Physician Clinical Experience and Inappropriate Prostate Specific Antigen Screening: Evidence From an Asian Country

Nai-Wen Kuo, Herng-Ching Lin* and Hsin-Chien Lee

From the Taipei Medical University, School of Health Care Administration (NWK, HCLin), and Cancer Research Center (HCLin) and Department of Psychiatry (HCLee), Taipei Medical University Hospital, Taipei, Taiwan

Purpose: We investigated the relationship between physician clinical experience and inappropriate prostate specific antigen testing using a Taiwan nationwide population based data set. We used physician age as a surrogate for general practice experience and the frequency of ordered prostate specific antigen tests as a surrogate for procedure specific experience.

Materials and Methods: This study used data sourced from the 2005 Taiwan National Health Insurance Research Database. We extracted all patients who underwent prostate specific antigen tests in 2005 and their corresponding physicians. A total of 24,595 patients and 2,086 physicians were included. Physician age was categorized into 8 age groups of younger than 31, 31 to 35, 36 to 40, 41 to 45, 46 to 50, 51 to 55, 56 to 60 and 60 years or older. Physicians were divided into 4 groups according to the frequency of prostate specific antigen tests ordered in 40 to 75-year-old patients, including low frequency—less than 1 case per 3 months, medium—between 1 in 3 months and 1 per month, high—between 1 per month and 1 per week, and very high—greater than 1 per week.

Results: In sampled physicians the mean ± SD rate of inappropriate prostate specific antigen test use was 30.8% ± 36.6%. Multiple regression analysis showed that after adjusting for other factors physicians who ordered fewer prostate specific antigen tests (those in the low and medium frequency groups) had a higher rate of inappropriate PSA test use than their counterparts who ordered prostate specific antigen tests with very high frequency (each $p < 0.001$) Furthermore, physicians in the age groups 30 years or younger and 31 to 35 years had higher rates of inappropriate prostate specific antigen testing than their counterparts in the 41 to 45-year-old group ($p = 0.019$ and 0.010, respectively).

Conclusions: The likelihood of inappropriate prostate specific antigen screening was significantly and negatively associated with physician clinical experience.

Key Words: prostate, clinical competence, prostate-specific antigen, professional practice, quality of health care

Prostate cancer is the most common nonskin cancer and the second leading cause of cancer related death in men in the United States as well as the most prevalent cancer in men worldwide, estimated to account for 4.3% of cancers in developing countries and 15.3% in developed countries.[1,2] In addition to this high incidence rate, the aging of the population and a tendency to overemphasize aggressive intervention have contributed to a surge in screening for this disorder in the last decade. After the United States Food and Drug Administration approved the PSA test in 1986 as a tool to monitor disease status in patients with prostate cancer, the PSA test became the most common method for early prostate cancer screening beginning in the early 1990s.[3,4] Although the value of PSA screening in asymptomatic men remains controversial, most guidelines published by major institutions agree that PSA tests should only be performed in asymptomatic men between ages 40 and 75 years with more than a 10-year life expectancy.

Unfortunately inappropriate PSA testing is not uncommon.[5–9] A nationwide study in the United States showed that more than 50% of male veterans 75 years or older underwent PSA screening in 2003. Studies have shown that inappropriate PSA testing is associated with physician characteristics such as age, years since graduation from medical school,[10] reimbursement mode,[10] gender,[10] specialty[10–12] and uncertainty about guidelines.[13] Although many investigators have reported a negative association between physician clinical experience and adherence to screening guidelines for different types of cancer, few studies have been done to examine the effect of physician clinical experience on inappropriate PSA testing specifically. In addition, all prior studies of physician inappropriate PSA screening have relied on regional samples, or samples from select hospitals or patient subpopulations, eg those covered by a specific insurance plan, and study findings may not be generalizable to the whole population. Furthermore, all prior studies were done in the United States and no evidence from other countries has been published previously.[14]

Therefore, we investigated the relationship between physician clinical experience and inappropriate PSA testing using a Taiwan nationwide population based data set. In accordance with findings from a controversial literature review by Choudhry et al, which concluded that physicians with more clinical experience were less likely to adhere to standard guidelines,[14] we hypothesized that more clinical experience in physicians would be negatively associated with adherence to PSA screening guidelines.

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* Correspondence: School of Health Care Administration, Taipei Medical University, 250 Wu-Hsing St., Taipei 110, Taiwan, Republic of China (telephone: 886-2-2736-1661, extension 3613; FAX: 886-2-2378-9788; e-mail: henry11111@tmu.edu.tw).

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The current study design has 2 unique advantages. Whereas Choudhry et al used physician age or years since graduation from medical school as a proxy for clinical experience,[14] in contrast, we measured clinical experience using age as a surrogate for general practice experience and the frequency of PSA tests ordered to evaluate procedure specific experience. In addition to our more nuanced way of defining clinical experience, a further strength of the current study is its statistical power to isolate possible confounding effects, which enabled more robust conclusions. The generalizability of our findings is based on the large-scale universal sample of PSA tests performed in 1 year in Taiwan.

METHODS

Data Set

This study used data sourced from the 2005 NHIRD provided by the Bureau of National Health Insurance, Department of Health. This data set covers all inpatient and outpatient medical benefit claims for the Taiwan population of more than 23 million individuals. NHIRD includes a registry of contracted medical facilities, a registry of board certified physicians, ambulatory care expenditures by visit, details of ambulatory care orders and monthly claim summaries for inpatient claims. Since these data were de-identified secondary data released to the public for research purposes, the study was exempt from full review by the institutional review board.

Study Sample

We extracted data on all patients who underwent PSA tests from the NHIRD between January 2005 and December 2005, and their corresponding physicians (31,102). We excluded those who underwent PSA testing for reasons other than screening, so that patients diagnosed with prostate cancer, prostate carcinoma in situ, nodular prostate and prostatitis were excluded. Ultimately our study sample comprised 24,595 patients and 2,086 physicians. Unlike in some countries where nonphysician providers as well as physicians can order PSA tests, only certified physicians are eligible to order PSA tests in Taiwan.

Variables of Interest

Published clinical guidelines have defined inappropriate PSA testing as PSA screening for prostate cancer in patients who are older than 75 years or younger than 40 years, or who have an estimated life expectancy of less than 10 years. According to data released by the Taiwan Department of Health the average man in Taiwan has an estimated life expectancy of 10 years when he is 77 years old. Therefore, the key dependent variable of interest in this study was the incidence of PSA screening ordered for patients older than 75 or younger than 40 years, while the key independent variable was physician age and the frequency of PSA tests ordered in 40 to 75-year-old patients. Physician age was categorized into 8 age groups, including younger than 31, 31 to 35, 36 to 40, 41 to 45, 46 to 50, 51 to 55, 56 to 60 and 60 years or older. In accordance with prior studies[9] the sample of 2,086 physicians was divided into 4 groups according to the frequency of PSA tests ordered in 40 to 75-year-old patients, including low frequency—1 case per 3 months, medium frequency—between 1 case per 3 months and 1 per month, high frequency—between 1 case per month and 1 per week, and very high frequency—greater than 1 case per week.

The variables adjusted for in the regression model included physician gender, specialty (primary vs nonprimary care), practice type (hospital-based vs office-based), practice location (northern vs other regions) and the number of visits by adult male patients per physician.

Statistical Analysis

SAS® for Windows®, version 8.2 was used to perform data analysis. Since the inappropriate PSA test rate was not distributed normally among physicians, logarithm transformation was used to analyze the data. Normality of the log transformed inappropriate PSA test rate variable was verified based on distribution symmetry with a mean log inappropriate PSA test rate of 1.65 (median 1.65, mode 1.72). ANOVA and the t test were used to examine the relationship between the logarithm of inappropriate PSA test rates and physician characteristics. Hierarchical linear regression modeling was done to examine whether inappropriate PSA test rates could be predicted by physician age and the frequency of PSA tests ordered, adjusting for other physician characteristics. Hierarchical linear regression modeling was used, specifying a hospital or practice level random effect to account for possible similar PSA screening patterns among physicians practicing at the same institution with 2-sided $p \leq 0.05$ considered statistically significant.

RESULTS

Table 1 lists physician characteristics. Of the 2,086 sampled physicians 68.7% were in the low frequency PSA testing group and only 8.2% were in the very high frequency group. With regard to physician age, most sampled physicians were between 36 and 45 years old. Only 4.3% and 4.7% of physicians were 30 years or younger and 61 or older, respectively.

TABLE 1. *Characteristics of 2,086 physicians who ordered PSA screening tests in Taiwan in 2005*

Variable	No. (%)
PSA tests ordered in 40–75-year-old men:	
Less than 1/3 mos	1,434 (68.7)
1/3 Mos–1/mo	174 (8.4)
1/Mo–1/wk	307 (14.7)
Greater than 1/wk	171 (8.2)
Age:	
30 or Younger	90 (4.3)
31–35	285 (13.7)
36–40	441 (21.1)
41–45	445 (21.3)
46–50	351 (16.8)
51–55	240 (11.5)
56–60	136 (6.5)
61 or Older	98 (4.7)
Sex:	
M	1,911 (91.6)
F	175 (8.4)
Practice type:	
Hospital based	89 (4.3)
Office based	1,997 (95.7)
Specialty:	
Primary care	904 (43.3)
Nonprimary care	1,184 (56.7)
Practice location:	
Northern	1,017 (48.8)
Other regions	1,069 (51.2)

The mean ± SD number of visits by adult male patients per physician was 7,648 ± 7,277 in 2005. The mean number per physician in the low, medium, high and very high frequency PSA testing groups was 7,156, 7,324, 7,298 and 7,423, respectively.

Table 2 shows the rate of inappropriate PSA testing by physician characteristics. In sampled physicians the mean rate of inappropriate PSA test use was 30.8% ± 36.6%. The rate of inappropriate PSA test use decreased with an increasing frequency of ordering PSA tests. Notably physicians who were 30 years or younger had the highest rate of inappropriate PSA testing of all age groups. ANOVA and the t test revealed significant differences in the rate of inappropriate test use related to the frequency with which physicians ordered PSA tests ($p < 0.001$), age ($p = 0.017$), gender ($p < 0.001$) and specialty ($p < 0.001$).

Table 3 shows the adjusted relationship between the logarithm of rates of inappropriate PSA test use and the frequency with which physicians ordered PSA tests. Of the observed variations in the rate of inappropriate PSA testing 58.5% were explained by the selected independent variables. Hierarchical linear regression modeling showed that after adjusting for other factors physicians who ordered fewer PSA tests (those in the low and medium frequency groups) had a higher rate of inappropriate PSA test use than their counterparts who ordered PSA tests with very high frequency (each $p < 0.001$).

Table 3 also shows the adjusted relationship between the logarithm of the rate of inappropriate PSA testing and physician age. It was noted that after adjusting for other factors physicians who were 30 years or younger and 31 to 35 years old had higher rates of inappropriate PSA testing than their counterparts in the 41 to 45-year age group ($p = 0.019$ and 0.010, respectively).

TABLE 2. *Inappropriate PSA test use by characteristics of 2,086 physicians*

Variable	Mean ± SD % Inappropriate PSA Tests	1-Way ANOVA Independent Sample t Test*	p Value
PSA tests ordered in 40–75-year-old men:		500.0	<0.001
Less than 1/3 mos	32.6 ± 43.0		
1/3 Mos–1/mo	32.0 ± 14.3		
1/Mo–1/wk	27.5 ± 11.4		
Greater than 1/wk	26.6 ± 11.0		
Age:		2.46	<0.05
30 or Younger	41.9 ± 43.2		
31–35	33.4 ± 38.4		
36–40	28.8 ± 36.1		
41–45	31.9 ± 36.5		
46–50	31.0 ± 36.5		
51–55	29.2 ± 33.4		
56–60	27.6 ± 34.8		
61 or Older	27.7 ± 36.3		
Sex:		6.04	<0.001
M	30.1 ± 35.7		
F	38.8 ± 44.3		
Practice type:		1.02	
Hospital based	33.2 ± 36.2		
Office based	30.7 ± 36.5		
Specialty:		2.71	<0.001
Primary care	31.8 ± 40.8		
Nonprimary care	30.1 ± 33.0		
Practice location:		1.92	
Northern Taiwan	32.2 ± 37.4		
Other regions	29.5 ± 35.7		

* Performed using the logarithm of inappropriate PSA test rates.

TABLE 3. *Hierarchical linear regression modeling analysis of adjusted relationship between log inappropriate PSA test rate and clinical experience in 2,086 physicians*

Variables	Log Inappropriate PSA Test Rate		
	Parameter Estimate	SE	p Value
PSA tests ordered in 40–75-year-old men:			
Less than 1/3 mos	0.432	0.021	<0.001
1/3 Mos–1/mo	0.077	0.022	<0.001
1/Mo–1/wk	0.031	0.021	0.134
Greater than 1/wk (referent)			
Age:			
30 or Younger	0.061	0.020	0.019
31–35	0.053	0.020	0.010
36–40	0.005	0.018	0.876
41–45 (referent)			
46–50	0.003	0.018	0.876
51–55	−0.011	0.020	0.592
56–60	0.014	0.026	0.600
61 or Older	0.031	0.031	0.318
Sex:			
M	−0.030	0.022	0.177
F (referent)			
Specialty:			
Primary care (referent)			
Nonprimary care	−0.120	0.014	0.154
No. visits by adult males/physician:	0.000	0.000	0.800
Constant	1.410	0.274	<0.001
Random effect associated with hospital or practice	0.0313		
Adjusted R^2		0.585	
F		103.8	<0.001

DISCUSSION

To our knowledge this is the first nationwide population based study to examine the relationship between clinical experience and inappropriate PSA testing. We found that the likelihood of inappropriate PSA screening was significantly and negatively associated with physician clinical experience. In other words, younger physicians and those who ordered PSA tests less frequently had a higher rate of inappropriate PSA test use.

Our finding is not consistent with observations from prior studies in the United States.[9,11,12,15,16] Some of these studies indicated an association between older health care providers and increasing PSA screening misuse.[11,12,15,16] Yet other studies showed a higher rate of PSA screening misuse associated with longer periods since graduation from medical school.[10] One group reported no effect of physician age on PSA screening behavior.[9]

These studies based in the United States have several types of limitations. Some series were based on the year that a PSA screening guideline had just been published,[10] while others have potential self-reporting bias,[11,12,15,16] were potentially distorted by including other types of practitioners besides physicians[9] or posed problems of generalizability to the whole population since findings were based on a single institution or region.[5,9] In contrast with these shortcomings, our study has several unique characteristics. The source of the sample was a nationwide population based data set and, therefore, there can be no question about the generalizability of our findings to the whole population. Another unique aspect of the Taiwan health care system is the absence of a referral system, giving patients the freedom to choose any provider of their choice, a fact suggesting a more natural environment for our study.

Contrary to our starting hypothesis, which was based on previous literature, we found that older physicians who tended to have more clinical experience had lower rates of inappropriate PSA testing. It may be that older physicians who are candidates for prostate cancer screening become more aware of risk factors and side effects of treatments because they face the decision about whether to undergo PSA testing. Surveys of physicians in Taiwan to determine their knowledge, attitudes and practice regarding PSA screening is recommended to identify reasons for the association between older physicians and the lower likelihood of misusing PSA screening orders found in this study.

There are many possible explanations for the discrepancy between our findings and American based studies suggesting that physician competence decreases with age, which have sparked highly contentious debates. Some groups have suggested that older physicians may intentionally disregard guidelines based on the greater confidence in their judgment that comes with accumulating experience. Theoretically it seems possible that older American physicians adhere less to PSA test guidelines than their younger peers, while older physicians in Taiwan adhere to them more. If this is true, apparent differences in adherence to screening standards between older physicians in the United States and Taiwan might imply cultural differences that shape how aging affects clinical judgment. Perhaps older physicians in Taiwan become more conservative about testing, while older American physicians become more comfortable with exercising individual discretion. However, the incompleteness and subjective nature of the American data provide a weak foundation for such cultural hypotheses. Perhaps older American physicians report more accurately about their use of screening than younger physicians. We are not convinced that there is a factual basis for claiming differences in adherence to testing standards or overall performance between physicians in the United States and Taiwan.

In support of the value of clinical experience our study showed that physicians who ordered more PSA tests were less likely to misuse them, which is consistent with other studies of the frequency of testing and adherence to screening standards.[9,17] While performing PSA tests frequently does not prove that physicians consult guidelines more often, it seems likely that they would read about procedures that they perform frequently in the course of staying up to date with the medical literature. Studies have shown that physicians who are uncomfortable with uncertainty[18] or show intolerance of ambiguity[19] can be expected to order more diagnostic tests, which is a mentality that may be common in less experienced and less self-confident physicians. Overuse of PSA screening by physicians with less experience may be driven by the fear of missing a diagnosis of cancer or the fear of legal action.[20]

Despite the statistical strength of our study 3 caveats deserve mention. 1) Our database does not permit us to identify whether some of the seemingly inappropriate PSA tests were actually appropriate because they were done in patients who had an abnormal digital rectal examination or a family history of prostate cancer. 2) Some practicing physicians registered with the Taiwan Department of Health have more than 1 specialty but NHIRD only allows us to identify 1 major specialty. 3) The number of years since graduation is a better proxy for clinical experience than physician age. However, NHIRD does not allow us to identify the date of graduation from medical school.

Even so, we found that whether we used physician age as a surrogate for general clinical experience or the frequency of PSA tests ordered as a measure of procedure specific experience, the relation between clinical experience and screening behavior was substantial and obvious. Younger age and less frequent ordering of PSA tests contributed to higher rates of inappropriate PSA screening.

Our findings have important policy implications. Based on the higher portion of PSA screening misuse observed in recently graduated physicians we suggest that updated guidelines should be emphasized more during medical training. Furthermore, since orders for PSA tests are processed through a computer system in Taiwan, it would be useful to create an automated program that could alert physicians when they may be ordering inappropriate PSA tests for their patients.

Abbreviations and Acronyms

NHIRD	=	Taiwan National Health Insurance Research Database
PSA	=	prostate specific antigen

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EDITORIAL COMMENT

In an article published 7 years ago Trunkey and Botney stated that there were 2 groups of physicians in which competency has been a problem, that is physicians or surgeons just entering practice and surgeons who are older.[1] The current authors provide interesting data that demonstrate a significant negative correlation between inappropriate PSA screening and physician clinical experience. This report corroborates the theory that professional societies should examine their young applicants and hold them accountable for proficiency and knowledge. Experience is the best teacher and experience is difficult to teach. However, the effort to construct clinical practice guidelines based on best available evidence will likely decrease the ordering of expensive clinical tests of marginal relevance.

Robert Bahnson
Department of Urology
Ohio State University
Columbus, Ohio

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