

# Response to a Mobile Health Decision-Support System for Screening and Management of Tobacco Use

Kenrick Cato, RN, PhD, Sookyoung Hyun, RN, PhD, and Suzanne Bakken, RN, PhD

Smoking is the most preventable cause of death in the United States (Jamal, Dube, Malarcher, Shaw, & Engstrom, 2012). About 443,000 premature deaths are attributed to cigarette smoke annually (Jamal et al., 2012). African Americans and Hispanics die from smoking-related cancers at much higher rates than Caucasians (Haiman et al., 2006). In addition, African Americans are diagnosed at later stages and die at higher rates from smoking-related cancers than their Caucasian counterparts (Haiman et al., 2006).

Consistently screening for and treating tobacco use and dependence is crucial to reducing tobacco use and dependence (Fiore et al., 2008). More than 50% of smokers have contact with a healthcare provider annually, providing important opportunities for counseling and treatment (Jamal et al., 2012). The 2008 update to the U.S. Public Health Service (PHS) Clinical Practice Guideline: Treating Tobacco Use and Dependence recommended that clinicians and healthcare delivery systems consistently identify and document tobacco use status and treat every tobacco user seen in a healthcare setting using the 5 A's model: (1) Ask—identify tobacco users at every visit, (2) Advise—strongly suggest that tobacco users quit, (3) Assess—determine willingness to attempt quitting, (4) Assist—aid in quitting by providing counseling and medication, and (5) Arrange—make sure patient follow-up occurs (Fiore et al., 2008). The PHS guideline also recommended individual, group, and telephone counseling, as well as provision of first-line medications approved by the U.S. Food and Drug Administration as methods for increasing successful cessation attempts (Fiore et al., 2008). Despite the PHS recommendations, clinicians and healthcare systems often do not screen for or treat tobacco use consistently and effectively (Doolan & Froelicher, 2006; Jamal et al., 2012; Schnoll, Rukstalis, Wileyto, & Shields, 2006).

Numerous studies reported that computer-based approaches may assist evidence-based practice at the point of care (Bakken et al., 2008; Lobach et al., 2007; Wells et al., 2008). In particular, computer-based systems have influenced healthcare provider adherence to clinical

**Purpose/Objectives:** To describe the predictors of nurse actions in response to a mobile health decision-support system (mHealth DSS) for guideline-based screening and management of tobacco use.

**Design:** Observational design focused on an experimental arm of a randomized, controlled trial.

**Setting:** Acute and ambulatory care settings in the New York City metropolitan area.

**Sample:** 14,115 patient encounters in which 185 RNs enrolled in advanced practice nurse (APN) training were prompted by an mHealth DSS to screen for tobacco use and select guideline-based treatment recommendations.

**Methods:** Data were entered and stored during nurse documentation in the mHealth DSS and subsequently stored in the study database where they were retrieved for analysis using descriptive statistics and logistic regressions.

**Main Research Variables:** Predictor variables included patient gender, patient race or ethnicity, patient payer source, APN specialty, and predominant payer source in clinical site. Dependent variables included the number of patient encounters in which the nurse screened for tobacco use, provided smoking cessation teaching and counseling, or referred patients for smoking cessation for patients who indicated a willingness to quit.

**Findings:** Screening was more likely to occur in encounters where patients were female, African American, and received care from a nurse in the adult nurse practitioner specialty or in a clinical site in which the predominant payer source was Medicare, Medicaid, or State Children's Health Insurance Program. In encounters where the patient payer source was other, nurses were less likely to provide tobacco cessation teaching and counseling.

**Conclusions:** mHealth DSS has the potential to affect nurse provision of guideline-based care. However, patient, nurse, and setting factors influence nurse actions in response to an mHealth DSS for tobacco cessation.

**Implications for Nursing:** The combination of a reminder to screen and integration of guideline-based recommendations into the mHealth DSS may reduce racial or ethnic disparities to screening, as well as clinician barriers related to time, training, and familiarity with resources.

**Key Words:** nursing informatics; quantitative nursing research; care of the medically underserved; prevention and detection; ambulatory care/office nursing

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practice guidelines for health promotion and screening (Bright et al., 2012; Gentles, Lokker, & McKibbin, 2010). In a randomized, controlled trial, the delivery of computer-generated smoking cessation care reminders to healthcare providers resulted in more frequently offered smoking cessation interventions when compared to no reminders (Wolfenden et al., 2005).

Mobile technology provides individuals with ubiquitous access to resources such as emails, text messaging, and social networking sites (e.g., wikis, blogs). In addition, mobile devices are easy to use for individuals who are less familiar with computer technology. About 25% of mobile phone users use their phone rather than a computer to access online resources (Smith, 2011).

Mobile health (mHealth) technologies can support health promotion and monitoring by expanding communications between healthcare providers and their patients (Blake, 2008). In nursing, mHealth-based inter-

vention studies are growing, such as a health outcome monitoring system for patients with cancer (Bielli et al., 2004), chemotherapy-related toxicity management (Maguire, McCann, Miller, & Kearney, 2008; McCann, Maguire, Miller, & Kearney, 2009), reminders to wear sunscreen using text messaging (Armstrong et al., 2009), and behavioral coaching for patients with diabetes (Quinn et al., 2011). In the area of smoking cessation, text messaging interventions have demonstrated positive results in increasing short-term smoking cessation rates (Bélanger, Plotnikoff, Clark, & Courneya, 2012; Coleman & Pasternak, 2012; Karvinen, Raedeke, Arastu, & Allison, 2011; Sommers, Miller, & Berry, 2012).

Numerous research studies have shown that nurse smoking cessation advice increased cessation rates in smokers (Lancaster & Stead, 2005; Mahon, 2005; Sarna et al., 2000). In one study, the likelihood of smoking cessation increased by about 50% if a nurse provided the appropriate advice (Doolan & Froelicher, 2006). Although cessation advice is effective, it remains underused (Cokkinides, Ward, Jemal, & Thun, 2005; Lancaster & Stead, 2005).

Lack of time and unfamiliarity with counseling resources discourage nurses from advising patients about smoking cessation (Chan, Sarna, Wong, & Lam, 2007; Marcy, Skelly, Shiffman, & Flynn, 2005; McCarty, Hennrikus, Lando, & Vessey, 2001; Pringle, 2002). In addition, nursing care for smoking cessation typically involves more assessment than intervention (Sarna et al., 2009). For instance, in one oncology nursing practice, a large number of nurses assessed patient smoking status; however, only a small number of them engaged in smoking cessation interventions (Sarna et al., 2000). In homecare settings, “asked” and “advised” were more frequently applied nursing interventions than “assisted” or “arranged” (Borrelli et al., 2001).

Providing adequate resources at the point of care is important. Nurses have identified the difficulty of selecting adequate information to help their patients seek information resources (La Porta, Hagood, Kornfeld, & Treiman, 2007; Olsen, 2002; Perocchia et al., 2005; Pringle, 2002). Studies have suggested that nurses feel competent in teaching and advising, but less competent in providing certain interventions (e.g., nicotine replacement therapy) (Chan et al., 2007; Lancaster & Stead, 2005). Also, they desire additional training for smoking cessation interventions (Chan et al., 2007; Sarna et al., 2000). If training includes integration of appropriate resources and technology, it may be more efficient and effective than simply providing training programs (e.g., computer-generated reminders with individualized smoking cessation interventions). This may enhance nurses’ ability to integrate smoking cessation interventions into practice.

Despite the substantial body of literature related to the positive effect of decision support for guideline-based

**Table 1. Total Versus Screened Patient Encounters**

Variable	Total (N = 14,115)		Total Screened (N = 11,792)	
	n	%	n	%
<b>Gender<sup>a</sup></b>				
Female	8,796	62	7,496	85
Male	5,301	38	4,283	81
<b>Race or ethnicity</b>				
African American	3,173	23	2,696	85
American Indian or Alaska Native	70	1	62	89
Asian or Pacific Islander	608	4	511	84
Caucasian	3,573	25	3,158	89
Hispanic	6,205	44	4,974	80
Other or unknown	486	3	391	80
<b>Payer type<sup>b</sup></b>				
Medicaid or SCHIP	5,233	37	4,056	77
Medicare	1,186	8	1,104	92
No charge	464	4	414	88
Private insurance	3,431	24	3,122	90
Self-pay	569	4	532	92
Worker's compensation	40	< 1	42	98
Unknown	2,958	24	2,422	82
<b>APN specialty</b>				
ACNP	1,106	8	920	84
ANP	2,285	16	2,230	98
FNP	4,762	34	4,031	85
ONP	139	1	130	94
PNP	3,641	26	2,452	67
WHNP	2,182	16	2,029	93

<sup>a</sup> Not reported in 18 patient encounters

<sup>b</sup> Not reported in 234 patient encounters

ACNP—acute care nurse practitioner; ANP—adult nurse practitioner; APN—advanced practice nurse; FNP—family nurse practitioner; ONP—oncology nurse practitioner; PNP—pediatric nurse practitioner; SCHIP—State Children's Health Insurance Program; WHNP—women's health nurse practitioner

Note. Because of rounding, percentages may not total 100.

**Table 2. Predictors of Proportion of Encounters in Which Nurses Screened for Tobacco Use (N = 14,097)**

Variable	n	Odds Ratio	95% Confidence Interval	p	Odds Ratio	95% Confidence Interval	p
<b>Gender</b>							
Male (reference)	5,301	1	—	—	1	—	—
Female	8,796	1.37	[1.52, 1.5]	< 0.001	1.14 <sup>a</sup>	[1.03, 1.25] <sup>a</sup>	0.011 <sup>a</sup>
<b>Race or ethnicity</b>							
Caucasian (reference)	3,569	1	—	—	1	—	—
African American	3,168	0.743	[0.645, 0.855]	< 0.001	1.178 <sup>b</sup>	[1.01, 1.38] <sup>b</sup>	0.042 <sup>b</sup>
Hispanic	6,199	0.531	[0.471, 0.599]	< 0.001	1.007 <sup>b</sup>	[0.875, 1.16] <sup>b</sup>	0.927 <sup>b</sup>
Other or unknown	1,161	0.633	[0.527, 0.761]	< 0.001	0.868 <sup>b</sup>	[0.711, 1.06] <sup>b</sup>	0.166 <sup>b</sup>
<b>Payer type</b>							
Private insurance (reference)	3,427	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	6,413	0.455	[0.401, 0.516]	< 0.001	0.663 <sup>c</sup>	[0.57, 0.771] <sup>c</sup>	< 0.001 <sup>c</sup>
Other	4,257	0.614	[0.535, 0.704]	< 0.001	0.627 <sup>c</sup>	[0.534, 0.736] <sup>c</sup>	< 0.001 <sup>c</sup>
<b>APN specialty</b>							
WHNP (reference)	2,182	1	—	—	1	—	—
ACNP	1,102	3.07	[2.23, 4.19]	< 0.001	0.525 <sup>d</sup>	[0.413, 0.668] <sup>d</sup>	< 0.001 <sup>d</sup>
ANP	2,280	0.156	[0.13, 0.186]	< 0.001	4.433 <sup>d</sup>	[3.2, 6.13] <sup>d</sup>	< 0.001 <sup>d</sup>
FNP	4,754	0.373	[0.297, 0.468]	< 0.001	0.543 <sup>d</sup>	[0.449, 0.658] <sup>d</sup>	< 0.001 <sup>d</sup>
ONP	139	0.416	[0.347, 0.499]	< 0.001	0.621 <sup>d</sup>	[0.306, 1.26] <sup>d</sup>	1.19 <sup>d</sup>
PNP	3,640	1.09	[0.543, 2.18]	< 0.001	0.197 <sup>d</sup>	[0.163, 0.237] <sup>d</sup>	< 0.001 <sup>d</sup>
<b>Predominant payer type in site (N = 14,115)</b>							
Private (reference)	2,380	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	11,735	2.23	[1.92, 2.59]	< 0.001	1.876 <sup>e</sup>	[1.57, 2.24] <sup>e</sup>	< 0.001 <sup>e</sup>

<sup>a</sup> Adjusted by race or ethnicity, payer type, APN specialty, and predominant payer type in site

<sup>b</sup> Adjusted by gender, payer type, APN specialty, and predominant payer type in site

<sup>c</sup> Adjusted by gender, race or ethnicity, APN specialty, and predominant payer type in site

<sup>d</sup> Adjusted by gender, race or ethnicity, payer type, and predominant payer type in site

<sup>e</sup> Adjusted by gender, race or ethnicity, payer type, and APN specialty

ACNP—acute care nurse practitioner; ANP—adult nurse practitioner; APN—advanced practice nurse; FNP—family nurse practitioner; ONP—oncology nurse practitioner; PNP—pediatric nurse practitioner; SCHIP—State Children's Health Insurance Program; WHNP—women's health nurse practitioner

Note. Logistic regression analysis was performed only on encounters where gender was reported.

care, nursing needs related to smoking cessation, and the evolving understanding of the role of mHealth, little is known about the predictors of nurse actions in response to an mHealth decision-support system (DSS) for guideline-based screening and management of tobacco use. To reduce this knowledge gap, the current study addressed two research questions. What are the predictors of screening rates of nurses receiving an mHealth DSS reminder to screen for tobacco use? What are the predictors of tobacco cessation-related interventions (patient teaching and referrals) of nurses receiving mHealth DSS guideline-based recommendations for the care for patients who indicated their willingness to quit smoking?

## Methods

### Design

As part of a randomized, controlled trial that tested the effect of an mHealth DSS on nurse adherence to guideline-based recommendations for screening and management of depression, obesity, and tobacco use

(Bakken et al., 2008; Lee et al., 2009; Schnall et al., 2010), the authors used an observational design to study predictors of screening rates and use of guideline-based recommendations by RNs randomized to mHealth DSS for screening and management of tobacco use.

### Sample and Setting

The sample for the study was a data set of clinical encounters for nurses randomized to the tobacco use screening and management arm of the study from January 2005 to September 2008. The data set consisted of 14,115 patient encounters in which nurses enrolled in advanced practice nurse (APN) training were prompted by an mHealth DSS to screen for tobacco use and select guideline-based treatment recommendations for patients who indicated their willingness to stop smoking. Patient encounters were documented by 185 nurses from six nurse practitioner (NP) specialty training areas: acute care (ACNP), adult (ANP), family (FNP), pediatric (PNP), oncology (ONP), and women's health (WHNP). The study setting comprised more than 200

acute care and ambulatory care sites used by the Columbia University School of Nursing for APN training located throughout the metropolitan New York City area. Care predominately was provided for underserved populations. The study was approved by the Columbia University Medical Center institutional review board. Participation in the mHealth DSS study was voluntary. Nurses could opt out of the study by requesting an mHealth documentation application that did not include the DSS. Only three nurses opted out of the study. Patients were not considered research participants for this study because nurses were the target of the mHealth DSS intervention.

## Procedures

The mHealth DSS was embedded in the nurse documentation software (i.e., the electronic student clinical log) and was used routinely in clinical encounters after nurses received training on its use. Because the nurses were familiar with the electronic student clinical log, the training focused on the mHealth DSS functions and their linkage to guideline-based care for tobacco cessa-

tion. The training session also included a discussion of the voluntariness of participation in research and the process of opting out. The mHealth DSS was not integrated into the documentation systems in the clinical sites; therefore, nurses were required to document in the clinical site record as well as in the mHealth DSS.

Nurses received reminders to screen patients older than nine years for tobacco use. Based on the results of the screening, the mHealth DSS provided guideline-based recommendations tailored to the patients' goals (e.g., willingness to quit smoking) as part of the documentation. The integration of guideline-based recommendations in the documentation process provided prompts for nurse actions based on the PHS guideline (Fiore, 2000).

## Data Collection and Measures

All data were stored in the mobile device during the course of nurse documentation in the mHealth DSS. These data were automatically uploaded to a secure centralized server. On a periodic basis, computer scripts were run to populate the study database

**Table 3. Predictors of Proportion of Encounters in Which Nurses Provided Tobacco Cessation Teaching and Counseling (N = 775)**

Variable	n	Odds Ratio	95% Confidence Interval	p	Odds Ratio	95% Confidence Interval	p
<b>Gender</b>							
Male (reference)	311	1	—	—	1	—	—
Female	464	0.701	[0.525, 0.935]	0.016	0.734 <sup>a</sup>	[0.530, 1.02] <sup>a</sup>	0.063 <sup>a</sup>
<b>Race or ethnicity</b>							
Caucasian (reference)	172	1	—	—	1	—	—
African American	218	0.898	[0.601, 1.34]	0.597	0.719 <sup>b</sup>	[0.457, 1.13] <sup>b</sup>	0.153 <sup>b</sup>
Hispanic	307	0.849	[0.584, 1.24]	0.392	0.618 <sup>b</sup>	[0.399, 0.957] <sup>b</sup>	0.031 <sup>b</sup>
Other or unknown	78	0.317	[0.178, 0.562]	< 0.001	0.472 <sup>b</sup>	[0.253, 0.88] <sup>b</sup>	0.018 <sup>b</sup>
<b>Payer type</b>							
Private insurance (reference)	164	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	308	1.395	[0.95, 2.05]	0.089	1.3 <sup>c</sup>	[0.817, 2.06] <sup>c</sup>	0.271 <sup>c</sup>
Other	303	0.407	[0.276, 0.601]	< 0.001	0.351 <sup>c</sup>	[0.221, 0.558] <sup>c</sup>	< 0.001 <sup>c</sup>
<b>APN specialty</b>							
WHNP (reference)	122	1	—	—	1	—	—
ACNP	48	1.206	[0.769, 1.891]	0.414	1.26 <sup>d</sup>	[0.72, 2.19] <sup>d</sup>	0.878 <sup>d</sup>
ANP	215	0.785	[0.399, 1.55]	0.485	0.758 <sup>d</sup>	[0.358, 1.61] <sup>d</sup>	0.422 <sup>d</sup>
FNPP	336	1.702	[0.868, 3.34]	0.121	1.06 <sup>d</sup>	[0.503, 2.24] <sup>d</sup>	0.369 <sup>d</sup>
ONP	3	1.781	[1.17, 2.71]	0.007	1.25 <sup>d</sup>	[0.765, 2.06] <sup>d</sup>	0.812 <sup>d</sup>
PNP	51	0.72	[0.064, 8.16]	0.791	0.742 <sup>d</sup>	[0.063, 8.69] <sup>d</sup>	0.42 <sup>d</sup>
<b>Predominant payer type in site</b>							
Private (reference)	110	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	665	1.28	[0.853, 1.992]	0.233	1.74 <sup>e</sup>	[1.03, 2.94] <sup>e</sup>	0.037 <sup>e</sup>

<sup>a</sup> Adjusted by race or ethnicity, payer type, APN specialty, and predominant payer type in site

<sup>b</sup> Adjusted by gender, payer type, APN specialty, and predominant payer type in site

<sup>c</sup> Adjusted by gender, race or ethnicity, APN specialty, and predominant payer type in site

<sup>d</sup> Adjusted by gender, race or ethnicity, payer type, and predominant payer type in site

<sup>e</sup> Adjusted by gender, race or ethnicity, payer type, and APN specialty

ACNP—acute care nurse practitioner; ANP—adult nurse practitioner; APN—advanced practice nurse; FNPP—family nurse practitioner; ONP—oncology nurse practitioner; PNP—pediatric nurse practitioner; SCHIP—State Children's Health Insurance Program; WHNP—women's health nurse practitioner



with the encounter information. Data associated with tobacco use screening, diagnosis, patient willingness to quit, smoking cessation counseling and teaching, and referrals were retrieved from the study database.

## Main Research Variables

Predictor variables were patient gender, patient race and ethnicity, patient payer source, APN specialty, and predominant payer source at clinical site. Dependent variables were the number of patient encounters in which nurses screened for tobacco use and the number of patient encounters in which nurses provided smoking cessation teaching, counseling, or referrals for patients who indicated their willingness to stop smoking.

## Data Analysis

Statistical analyses were performed using SPSS®, version 18.0. The unit of analysis was the patient encounter. Descriptive statistics were used to summarize screening rates for patient encounters. Predictor variables related to the odds of receiving teaching and counseling, and smoking cessation referrals were examined using multivariate logistic regressions. Prior to the multivariate analysis, payer source and race and ethnicity were condensed to a smaller number of categories because of small sample sizes in some categories. Payer source was categorized as private, public (Medicare, Medicaid, and SCHIP), and other. Race and ethnicity was categorized as African American, Caucasian, Hispanic, and other. Site source was coded as private or public (Medicaid, Medicare, and SCHIP) based on the majority of patient encounter payer sources. The strength of associations was measured by adjusted odds ratio (OR) with 95% confidence interval (CI). All statistical tests were two-sided and considered statistically significant if *p* values were less than 0.05.

## Results

Women made up 63% of the 14,115 patient encounters (see Table 1). Hispanics comprised the largest race or ethnic group in the clinical encounters (44%). Only 28% of the patient encounters had private insurance as payer source. The majority of patient encounters involved nurses in FNP (34%) or PNP (26%) specialties. The overall screening rate for tobacco use was 84%.

A logistic regression model (see Table 2) revealed that gender (*p* = 0.011), race and ethnicity (*p* = 0.01), patient payer source (*p* < 0.001), APN specialty (*p* < 0.001), and predominant payer source in clinical site (*p* < 0.001) significantly predicted the proportion of patient encounters in which nurses screened for tobacco use. Screening was more likely to occur in patient encounters where patients were female (OR = 1.14, 95% CI [1.03, 1.25]) or African American (OR = 1.18, 95% CI [1.01, 1.38]). The odds of being screened also were higher for those who received

## Knowledge Translation

A mobile health decision-support system (mHealth DSS) has the potential to affect nurse provision of guideline-based care.

Nurse actions in response to an mHealth DSS reminder to screen were influenced by patient gender and race as well as nurse and setting factors.

Payer source and nurse practitioner specialty influenced provision of tobacco cessation teaching and counseling and tobacco cessation referral.

care from a nurse in the ANP specialty (OR = 4.43, 95% CI [3.2, 6.13]) or in a clinical site in which the predominant payer source was Medicare, Medicaid, or SCHIP (OR = 1.88, 95% CI [1.57, 2.24]). In patient encounters in which screening occurred, 2,022 (14%) reported tobacco use and, of those, 779 (38%) indicated willingness to quit.

Tobacco cessation teaching and counseling were provided in 775 (99%) encounters in which a patient expressed willingness to discontinue tobacco use. Patient payer source (*p* < 0.001) and predominant payer source in clinical site (*p* = 0.037) significantly predicted the proportion of patient encounters in which nurses provided tobacco cessation teaching and counseling (see Table 3). In encounters where patient payer source was other (e.g., worker compensation, self-pay) compared to private insurance, screening was less likely (OR = 0.351, 95% CI [0.221, 0.558]) to occur. In patient encounters that occurred in sites where Medicare, Medicaid, or SCHIP was the predominant payer source, nurses were more likely to provide tobacco cessation teaching and counseling (OR = 1.74, 95% CI [1.03, 2.94]).

Nurses referred patients to smoking cessation services in 775 (99%) of patient encounters in which a willingness to quit was expressed. Only payer source (*p* < 0.001) and APN specialty (*p* < 0.001) significantly predicted the proportion of patient encounters in which nurses provided tobacco cessation referral (see Table 4). Referral was less likely to occur in patient encounters in which payer source was Medicare, Medicaid, or SCHIP (OR = 0.439, 95% CI [0.252, 0.764]), or in which care was provided by nurses in FNP (OR = 0.381, 95% CI [0.209, 0.693]) or PNP (OR = 0.314, 95% CI [0.109, 0.906]) specialty.

## Discussion

The current study investigated the predictors for screening for tobacco use and subsequent counseling and treatment of tobacco dependence by nurses in APN training who received mHealth DSS guideline-based recommendations. In contrast to Sarna et al.'s (2000) findings in oncology nursing practice and Borrelli et al.'s (2001) findings in the home care setting that nurses are

**Table 4. Predictors of Proportion of Encounters in Which Nurses Provided Tobacco Cessation Referrals (N = 775)**

Variable	n	Odds Ratio	95% Confidence Interval	p	Odds Ratio	95% Confidence Interval	p
<b>Gender</b>							
Male (reference)	311	1	—	—	1	—	—
Female	464	0.886	[0.625, 1.26]	0.489	0.814 <sup>a</sup>	[0.546, 1.21] <sup>a</sup>	0.312 <sup>a</sup>
<b>Race or ethnicity</b>							
Caucasian (reference)	172	1	—	—	1	—	—
African American	218	0.526	[0.334, 0.827]	0.005	0.72 <sup>b</sup>	[0.437, 1.19] <sup>b</sup>	0.199 <sup>b</sup>
Hispanic	307	0.345	[0.221, 0.539]	< 0.001	0.52 <sup>b</sup>	[0.316, 0.855] <sup>b</sup>	0.01 <sup>b</sup>
Other or unknown	78	0.447	[0.235, 0.85]	0.014	0.552 <sup>b</sup>	[0.277, 1.1] <sup>b</sup>	0.093 <sup>b</sup>
<b>Payer type</b>							
Private insurance (reference)	164	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	308	0.382	[0.239, 0.609]	< 0.001	0.439 <sup>c</sup>	[0.252, 0.764] <sup>c</sup>	0.004 <sup>c</sup>
Other	303	0.781	[0.511, 1.2]	0.255	0.633 <sup>c</sup>	[0.38, 1.05] <sup>c</sup>	0.079 <sup>c</sup>
<b>APN specialty</b>							
WHNP (reference)	122	1	—	—	1	—	—
ACNP	48	1.92	[0.948, 3.9]	0.07	1.239 <sup>d</sup>	[0.565, 2.72] <sup>d</sup>	0.593 <sup>d</sup>
ANP	215	1.3	[0.789, 2.14]	0.303	0.88 <sup>d</sup>	[0.477, 1.62] <sup>d</sup>	0.683 <sup>d</sup>
FNP	336	0.425	[0.253, 0.713]	0.001	0.381 <sup>d</sup>	[0.209, 0.693] <sup>d</sup>	0.002 <sup>d</sup>
ONP	3	1.67	[0.129, 16.8]	0.757	1.69 <sup>d</sup>	[0.14, 20.4] <sup>d</sup>	0.68 <sup>d</sup>
PNP	51	0.319	[0.116, 0.875]	0.026	0.314 <sup>d</sup>	[0.109, 0.906] <sup>d</sup>	0.032 <sup>d</sup>
<b>Predominant payer type in site</b>							
Private (reference)	110	1	—	—	1	—	—
Medicare, Medicaid, or SCHIP	665	0.695	[0.406, 1.189]	0.184	0.397 <sup>e</sup>	[0.2, 0.787] <sup>e</sup>	0.008 <sup>e</sup>

<sup>a</sup> Adjusted by race or ethnicity, payer type, APN specialty, and predominant payer type in site<sup>b</sup> Adjusted by gender, payer type, APN specialty, and predominant payer type in site<sup>c</sup> Adjusted by gender, race or ethnicity, APN specialty, and predominant payer type in site<sup>d</sup> Adjusted by gender, race or ethnicity, payer type, and predominant payer type in site<sup>e</sup> Adjusted by gender, race or ethnicity, payer type, and APN specialty

ACNP—acute care nurse practitioner; ANP—adult nurse practitioner; APN—advanced practice nurse; FNP—family nurse practitioner; ONP—oncology nurse practitioner; PNP—pediatric nurse practitioner; SCHIP—State Children's Health Insurance Program; WHNP—women's health nurse practitioner

more likely to screen than intervene, the current study found that teaching and counseling as well as referral interventions occurred in 99% of the encounters in which a patient indicated willingness to quit. The high rates of cessation teaching and cessation referral also differ from previous literature, reporting a range of 17%–22% (Cokkinides et al., 2005; Jamal et al., 2012). This suggests that the mHealth DSS may have reduced barriers such as lack of training and unfamiliarity with available resources by teaching and counseling (assisting) as well as referrals (arranging).

The findings suggest that multiple factors significantly predicted nursing actions in the context of an mHealth reminder to screen and presentation of guideline-based recommendations for management. In terms of screening, these rates were higher in all racial and ethnic groups compared to previous research (Jamal et al., 2012; Schnoll et al., 2006; Sonnenfeld, Schappert, & Lin, 2009; Wells et al., 2008). African Americans had the greatest odds of being screened for tobacco use. The higher screening rate for African Americans was unexpected given disparities in other types of screenings (Lin, Watkins, Johnson,

Rodriguez, & Barton, 2008; Littner, 2011). Women also were more likely to be screened. In contrast, no racial and ethnic or gender differences existed in nursing actions related to teaching and counseling or referrals.

The current findings related to payer source and nursing actions were consistent across screening, patient teaching and counseling, and referrals. Reflecting previous research, privately insured patients were more likely to be screened than those with Medicare or Medicaid (Jamal et al., 2012). This also is similar to Schnall et al.'s (2010) work on an mHealth DSS for depression screening and management. Similar to research by Jamal et al. (2012), privately insured patients also were more likely to receive patient teaching and counseling and referrals. Research has suggested that patients with Medicare, Medicaid, or SCHIP insurance typically have higher levels of comorbidity when compared to private or self-payer patients (Cashman et al., 2005; Kronick, Bella, & Gilmer, 2009; Lin, Shaya, & Scharf, 2010). This may result in prioritizing chronic illness management above preventive screenings (Holtrop, Malouin, Weismantel, & Wadland, 2008).

The authors also analyzed site payer composition with the thought that payer difference could be a reflection of patient volume in the clinical site or the types of services typically available in the site. The findings suggest that patients seen at clinical sites with predominantly Medicare, Medicaid, or SCHIP patient encounters were more likely to be screened for tobacco use and receive teaching and counseling interventions. Similar to previous research, these findings suggest that clinic setting plays an important role in screening and tobacco cessation teaching and counseling (Holtrop et al., 2008; Jamal et al., 2012). However, more research is needed to understand the differences between the effects of individual payer source versus predominant site payer source in the setting on nurse actions.

## Limitations

The current literature is limited regarding predictors of tobacco screening based on nursing specialty. In the current study, nurses in ANP training were more likely to screen for tobacco use, and all other specialties were less likely to screen than WHNP. The ANP program director had a particular interest in smoking cessation and may have placed more emphasis on this topic. Those in FNP or PNP also were less likely than WHNP to provide referrals. This is a potential reflection of the scarcity of resources provided for pediatric smoking cessation. However, screening and management of tobacco use is in the purview of nurses who are not APNs. In addition, no differences existed among specialties in patient teaching and counseling. Therefore, this is not a major limitation.

Several other limitations exist in this study. The unit of analysis was the clinical encounter; therefore, tracking patients over time to determine intervention-related patient outcomes was not possible. In addition, provider characteristics other than specialty training type were not considered in the analysis. Provider variables such as years of nursing experience, nurse gender, race and ethnicity, age, or smoking status may have affected their actions related to tobacco use. Also, the assumption of this study was that when screening was not documented, it was not done, which may underestimate the services provided.

## Implications for Nursing

This study suggests that the use of an mHealth DSS has the potential to increase tobacco screening and guideline-based management. The research also suggests that nursing use of the mHealth DSS may reduce disparities in screening and management of tobacco dependence in acute and ambulatory care settings. The combination of a reminder to screen and integration of guideline-based recommendations into the mHealth DSS may reduce barriers related to time, training, and familiarity with resources.

Despite the high tobacco screening, cessation teaching, and cessation referral rates in this study, additional research is needed to investigate the impact of the use of mHealth DSS tools in several areas. More research is needed to understand the use of mHealth tools in the work flow of clinicians. Additional investigation is needed to measure the possible effects on patient outcomes from the use of an mHealth DSS tool. Work also is needed to understand variation of use of the tool based on APN specialty.

## Conclusions

Screening for tobacco use and treatment of tobacco dependence remains the most cost effective and successful clinical preventive approach (Maciosek et al., 2006). The study indicates that an mHealth DSS has the potential to reduce screening disparities because of race or ethnicity and increase tobacco use cessation by affecting the nurse provision of guideline-based care.

Kenrick Cato, RN, PhD, is an associate research scientist in the School of Nursing at Columbia University in New York, NY; Sookyoung Hyun, RN, PhD, is an assistant professor in the College of Nursing and Department of Biomedical Informatics at Ohio State University in Columbus; and Suzanne Bakken, RN, PhD, is an alumni professor in the School of Nursing and the Department of Biomedical Informatics at Columbia University. This research was supported, in part, by grants from the National Institute of Nursing Research (Nos. R01NR008903 and T32NR007969) and the National Cancer Institute (No. R21CA126325). Cato can be reached at kdc2110@columbia.edu, with copy to editor at ONFEditor@ons.org. (Submitted April 2013. Accepted for publication July 9, 2013.)

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