14(4):44–51.
37. **Altschuler J, Margolius D, Bodenheimer T, Grumbach K.** Estimating a reasonable patient panel size for primary care physicians with team-based task delegation. *Ann Fam Med.* 2012;10(5):396–400.
38. Oregon Health Authority and the Department of Consumer and Business Services. Primary care spending in Oregon, 2014. Available at: http://www.oregon.gov/oha/HPA/CSI-PCPCH/Documents/2017%20SB231_Primary-Care-Spending-in-Oregon-Report-to-the-Legislature.pdf. Accessed May 11, 2018.
39. Center for Medicare and Medicaid Services. National health expenditures 2015 highlights. Available at: <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/downloads/highlights.pdf>. Accessed May 11, 2018.
40. **Bailit MH, Friedberg MW, Houy ML.** Standardizing the measurement of commercial health plan primary care spending. Available at: <https://www.milbank.org/wp-content/uploads/2017/07/MMF-Primary-Care-Spending-Report.pdf>. Accessed May 11, 2018.
41. **Watkins LD.** Aligning payers and practices to transform primary care: a report from the multi-state collaborative. Available at: <https://www.milbank.org/publications/aligning-payers-and-practices-to-transform-primary-care-a-report-from-the-multi-state-collaborative/>. Accessed May 11, 2018.
42. **Phillips RL, Green LA, Fryer GE, Dovey SM.** Uncoordinated growth of the primary care work force. *Am Fam Physician.* 2001;64(9):1498.
43. **Pettersen SM, Liaw WR, Phillips RL Jr, et al.** Projecting US primary care physician workforce needs: 2010–2025. *Ann Fam Med.* 2012;10(6):503–9.
44. **Pettersen SM, Phillips RL Jr, Bazemore AW, Koinis GT.** Unequal distribution of the U.S. primary care workforce. *Am Fam Physician.* 2013 1;87(11). Available at: <http://www.aafp.org/afp/2013/0601/od1.pdf>. Accessed May 11, 2018.
45. **Auerbach DI, Chen PG, Friedberg MW, et al.** Nurse-managed health centers and patient-centered medical homes could mitigate expected primary care physician shortage. *Health Aff.* 2013;32(11):1933–41.
46. **Bodenheimer TS, Smith MD.** Primary care: proposed solutions to the physician shortage without training more physicians. *Health Aff.* 2013;32(11):1881–6.