EHR Adoption Among Ambulatory Care Teams

Philip Wesley Barker, MS; and Dawn Marie Heisey-Grove, MPH

ABSTRACT

Objectives: This study provides information on the types of practices that employ 2 types of advance practice providers (APPs), nurse practitioners (NPs) and physician assistants (PAs), and the association between employment of APPs and health information technology (IT) adoption by the practice.

Study Design: Three outcomes predicted the likelihood that practices employed at least 1 NP, at least 1 PA, or at least 1 of either type of APP; one outcome estimated electronic health record (EHR) adoption across practices; and 4 models assessed the EHR functionalities used by practices.

Methods: Data from SK&A Information Services' 2013 Office-Based Provider Database were used to estimate EHR adoption using a Poisson regression model. Independent variables included practice size, care setting, practice specialty, ownership, geographic region, whether a practice employed a NP, and whether a practice employed a PA.

Results: In 2013, three-fourths of practices that employed at least 1 APP had adopted an EHR. Practices that employed at least 1 APP were 9% to 12% more likely to have an EHR that had advanced functionalities, compared with practices without an APP.

Conclusions: This study found an association between employment of APP staff and practice-level adoption of EHRs and practice-level adoption of certain EHR functionalities. Practices that employ APPs are prepared to implement team-based approaches to care that may be further enhanced through the use of health IT. Future research should examine how practices with APPs are using health IT to promote better health and coordinate care.

Am J Manag Care. 2015;21(12):894-899

The "triple aim" of better care, smarter spending, and healthier individuals was originally described in a publication in 2008, although even at the time, those goals were not new.[1] The authors described functions necessary to achieve balance within those 3 goals: patient engagement, expansion of the role of primary care providers, population health management, payment reform, and care coordination. Health information technology (IT) tools such as electronic health records (EHRs) enable a change in work flow and practice redesign, facilitate population health management, enhance communication between providers of care teams by enabling the safe and secure exchange of health information, and may improve patient care and safety through clinical decision and order entry support tools. In spite of these advanced functionalities, health IT is a tool that must be accompanied with a change in how care is delivered, with a focus on patient-centered care coordinated by a team of healthcare providers.

With an anticipated primary care physician shortage through 2020, implementation of team-based approaches could not only maintain, but also potentially increase access to, primary care services.[2-5] Advance practice professionals (APPs), such as nurse practitioners (NPs) and physician assistants (PAs), are positioned to be key components of such care delivery teams. In team-based approaches, APPs can provide care for the more routine cases, freeing up physicians to care for patients with more complex health problems.[6,7] APP-provided care has been demonstrated to be comparable with care provided by physicians—sometimes with lower costs and improvements in patient trust and satisfaction.[8-11]

Knowing that practices that employ APPs are prepared to implement team-based approaches to care, which could be further enhanced through the use of health IT, it is important to more fully examine the association between health IT adoption and the presence of APPs in a practice. Using national data from 2013, this study seeks to answer 3 ques-

tions: 1) What were the practice characteristics associated with having APPs on staff? 2) Were practices with APPs on staff more likely to adopt an EHR? 3) Among practices that adopted an EHR, were practices with APPs more likely to have adopted EHRs with advanced functionalities?

Take-Away Points

As healthcare delivery shifts to a patient-centered care coordination model, skilled advance practice providers (APPs), such as nurse practitioners (NPs) and physician assistants (PAs), will be necessary components of a care team. Sharing information across the care coordination team can be facilitated by health information technology (IT), so a better understanding of the intersection of practice staffing of APPs and health IT adoption is important.

- Practices that employed NPs or PAs were more likely to adopt health IT.
- Practices that employed NPs or PAs were more likely to have access to advanced health IT functionalities.

METHODS

Data Source

The primary data source for this paper was the SK&A Office-Based Provider Database, a commercial product from SK&A Information Services, Irvine, California. SK&A Information Services maintains a database of all US office-based practices' contact information (eg, phone number, street address). SK&A staff call each practice annually to collect information about the practice, including whether or not the practice has an EHR, type of personnel employed at the practice, personnel specialties, practice size, and other practice-specific data. Additional information on the data set has been published previously.[12] Data gathered during 2013 were used.

Independent Variables

Variables used to characterize practices included the practice size, rural setting, geographic region, practice specialty, whether a practice employed an NP, practice employment of a PA, and practice ownership. Practice size was based on the number of full-time equivalent physicians (FTPs) practicing at a unique practice site in a given year, and ranged from less than 1 FTP to more than 10 FTPs.

Rural setting was a binomial variable that assessed whether the practice was located in a rural setting. Urban and rural designations were determined using the Health Resources and Services Administration Area Resource File (ARF).[13] The site's federal information processing standards (FIPS) code and zip code were used to match the ARF and SK&A data. Practices were considered to be urban if located in a Metropolitan core-based statistical area. The geographic region in which the practice was located was based on US Census Bureau regions.[14]

Practices were designated primary care if all practicing providers specialized in adolescent medicine, pediatrics, family practice, general practice, geriatrics, internal medicine, obstetrics, or gynecology. Practices were considered to have employed an NP or PA if, in a given year, the practice had at least 1 part- or full-time NP or PA on staff.

Practice ownership was based on 2 binary data fields that assessed whether the practice was hospital-owned or system-affiliated. These elements were combined to create 4 categories: owned by a hospital, affiliated with a health system, owned by a hospital and affiliated with a health system, and independent (neither hospital-owned nor system-affiliated).

Outcomes

Eight outcomes were measured for this study: 3 outcomes predicted the likelihood that practices employed NPs, PAs, or either type of APP; 1 outcome estimated EHR adoption, using employment of APPs as independent variables; and 4 outcomes estimated the likelihood that certain EHR functionalities were available among practices that had adopted EHRs.

EHR adoption was ascertained through responses to 2 questions from SK&A's survey of office-based practices: "Are you currently utilizing electronic health record software?" or "Are you currently utilizing EHR software?" Respondents who answered "yes" to either question were coded as having an EHR. Nine percent of practices did not respond to this question. For a conservative approximation of EHR adoption, practices with a missing response were classified as non-adopters. Practices that had adopted an EHR were asked if their system offered any of 3 advanced functions: managing patient notes, electronic prescribing, and viewing patient lab reports and x-rays. Each of these functions was modeled individually as an outcome. In addition, an aggregate measure was created to assess whether practices had access to all 3 functions.

Data Analysis

Eight models were fitted using a Poisson regression that generated relative risk statistics with robust standard errors. This study used R Statistical Software (R Core Team, Vienna, Austria) to fit the models and produce these statistics, using a Poisson generalized linear model.[15-18] All models used practice size, care setting, practice specialty, ownership, and geographic region as independent vari-

Table 1. Characteristics of Ambulatory Care Practices in the United States, 2013

	N	%
Providers	725,456	100
Physicians[a]	592,988	82
Nurse practitioners	78,341	11
Physician assistants	54,127	8
Practices	266,627	100
With at least 1 nurse practitioner	53,182	20
With at least 1 physician assistant	36,295	14
With at least 1 advance practice provider	77,825	29
With an EHR[b]	266,627	63
With an EHR that manages patient notes	167,581	80
With an EHR that manages electronic prescribing	167,581	77
With an EHR that views patient laboratory reports and x-rays	167,581	76
With an EHR that manages notes, eRx, and views reports	167,581	71

EHR indicates electronic health record; eRx, electronic prescription.
[a]Medical doctors and doctors of osteopathy in ambulatory care settings.
[b]Of the 266,627 practices, 24,819 did not respond to the question, "Do you have an EHR?" These missing responses were coded as "no" responses for this analysis.

ables. EHR adoption and EHR functionality models included both independent variables for NP and PA employment. The NP employment model included the independent variable for the employment of PAs, and the PA employment model included the independent variable for the employment of NPs.

RESULTS

Practice Demographics

Nurse practitioners and PAs comprised nearly one-fifth of ambulatory care providers (Table 1). Twenty percent of practices employed at least 1 NP; 14% of practices employed at least 1 PA. Overall, 3 in 10 practices employed at least 1 NP or PA.

EHR Adoption

Practices with an NP or PA had higher adoption rates (74% and 76%, respectively) than practices without an APP (58%) (Figure). Among practices that adopted an EHR in 2013, 80% adopted an EHR that managed patient notes, 77% adopted an EHR that managed electronic prescriptions, and 76% adopted an EHR that viewed patient laboratory reports and x-rays (Table 1).

Practice Characteristics Associated With Employment of Nurse Practitioners and Physician Assistants

Factors that best predicted employment of APPs were practice size, rural setting, and primary care specialty (Table 2). Primary care practices were twice as likely to employ APPs compared with multi-specialty practices, when controlling for other factors. Rural practices were almost 50% more likely to employ a NP, and 41% more likely to employ a PA, than urban practices; larger practices were also more likely to employ NPs and PAs. Regionally, northeastern and western practices were less likely to employ NPs than midwestern practices; however, those same regions had higher PA employment. Practices that employed 1 type of APP were also more likely to employ other APPs. Controlling for all other characteristics, practices that employed at least 1 PA were 44% more likely to also employ an NP, and practices that employed at least 1 NP were 36% more likely to also employ a PA, compared with practices that did not employ these APPs.

Practice Characteristics Associated With EHR Adoption

After controlling for other practice characteristics, ownership, practice size, and employment of NPs and PAs were statistically associated with EHR adoption (Table 2). Controlling for all other characteristics, practices with at least 1 NP were 12% more likely to adopt EHRs than practices without an NP, while practices with at least 1 PA were 15% more likely to adopt an EHR than practices without a PA.

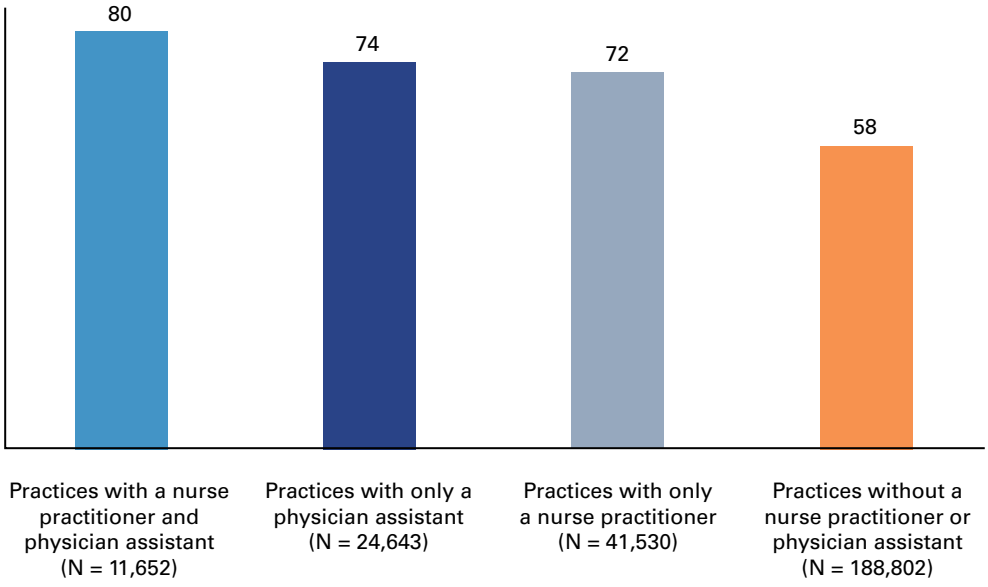
Practice Characteristics Associated With EHR Functional Capabilities

Compared with overall EHR adoption, differences in availability of specific EHR functionalities were smaller. Controlling for other practice characteristics, practice specialty, size, and employment of APPs were major predictors for the availability of an EHR system that could manage clinical notes, electronically prescribe, or permit viewing of laboratory results and x-rays. Practices with either an NP or a PA on staff were more likely to have an EHR with any of these functionalities than practices that did not employ a similar APP. In addition, practices that employed either an NP or PA were 9% to 12% more likely to use an EHR with all 3 functionalities than practices without those APPs.

DISCUSSION

This research found that, after controlling for other practice-level characteristics, there were strong associa-

Figure. Electronic Health Record Adoption Rates Among Ambulatory Care Practices, 2013



tions between the employment of APPs and EHR adoption. Three-fourths of practices that employed an APP had adopted an EHR compared with 60% of practices without these staff members. In addition, practices that employed APPs were more likely to have EHRs that had high-level functions promoting communication (eg, managing clinical notes, viewing laboratory results and x-rays) and patient safety (eg, electronic prescribing), when compared with practices not staffed with APPs.

The intersection of health IT-enabled care and the availability of APPs within a practice has only been minimally researched to date [19,20] Drs Adler-Milstein and Jha proposed that the use of skilled labor for EHR-related tasks allows physicians to "off-load self-contained tasks that they previously performed," such as preventive care or care based on clinical care guidelines.[19] In addition, practices that delegated EHR-related work to support staff have demonstrated improved clinician productivity.[21] By performing some of the more routine care tasks, APPs provide more time for the physician to manage complex care situations. These results demonstrate that the largest practices were 2 times more likely to have an APP on staff and 34% more likely to have an EHR compared with those practices with less than 1 FTP, thereby positioning larger practices to be able to take fuller advantage of the high-level EHR functions.

Notably, although practices with less than 1 FTP were more likely to be staffed with an APP than solo physician practices, these practices were least likely to have adopted an EHR. This suggests that staffing with APPs is not sufficient to facilitate EHR adoption. Howard et al reported that among small primary care practices, unless the practice had redesigned its work flow, clinicians complained of increased documentation times and increased complexity in performing tasks such as ordering and reviewing laboratory results.[22] Thus, in order to fully maximize the advantages of having APPs on staff and having adopted health IT, a practice should consider making changes that enhance patient flow within the office, improve data collection, and enhance the teamwork that allows APPs and other office staff to work to the highest level of their training. In resource-constrained practices, such as small and rural practices, implementing these work flow changes may require financial and technical assistance.

These analyses provided practice-level estimates on the adoption and availability of EHR functionalities, but did not provide information on which providers within the practice were using the EHRs, nor did it provide information on how the practices were using their EHRs. Other analyses have shown that APPs eligible for the Medicaid EHR Incentive Program achieved meaningful use of certified health IT at a lower rate than eligible physicians.[23] In order for a team-based approach to patient care to work, members of the care team should be able to use the health IT to the highest level of their training. Although practices that employ APPs have higher rates of access to these EHR functionalities than practices without those staff, it is not clear from these data which healthcare providers were actually using those EHR functions.

These results provide statistical associations between practice characteristics and the adoption and use of health

Table 2. Ambulatory Care Practice Characteristics Associated With Employment of Advance Practice Providers and the Adoption of EHRs

	Dependent Variables (practice level)							
Independent Variables	**Nurse Practitioner on Staff**	**Physician Assistant on Staff**	**Any Advance Practice Provider**	**Has an EHR[a]**	**EHR Manages Patient Notes**	**EHR Manages eRxs**	**EHR Views Patient Laboratory Reports and X-Rays**	**EHR Manages Notes, eRx, and Views Labs**
Nurse practitioner in practice (ref = no NP in practice)	N/A	1.44**	N/A	1.12**	1.05**	1.07**	1.05**	1.09**
Physician assistant in practice (ref = no PA in practice)	1.36**	N/A	N/A	1.15**	1.06**	1.08**	1.08**	1.12**
Practice size (ref = <1 FTP)								
>10 FTP[b]	2.14**	3.03**	2.08**	1.34**	1.05**	1	1.11**	1.05**
>5-10 FTP	1.72**	2.35**	1.77**	1.3**	1.06**	1.03**	1.12**	1.09**
>1-5 FTP	1.13**	1.53**	1.21**	1.24**	1.05**	1.06**	1.09**	1.09**
1 FTP	0.54**	0.69**	0.57**	1.03**	1.01**	1.04**	1.02**	1.03**
Rural setting (ref = urban)	1.47**	1.41**	1.44**	1.1**	1.02**	1.02**	1.02**	1.01*
Primary care practice (ref = multi-specialty)	2.12**	1.2**	1.73**	1.08**	1.06**	1.12**	1.1**	1.17**
Ownership (ref = independent)								
Hospital-owned	1.17**	0.96*	1.11**	1.11**	0.98**	0.95**	1.03**	1
System-affiliated	1.15**	1	1.1**	1.08**	1	0.98**	1.05**	1.04**
Hospital-owned/ system-affiliated	1.25**	0.91**	1.13**	1.14**	1.01*	1	1.07**	1.07**
Region (ref = midwest)								
Northeast	0.92**	1.05*	0.96**	0.92**	0.96**	0.95**	0.96**	0.95**
South	1.08**	1.11**	1.1**	1.01*	1	0.99*	1.01**	1.01*
West	0.92**	1.33**	1.05**	0.98**	1.01	0.98**	1.01*	1

EHR indicates electronic health record; eRx, electronic prescription; FTP, full-time equivalent physician; PA, physician assistant; NP, nurse practitioner; ref, reference.
[a]Of the 266,627 practices, 24,819 did not respond to the question, "Do you have an EHR?" These missing responses were coded as "no" responses for this analysis.
[b]The number of full-time equivalent physicians practicing at a unique practice in a given year.
Four model results are Poisson regression estimates displayed as relative risk statistics with robust standard errors.
"*" indicates $P<.05$;"**" indicates $P<.01$

IT. It is difficult with these statistical analyses, however, to determine causality. The associations between EHR adoption and APP employment may be the result of underlying factors influencing both, such as the presence of innovative physicians who are both more likely to adopt EHRs and hire APPs. Prior work has shown that practices that adopted EHRs were more likely to have innovative physicians on staff.[24] The associations identified here may be a result of having innovative physicians on staff, and those physicians promoting team-based care, as well as EHR adoption. More work in this area is necessary, but these results do demonstrate that practices with APPs on staff have higher rates of health IT adoption and use, and thus, are primed to take the next steps to delivery system reform.

CONCLUSIONS

Adoption of any EHR is progress toward greater integration with the healthcare system and the triple aim of better health, smarter spending, and healthier people.

However, practices must have health IT that facilitates communication, promotes patient safety, and allows healthcare providers to coordinate care effectively and easily. Future research should examine how practices with APPs are using health IT to promote better health and coordinate care, as APPs become a more integral part of office-based care coordination teams to provide coordinated, patient-centered care.

Author Affiliations: HHS, Office of the National Coordinator for Health IT (PWB, DH-G), Washington, DC.

Source of Funding: None.

Author Disclosures: The authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (PWB, DH-G); analysis and interpretation of data (PWB, DH-G); drafting of the manuscript (PWB, DH-G); critical revision of the manuscript for important intellectual content (PWB, DH-G); statistical analysis (PWB); and supervision (DH-G).

Address correspondence to: P. Wesley Barker, MS, US Department of Health and Human Services, Office of the National Coordinator for Health IT, 200 Independence Ave, SW, Ste 745H.3, Washington, DC 20201. E-mail: Wesley.Barker@hhs.gov.

REFERENCES

1. Berwick DM, Nolan TW, Whittington J. The trip aim: care, health, and cost. *Health Aff (Millwood).* 2008;27(3):759-769.

2. Institute of Medicine. 2011. *The Future of Nursing: Leading Change, Advancing Health*. Washington, DC: The National Academies Press; 2010.

3. Health Resources and Services Administration, National Center for Health Workforce Analysis. Projecting the supply and demand for primary care practitioners through 2020. Health Resources and Services Administration website. http://bhpr.hrsa.gov/healthworkforce/supplydemand/usworkforce/primarycare/projectingprimarycare.pdf. Published November 2013. Accessed November 2015.

4. Primary Care Workforce Facts and Stats No. 3. [AHRQ pub. No 12-P001-4-EF]. Agency for Healthcare Research and Quality website. http://www.ahrq.gov/research/findings/factsheets/primary/pcwork3/index.html. Published October 2014. Accessed March 15, 2015.

5. Auerbach DI, Chen PG, Friedberg MW, Reid R, Lau C, Buerhaus PI, Mehrotra A. Nurse-managed health centers and patient-centered medical homes could mitigate expected primary care physician shortages. *Health Aff (Millwood).* 2013;32(11):1933-1941.

6. Green LV, Savin S, Lu Y. Primary care physician shortages could be eliminated through use of teams, nonphysicians, and electronic communication. *Health Aff (Millwood).* 2013;32(1):11-19.

7. Margolius D, Bodenheimer T. Transforming primary care: from past practice to the practice of the future. *Health Aff (Millwood).* 2010;29(5):779-784.

8. Naylor MD, Kurtzman ET. The role of nurse practitioners in reinventing primary care. *Health Aff (Millwood).* 2010:29(5);893-899.

9. Lenz ER, Mundinger MO, Kane RL, Hopkins SC, Lin SX. Primary care outcomes in patients treated by nurse practitioners or physicians: two-year follow-up. *Med Care Res Rev.* 2004:61(3);332-351.

10. Blackmore CC, Edwards JW, Searles C, Wechter D, Mecklenburg R, Kaplan GS. Nurse practitioner-staffed clinic at Virginia Mason improves care and lowers costs for women with benign breast conditions. *Health Aff (Millwood).* 2013;32(1):20-26.

11. Potts B, Adams R, Spadin M. Sustaining primary care practice: a model to calculate disease burden and adjust panel size. *Perm J.* 2011;15(1):53-56.

12. King J, Furukawa MF, Buntin MB. Geographic variation in ambulatory electronic health record adoption: implications for underserved communities. *Health Serv Res.* 2013;48(6, pt 1):2037-2059.

13. Area Health Resources Files [2012-2013]. Health Resources and Services Administration Health Workforce website. http://ahrf.hrsa.gov/download.htm. Accessed January 21, 2014.

14. Census Bureau regions and divisions with state FIPS codes. US Census Bureau website. http://www2.census.gov/geo/docs/maps-data/maps/reg_div.txt. Accessed March 16, 2015.

15. R [software]. R Foundation for Statistical Computing, Vienna, Austria: R Core Team; 2013. http://www.R-project.org/. Accessed March 16, 2015.

16. Zeileis A. Econometric computing with HC and HAC covariance matrix estimators. *J Stat Softw.* 2004;11(10):1-17.

17. Zeileis A. Object-oriented computation of sandwich estimators. *J Stat Softw.* 2006;16(9):1-16.

18. Zeileis A, Hothorn T. Diagnostic checking in regression relationships. *The Comprehensive R Archive Network website.* https://cran.r-project.org/doc/Rnews/Rnews_2002-1.pdf. Published March 2002. Accessed March 16, 2015.

19. Adler-Milstein J, Jha AK. Organizational complements to electronic health records in ambulatory physician performance: the role of support staff. *J Am Med Inform Assoc.* 2012;19(4):537-540.

20. O'Malley AS, Draper K, Gourevitch R, Cross DA, Scholle SH. Electronic health records and support for primary care teamwork. *J Am Med Inform Assoc.* 2015;22(2):426-434.

21. Adler-Milstein J, Huckman RS. The impact of electronic health record use on physician productivity. *Am J Manag Care.* 2013;19(spec no. 10):SP345-SP352.

22. Howard J, Clark EC, Friedman A, et. al. Electronic health record impact on work burden in small, unaffiliated, community-based primary care practices. *J Gen Intern Med.* 2013;28(1):107-113.

23. Heisey-Grove, D, Klintworth, P, Tavernia, K, Lynch K. Regional Extension Center nurse practitioners and physician assistants: crucial primary care providers on the path to meaningful use [ONC data brief No. 11]. Office of the National Coordinator for Health Information Technology website. https://www.healthit.gov/sites/default/files/onc_databrief_no11_may_2013.pdf. Published May 2013. Accessed March 15, 2015.

24. Simon SR, Kaushal R, Cleary PD, et.al. Correlates of electronic health record adoption in office practices: a statewide survey. *J Am Med Inform Assoc.* 2007;14(1) :110-117. ■

www.ajmc.com Full text and PDF