Published in final edited form as:

Addict Behav. 2013 March ; 38(3): 1792–1795. doi:10.1016/j.addbeh.2012.11.006.

Utility of Biochemical Verification of Tobacco Cessation in the Department of Veterans Affairs

Devon Noonan,

The University of Michigan, School of Nursing, 400 North Ingalls, Ann Arbor, MI, 48109-5482, United States

Yunyun Jiang, and

The University of Michigan, School of Nursing, 400 North Ingalls, Ann Arbor, MI, 48109-5482, United States

Sonia A. Duffy

The University of Michigan, School of Nursing, 400 North Ingalls, Ann Arbor, MI, 48109-5482, United States; Ann Arbor VA Center for Clinical Management Research, VA Ann Arbor Healthcare System, HSR&D (152), P.O. Box 130170, Ann Arbor, MI, 48113-0170, United States; Tel.: +1 734 845 3608; Fax: +1 734 222 7514

Devon Noonan: devon.noonan@duke.edu; Sonia A. Duffy: bump@umich.edu

Abstract

Research on the validity of self-report tobacco use has varied by the population studied and has yet to be examined among smokers serviced by the Department of Veterans Affairs (VA). The purpose of this study was to determine the predictors of returning a biochemical urine test and the specificity and sensitivity of self-reported smoking status compared to biochemical verification. This was a sub-analysis of the larger Tobacco Tactics research study, a pre- post- non-randomized control design study to implement and evaluate a smoking cessation intervention in three large VA hospitals. Inpatient smokers completed baseline demographic, health history and tobacco use measures. Patients were sent a follow-up survey at six-months to assess tobacco use and urine cotinine levels. A total of 645 patients returned 6 month surveys of which 578 also returned a urinary cotinine at six months. Multivariate analysis of the predictors of return rate revealed those more likely to return biochemical verification of their smoking status were younger, more likely to be thinking about quitting smoking, have arthritis, and less likely to have heart disease. The sensitivity and specificity of self-report tobacco use was 97% (95% confidence interval=0.95–0.98) and 93% (95% confidence interval=0.84–0.98) respectively. The misclassification rate among self-reported quitters was 21%. The misclassification rate among self-reported smokers was 1%. The sensitivity and specificity of self-report tobacco use was high among veteran smokers, yet among self-report quitters that misclassification rate was high at 21% suggesting that validating self-report tobacco measures is warranted in future studies especially in populations that are prone to misclassification.

Keywords

tobacco; veteran; smoking; cessation; validity of self-report

1. Introduction

Smoking is particularly high among subgroups of patients serviced by the Department of Veterans Affairs (VA), many of whom suffer from comorbid psychiatric and substance abuse disorders, making quitting smoking even more difficult. As a result, patients serviced by the VA suffer from a disproportionate amount of tobacco-related diseases (McLaughlin, Hrubsec, Blot, & Fraumeni, 1995). Hence, the VA has spent a tremendous amount of money on assisting veterans to quit smoking and also funds a considerable amount of research on smoking cessation.

Tobacco related research has relied on both self-reported and biochemical verification of tobacco cessation. Biochemical verification of tobacco cessation, in the form of urine, blood and saliva samples, has been used to validate self-report smoking status to decrease underrepresentation of the actual prevalence of tobacco use (Gorber, Schofield-Hurwitz, Hardt, Levasseur, & Tremblay, 2009). However, biochemical validation of tobacco cessation is expensive (ranging \$7.00 per test strip to \$40.00 for laboratory confirmation not to mention patient incentives and labor costs associated with collecting samples) and samples can be difficult to obtain, therefore increasing the response burden for participants.

Various studies examining the validity of self-report tobacco use have yielded conflicting results depending on the population studied (From Attebring, Herlitz, Berndt, Karlsson, & Hjalmarson, 2001; Gorber, et al., 2009; Patrick, et al., 1994; Sagar, Jain, Sundar, & Balhara, 2011; Shipton, et al., 2009; Studts, et al., 2006; Wilson, Elborn, Fitzsimons, & McCrum-Gardner, 2011). In a recent systematic review examining the validity of self-report tobacco use status, the authors conclude that overall the data show underestimation of the prevalence of tobacco use when using self-report data, with varying sensitivity levels based on the population studied and the method of biochemical verification used (Gorber, et al., 2009). For example, when self-reported smoking status and urine cotinine levels were compared among patients from a lung cancer screening trial, the sensitivity and specificity was 91% and 95% respectively; the misclassification rate was only 7%, however more than half of these patients had been using nicotine replacement therapy (Studts, et al., 2006). On the contrary, studies have reported the validity of self-report smoking to be low among populations such as pregnant woman, patients with heart disease and psychiatric patients (Pell, et al., 2008; Shipton, et al., 2009; Takeuchi, Nakao, Shinozaki, & Yano, 2010) perhaps due to the social stigma surrounding tobacco use in these particular groups (Gorber, et al., 2009). Thus far, to our knowledge the utility of biochemical verification among smokers serviced by the VA has not been studied. Hence, the specific aims of this study were to, in a sample of inpatient veteran smokers: 1) determine the predictors of returning a biochemical urine test; and 2) determine the sensitivity and specificity of self-reported smoking status compared to biochemical verification.

2. Methods

2.2 Design

This study was a sub-analysis of the larger Tobacco Tactics research study conducted from 2006 to 2009 as a pre-/post- non-randomized comparison study to implement and evaluate an inpatient nurse-administered smoking cessation intervention program in three hospitals located in the same Veterans' Integrated Service Network (VISN) (Duffy, Karvonen-Gutierrez, Ewing & Smith, 2009). VA hospitals in Ann Arbor, MI and Detroit, MI were selected as intervention sites and Indianapolis, IN was selected as the usual care control site. The intervention included training of inpatient unit nurses to provide a pre-designed tobacco cessation program to hospitalized smokers with six month follow up. Institutional review board approval was received from the VA.

2.3 Sample

Inclusion criterion for patients enrolled in the Tobacco Tactics study were those veterans who: 1) were admitted as inpatients to intensive care units, general medical, surgical, and extended care units; 2) had smoked within one month prior to hospitalization; and 3) had a projected hospital stay of at least 24 hours. Exclusion criterion were those veterans who: 1) were too ill to participate, for example they were comatose; 2) were terminal; 3) were involved in a concurrent trial that included interventions on smoking; 4) were non-English speaking; and 5) were pregnant. For this sub-analysis only participants (n=645) that returned six month follow-up data as part of the Tobacco Tactics study were eligible for analysis.

2.4 Procedures

Inpatient veteran smokers were enrolled and completed a baseline health questionnaire during hospitalization. Patients were then sent a follow-up survey approximately six-months post-discharge to assess current tobacco use. Along with the survey, all participants (including self-reported quitters and continuing smokers) were mailed urinary cotinine test strip to return by mail at the six month follow-up. Participants were told the cotinine strips would determine the presence of nicotine only in their urine. Participants were provided with \$5.00 for returning the survey and \$15.00 for returning the test strip.

2.5 Measures

Demographic and health information variables were collected at baseline. Self-rated health was assessed at baseline using a 5-level Likert scale including "Excellent", "Very good", "Good", "Fair", or "Poor" (Ware, 1993).

Comorbidity information were self-reported by patients and abstracted by research staff from the patient's electronic medical record. (Mukerji, et al., 2007) The Alcohol Use Disorders Identification Test (AUDIT) was used to measure alcohol use (AUDIT score >8 were considered having alcohol problem) (Babor, 2001) and the abbreviated form of the Center for Epidemiologic Studies (CES-D) was used to measure depression (CES-D score >4 were considered having depression) (Irwin M, 1999).

Patients were also asked if they thought that quitting smoking would make them feel nervous; responses were categorized as “extremely unlikely to 50/50 chance” vs. “moderately to extremely likely”. Patients were asked to rate the importance of quitting (“not at all to moderately” vs. “very to extremely important”), difficulty in quitting (“not at all to slightly” vs. “fairly to extremely difficult” and whether they were thinking about quitting in the next thirty days. Further patients were asked if they experienced withdrawal symptoms (yes/no) and whether they were interested in receiving cessation services (yes/no). Nicotine addiction was assessed using the Fagerstrom Test for Nicotine Dependence (FTND). (For this study, a Fagerstrom score >6 were considered highly nicotine dependent) (Fagerstrom, 1995). The medical records of those participants who reported not smoking, but had a positive cotinine test were reviewed to determine if they were prescribed nicotine replacement therapy by the VA within 1 month prior to their 6 month survey date.

The two outcomes of interest were six-month self-reported smoking cessation rate and cotinine-verified smoking cessation rate. To be considered as having quit on the first outcome, the patient had to self-report on their 6-month follow-up survey that they had not “Used any tobacco products in the past 7 days”. To be considered as having quit on the second outcome measure they also had to have a negative urinary cotinine test strip returned with their survey. Cotinine is a by-product of nicotine with a half-life of approximately 16 to 19 hours and values >50 ng/L are indicative of smoking.(Benowitz) (M J Jarvis, 1988) For the present study NicAlert Semiquantitative test strips, which determine exposure to cigarette use, pipe use and chewing tobacco were used.

2.6 Data analysis

Means and frequencies were conducted for all variables. Among those that returned the 6 month survey, Chi-square or Fisher’s exact tests and Student’s t-tests were used to determine baseline differences in demographics and health information between those who did and did not return a urinary cotinine test. Based on these bivariate analyses and clinical judgment, multivariate logistic regression analyses was used to determine the predictors of returning a cotinine test (Yes/No). Lastly binary classification tests were performed to determine the sensitivity and specificity of self-reported smoking status compared to biochemical verification. The sample size varied for different results. Values for $P < 0.05$ were considered significant. Data analysis was conducted using SAS version 9.2 (SAS Institute, Cary, NC).

3. Results

3.1 Univariate and Bivariate Analyses

The descriptive statistics are shown in Table 1. In the main Tobacco Tactics study, 2403 patients were approached to participate of which 1207 consented. Of the 1207 consented participants 1145 completed baseline data. In the present sub-analysis 103 baseline cases that had died before 6 month follow-up were removed. Of the 1042 participants at baseline in the present study, 62% ($n=645$) of the total sample returned the six-month follow-up survey. The only difference found between the 6 month survey responders ($n=645$) and non-responders ($n=397$) was that there were slightly more subjects with depression (67.6%) in the responder group than in non-responder group (60.0%) ($P=0.02$). Among subjects with 6

month follow up surveys (n=645), 90% (n=578) returned biochemical verification of their smoking status. Those who returned biochemical verification of their smoking status were slightly younger ($P=0.03$), more likely to have arthritis ($P<.0001$), and less likely to have heart disease ($P=0.02$) compared to participants who did not return biochemical verification. See Table 1.

3.2 Multivariate analyses

Based on the results of the bivariate analysis and considering the sample size, five variables were included in the multivariate analysis including age, thinking of quitting in next 30 days, self-reported comorbidities, arthritis, heart disease and hypertension. Every 5 year increase in age was associated with a 25% decreased odds of returning test strip ($OR=0.754$, 95% $CI=0.629-0.903$, $P=0.002$). The odds of returning test strip among patients who were thinking of quitting using tobacco products in next 30 days was nearly 2.4 times greater ($OR=2.39$, 95% $CI= 1.074-5.328$, $P=0.033$) as compared to people who were not thinking of quitting using tobacco products in next 30 days. The odds of returning biochemical verification among people with arthritis was nearly 3 times ($OR=2.9$, 95% $CI=1.54-5.39$, $P=0.0009$) the odds of returning biochemical verification among people without arthritis. By contrast, the odds of returning biochemical verification among people with heart disease was nearly half ($OR=0.50$, 95% $CI=0.250-0.996$, $P=0.05$) the odds of returning test strip among people without heart disease. Though not significant itself, hypertension attenuated the effect of heart disease in the model. See Table 2.

3.3 Sensitivity and Specificity of Self-Report Smoking versus Biochemical Verification

Of the 578 participants who sent back cotinine strips, 549 (95.0%) people had a readable test strip and 2 of the 549 participants had a readable test strip but did not self-report smoking status resulting in 547 participants eligible for this analysis. The sensitivity of self-reported tobacco use status versus biochemical verification was 96.9% (95% confidence interval=0.950–0.983) and the specificity was 93.4% (95% confidence interval=0.840–0.982) with an overall misclassification rate of 3.5%. Four participants who reported using tobacco were classified as nonsmokers by their urinary cotinine test (1% misclassification rate among self-reported smokers). Fifteen participants who self-reported not smoking were classified as tobacco users by their urinary cotinine levels (21% misclassification rate among self-reported quitters); none of these participants were obtaining nicotine replacement therapy from the VA at the time of 6 month follow-up.

4. Discussion

The results show a high sensitivity and specificity of the biochemical validation of tobacco cessation in general among veterans. Four (1%) veterans reported that they were using tobacco products, but tested negative for cotinine; these false negatives may be related to very low, perhaps non-daily rates of smoking. The misclassification rate of veterans who reported no tobacco use, but tested positive for tobacco use with biochemical verification was 21% suggesting higher misclassification rates among self-reported quitters which is higher than reported in previous studies in the literature; (Pickett, Rathouz, Kasza, Wakschlag, & Wright, 2005; Studts, et al., 2006; West, Zatonski, Przewozniak, & Jarvis,

2007). One explanation for this finding could be the use of nicotine replacement therapy, which has inflated lie rates in past studies (Studts, et al., 2006), however none of the participants in this study received nicotine replacement therapy from the VA around the time of the 6 month survey. Participants may have received nicotine replacement therapy from outside the VA, which could have increased misclassification rates in this study; however this is unlikely as the VA population is of lower socio-economic status.

Urinary cotinine test strips have been shown to be reliable in distinguishing non-smokers from smokers and have high levels of sensitivity and specificity in previous studies (Benowitz; Cooke, et al., 2008). While we were unable to obtain the exact sensitivity and specificity of the NicAlert urinary cotinine tests from the manufacturer used in this study, both false positive and false negative misclassifications may be related to a faulty test, inaccurate self-report or poorly implemented test procedures by the participant.

Those most likely to return urinary cotinine strips were those that were younger perhaps because the urine test may be an added burden for elderly smokers. Those thinking of quitting in the next 30 days were more likely to return the cotinine tests perhaps because they represent the most motivated smokers (Hyland, et al., 2006) who had a greater investment in the study. While it is unclear why those with arthritis were more likely to return the urine cotinine tests, arthritis is common among veterans (Dominick, Golightly, & Jackson, 2006) and our prior work has shown increased motivation to quit smoking among those with arthritis (Duffy, Biotti, Karvonen-Gutierrez, & Essenmacher, 2011). Similar to other studies, those with heart disease were less likely to return the cotinine test perhaps due to the social stigma associated with smoking among heart patients (Gorber, et al., 2009).

There were several limitations to this study. The sample included only inpatient smokers serviced by the VA and the results are therefore not generalizable to non-VA populations. While the sample size was large and representative of the institutions in which we recruited including a large number of African Americans, other minorities and women were under-represented. While the return rate of urinary cotinine tests was high (90%) among survey responders, 38% of those enrolled in the study were non-responsive at 6-month follow-up perhaps due to severe chronic illness experienced by VA inpatients and hardships related to low socioeconomic status common among veterans (Long, 2003) however this response rate is similar to other inpatient smoking cessation trials (Faseru, et al., 2011; Regan, Reyen, Lockhart, Richards, & Rigotti, 2011).

4.1 Conclusion

In summary, those who were more likely to return cotinine tests were younger, more likely to be thinking of quitting in the next 30 days, more likely to have arthritis, and less likely to have heart disease. The sensitivity and specificity of self-report tobacco use was high among inpatient veteran smokers, however the misclassification rate among self-reported quitters was about 1 in 5. Biochemical verification of tobacco use is helpful in determining true quit rates in VA smoking cessation studies.

References

- Babor, TF.; Higgins-Biddle, JC.; Saunders, JB.; Monteiro, MG. [Assessed on November 12, 2011] The alcohol use disorders identification test guidelines for use in primary care. 2nd2001. at http://www.who.int/substance_abuse/publications/alcohol/en/
- Benowitz NL. The use of biologic fluid samples in assessing tobacco smoke consumption. NIDA Research Monographs. 1983; 48:6–26.
- Dominick KL, Golightly YM, Jackson GL. Arthritis prevalence and symptoms among US non-veterans, veterans, and veterans receiving Department of Veterans Affairs Healthcare. The Journal of Rheumatology. 2006; 33(2):348–354. [PubMed: 16465668]
- Duffy SA, Biotti JK, Karvonen-Gutierrez CA, Essenmacher CA. Medical Comorbidities Increase Motivation to Quit Smoking Among Veterans Being Treated by a Psychiatric Facility. Perspectives in Psychiatric Care. 2011; 47(2):74–83. [PubMed: 21426352]
- Duffy SA, Karvonen-Gutierrez C, Ewing LA, Smith PM. Implentation of the tobacco tactics program in the department of veterans affairs. Journal of General Internal Medicine. 2009; 25(1):3–10. [PubMed: 20077145]
- Fagerstrom KO, Heatherton TF, Kozlowski LT. Nicotine Addiction and its Assessment. Ear, Nose Throat Journal. 1995; 69:763–765.
- From Attebring M, Herlitz J, Berndt AK, Karlsson T, Hjalmarson A. Are patients truthful about their smoking habits? A validation of self-report about smoking cessation with biochemical markers of smoking activity amongst patients with ischaemic heart disease. Journal of Internal Medicine. 2001; 249(2):145–151. [PubMed: 11296802]
- Gorber SC, Schofield-Hurwitz S, Hardt J, Levasseur G, Tremblay M. The accuracy of self-reported smoking: A systematic review of the relationship between self-reported and cotinine-assessed smoking status. Nicotine & Tobacco Research. 2009; 11(1):12–24. [PubMed: 19246437]
- Faseru B, Turner M, Casey G, Ruder C, Befort CA, Ellerbeck EF, Richter KP. Evaluation of a hospital-based tobacco treatment service: Outcomes and lessons learned. Journal of Hospital Medicine. 2011; 6(4):211–218. [PubMed: 21480493]
- Hyland A, Borland R, Li Q, Yong H-H, McNeill A, Fong GT, et al. Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey. Tobacco Control. 2006; 15(suppl 3):iii83–iii94. [PubMed: 16754952]
- Irwin M, Haydari Artin K, Oxman MN. Screening for depression in the older adult. Archieves of Internal Medicine. 1999; 159:1701–1704.
- Jarvis MJ, Russell MA, NL Benowitz NL, Feyerabend C. Elimination of cotinine from body fluids: implications for noninvasive measurement of tobacco smoke exposure. American Journal of Public Health. 1988; 78(6):696–698. [PubMed: 3369603]
- Long JA, Polsky D, Asch DA. Receipt of Health Services by Low-Income Veterans. Journal of Health Care for the Poor and Underserved. 2003; 14(3):305–317. [PubMed: 12955911]
- McLaughlin JK, Hrubsec Z, Blot WJ, Fraumeni JF. Smoking and cancer mortality among U.S. veterans: A 26-year follow-up. International Journal of Cancer. 1995; 60(2):190–193. [PubMed: 7829214]
- Mukerji SS, Duffy SA, Fowler KE, Khan M, Ronis DL, Terrell JE. Comorbidities in head and neck cancer: agreement between self-report and chart review. Otolaryngology- Head Neck Surgery. 2007; 136(4):536–542. [PubMed: 17418247]
- Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: a review and meta-analysis. Am J Public Health. 1994; 84(7):1086–1093. [PubMed: 8017530]
- Pell JP, Cobbe SM, Haw SJ, Newby DE, Pell ACH, Oldroyd KG, et al. Validity of Self-Reported Smoking Status: Comparison of Patients Admitted to Hospital with Acute Coronary Syndrome and the General Population. Nicotine & Tobacco Research. 2008; 10(5):861–866. [PubMed: 18569760]
- Pickett KE, Rathouz PJ, Kasza K, Wakschlag LS, Wright R. Self-reported smoking, cotinine levels, and patterns of smoking in pregnancy. Paediatric and Perinatal Epidemiology. 2005; 19(5):368–376. [PubMed: 16115289]

- Regan S, Reyen M, Lockhart AC, Richards AE, Rigotti NA. An Interactive Voice Response System to Continue a Hospital-Based Smoking Cessation Intervention After Discharge. *Nicotine & Tobacco Research*. 2011; 13(4):255–260. [PubMed: 21330278]
- Sagar R, Jain R, Sundar S, Balhara Y. A comparative study of reliability of self report of tobacco use among patients with bipolar and somatoform disorders. *Journal of Pharmacology and Pharmacotherapeutics*. 2011; 2(3):174–178. [PubMed: 21897711]
- Shipton D, Tappin DM, Vadiveloo T, Crossley JA, Aitken DA, Chalmers J. Reliability of self reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross sectional study. *British Medical Journal*. 2009; 339(4347)
- Studts JL, Ghate SR, Gill JL, Studts CR, Barnes CN, LaJoie AS, et al. Validity of Self-reported Smoking Status among Participants in a Lung Cancer Screening Trial. *Cancer Epidemiology Biomarkers & Prevention*. 2006; 15(10):1825–1828.
- Takeuchi T, Nakao M, Shinozaki Y, Yano E. Validity of self-reported smoking in schizophrenia patients. *Psychiatry and Clinical Neurosciences*. 2010; 64(3):274–278. [PubMed: 20602728]
- Ware, JE.; Snow, KK.; Kosinski, M.; Gandek, B. SF-36 health survey manual and interpretation guide. Boston MA: The Health Institute, New England Medical Center; 1993.
- West R, Zatonski W, Przewozniak K, Jarvis MJ. Can We Trust National Smoking Prevalence Figures? Discrepancies Between Biochemically Assessed and Self-Reported Smoking Rates in Three Countries. *Cancer Epidemiology Biomarkers & Prevention*. 2007; 16(4):820–822.
- Wilson JS, Elborn JS, Fitzsimons D, McCrum-Gardner E. Do smokers with chronic obstructive pulmonary disease report their smoking status reliably? A comparison of self-report and biochemical validation. *International Journal of Nursing Studies*. 2011; 48(7):856–862. [PubMed: 21288520]

Table 1
Description of the Sample and Bivariates

Baseline difference in characteristics between patients who returned biochemical cotinine verification (N=578) and who did not return the biochemical cotinine verification (N=67) among subjects who returned 6 month follow-up survey(N=645).

Factors	Total (N=645) N (%)	Return (N=578) N (%)	Not Return (N=67)* N (%)	P-value
Age	55.2±9.6	55.0±9.5	58.0±9.9	0.03
Sex				
Male	610 (94.6)	545 (94.3)	65 (97.0)	0.35
Female	35 (5.4)	33 (5.7)	2 (3.0)	
Race				
White	407 (63.4)	358 (62.3)	49 (73.1)	0.08
Non-white	235 (36.6)	217 (37.7)	18 (26.9)	
Marital Status				
Yes	153 (23.8)	135 (23.4)	18 (26.9)	0.53
No	491 (76.2)	442 (76.6)	49 (73.1)	
Education				
High School or Less	273 (42.7)	238 (41.5)	35 (52.2)	0.09
Some college or More	367 (57.3)	335 (58.5)	32 (47.8)	
Employed				
Yes	89 (14.9)	80 (15.0)	9 (14.3)	0.88
No	508 (85.1)	454 (85.0)	54 (85.7)	
Living Alone				
Yes	232 (38.2)	211 (38.9)	21 (32.3)	0.30
No	375 (61.8)	331 (61.1)	44 (67.7)	
Site				
Ann Arbor	259 (40.2)	224 (38.8)	35 (52.2)	0.09
Detroit	166 (25.7)	151 (26.1)	15 (22.4)	
Indianapolis	220 (34.1)	203 (35.1)	17 (25.4)	
Health Status at 6 month				
Excellent, extremely good or good	319 (49.8)	293 (51.0)	26 (39.4)	0.07
Fairly	244 (38.1)	217 (37.8)	27 (40.9)	
Not good	77 (12.0)	64 (11.2)	13 (19.7)	
Self-reported medical comorbidities				
Arthritis	368 (57.0)	345(40.3)	23 (34.3)	<.0001
Cancer	108 (16.7)	93 (16.1)	15 (22.4)	0.19
Diabetes	173 (26.8)	154(26.6)	19 (28.4)	0.76
Heart	246 (38.1)	212(36.7)	34 (50.8)	0.02
Hypertension	437 (67.8)	392(67.8)	45 (67.2)	0.91
lung disease	232 (36.0)	203 (35.1)	29 (43.3)	0.19

Factors	Total (N=645) N (%)	Return (N=578) N (%)	Not Return (N=67)* N (%)	P-value
psych problem	390 (60.5)	354 (61.2)	36 (53.7)	0.23
stroke	79 (12.2)	69 (11.9)	10 (14.9)	0.48
Other	294 (82.6)	267 (82.7)	27 (81.8)	0.90
Alcohol Problem				
Yes	172 (27.5)	155 (27.7)	17 (26.2)	0.80
No	453 (72.5)	405 (72.3)	48 (73.8)	
Depression				
Yes	445 (71.3)	403 (71.7)	42 (67.7)	0.51
No	179 (28.7)	159 (28.3)	20 (32.3)	
Nervous about quitting				
Not at all-moderately	276 (52.5)	249 (52.5)	27 (51.9)	0.93
Very-extremely important	250 (47.5)	225 (47.5)	25 (48.1)	
Importance in quitting				
Not at all-moderately	120 (22.8)	105 (22.2)	15 (27.8)	0.35
Very-extremely important	407 (77.2)	368 (77.8)	39 (72.2)	
Difficulty in quitting				
Not at all - slight	171 (32.5)	159 (33.6)	12 (22.6)	0.10
Fairly - extremely difficult	355 (67.5)	314 (66.4)	41 (77.4)	
Thinking about quitting				
Yes, within 30 days	157 (30.6)	149 (32.2)	8 (16.0)	0.02
No, not thinking of quitting	356 (69.4)	314 (67.8)	42 (84.0)	
Withdraw Symptoms				
Yes	182 (53.7)	165 (54.1)	17 (50.0)	0.65
No	157 (46.3)	140 (54.9)	17 (50.0)	
Nic Dependence				
Yes	238 (38.4)	211 (38.0)	27 (42.2)	0.52
No	381 (61.6)	344 (62.0)	37 (57.8)	
Interested in smoking cessation services				
Yes	146 (44.4)	139 (44.3)	7 (46.7)	0.86
No	183 (55.6)	175 (55.7)	8 (53.3)	

^a * participants who returned 6 month follow up survey but did not return test strip

Table 2Multivariate analysis predicting return of biochemical verification.^a

	OR	P-value	95% CI
Age (5-year increase)	0.754	0.0021	0.629–0.903
Thinking of quitting in next 30 days	2.392	0.0328	1.074–5.328
Heart disease	0.499	0.0486	0.250–0.996
Hypertension	1.650	0.1792	0.795–3.426
Arthritis	2.881	0.0009	1.540–5.388

^aResults in bold indicate P<0.05.

Table 3

Sensitivity and specificity of self-reported smoking status and urinary cotinine test

Self-reported smoking status in last 7 days	Biochemical cotinine test result		Total (N=547)
	Positive	Negative	
Smoking	471	4	475
Not smoking	15	57	72
Total	486	61	

^aNote: Based on urinary cotinine results as the gold standard, self-reported smoking status had a sensitivity of 96.9% (Exact 95% confidence interval=0.950–0.983) and specificity of 93.4% (Exact 95% confidence interval=0.840–0.982). The positive predictive value was 99% and the negative predictive value was 79%. Misclassification among self-reported quitters was 21% while the misclassification rate among self-reported smokers is only 1%