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ORIGINAL PAPER

A Mixed-Methods Assessment of a Peer-Enforced Tobacco- and Smoke-Free Policy at a Large Urban University

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Abstract

The study aims to evaluate the enforcement, opinions, and effectiveness of the University of South Florida's tobacco free policy one year following implementation. By assessing readiness to change and using geographic information system (GIS) mapping this study sought to introduce a unique and effective way of evaluating college tobacco free policies. A cross-sectional survey was administered to students, faculty, and staff to assess knowledge of policy and resources, tobacco use observations, stage change regarding policy enforcement, self-efficacy to enforce, and policy impact on perceived campus tobacco use (n = 5242). Additionally, using ArcGIS Collector (in: ESRI, ArcGIS desktop: release 10, Environmental Systems Research Institute, Redlands, 2011) volunteers collected geospatial data on tobacco use continuing to occur on campus following policy implementation. Overall there was moderate knowledge of the current policy and low beliefs for policy enforcement. Majority of respondents were not approaching violators to remind them of the policy and did not plan to do so in the future. There were statistically significant differences between smokers and non-smokers as well as between students and faculty and staff. The mapping of observed violations revealed continued tobacco use on campus with 158 data points. From both the geospatial results as well as the survey findings, the current policy is ineffective in reducing tobacco use across campus. With rapidly increasing numbers of smoke and tobacco free universities, new and innovative evaluation tools are needed so institution leaders can efficiently evaluate their implementation.

Keywords Tobacco use · College student · Tobacco-free policy · Geographic information systems (GIS) · Transtheoretical model

Introduction

Smoking remains a leading cause of preventable death in the United States as more than 16 million Americans suffer from tobacco-related illnesses [1, 2]. Although, overall smoking prevalence has declined over the past decade [2, 3], a 10% increase in tobacco use was observed between 1990 and 1999 among college students [4]. More recently, the American College Health Association (ACHA) surveyed over 80,000 diverse college students in Spring 2017 using the National College Health Assessment (NCHA) [5]. Results revealed 9.6% of participants self-reporting "any cigarette use" within the last 30 days, 4.3% self-reporting e-cigarette use, and 3.2% indicating hookah use [5]. With the goal of decreasing the risk for tobacco-related illnesses, the reduction of tobacco use among college students was developed as a Healthy Campus 2020 goal by the ACHA [6].

Strong tobacco policies restricting tobacco use on college campuses have the potential to deter students from

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smoking and prevent initiation [7]. Previous studies indicate that campus-based tobacco-free initiatives are supported by students [8–10]. Moreover, schools with tobacco policies have been found to have lower rates of smoking [7, 11, 12], decreased smoking norms, and a positive increase in attitudes towards tobacco regulation [13]. To better understand the effectiveness of smoke-free policies at university campuses, a systematic review of 19 studies, which included two cross-sectional studies, found reductions in undergraduate student smoking prevalence, decreased exposure to secondhand smoke, and decreased daily tobacco use [9]. Nonetheless, a research report on college tobacco control policies indicated that college administrators did not regard tobacco use as a top priority since there is no immediate risk to the student, in addition to the concern that tobacco use policies would decrease enrollment [10].

While smoke- and tobacco-free campus policies are becoming commonplace, various versions exist [4]. The two most common indicators of a successful tobacco- and smoke-free campus are a written policy outlining 100% smoke-free and compliance of at least 90% of the campus population [6, 14]. However, some policies do allow tobacco use, but either restrict use in areas such as building entrances or provide designated smoking areas [4]. Additionally, differences in policy enforcement are also found. Effective enforcement models include both passive (no direct contact with individuals) and active (includes direct contact) enforcement [15]. Passive methods, which may include ground markings, signage, and removal of receptacles, illustrate that the policy exists, yet they may become routine over long periods of time and lose some of their effectiveness [15]. Active methods, including approaching violators, allow for education on the policy or stricter university sanctions, but are limited based on who is enforcing the policy [16]. Although colleges and universities have implemented multiple strategies for passive and active enforcement, barriers with implementation and enforcement have been reported [16].

The purpose of this mixed-methods study was to assess knowledge, attitudes, and beliefs regarding the policy, enforcement behavior, and overall compliance with the policy at a large urban research university located in the southern region of the U.S. following implementation of a tobacco- and smoke-free campus policy. The current study was comprised of the following: (1) a quantitative survey assessing knowledge of policy and resources, tobacco use observations, stage change regarding policy enforcement, self-efficacy to enforce, and policy impact on perceived campus tobacco use, and (2) geographic information systems (GIS) mapping to identify tobacco use area, campus hotspots, and correlations with smoke- and tobacco-free signage.

Methods

The University of South Florida-Tampa is a large research university in the southern U.S. with approximately 45,000 enrolled students and more than 2000 faculty members [17]. USF is a diverse institution enrolling students who identify as Hispanic (18%), Black (10%), Asian (6%), Native American or Pacific Islander (< 1%), and multiple races (3%) and employing faculty who are Hispanic (7%), Black (5%), Asian (14%) and White (72%) [17]. Of enrolled students, 44% are male and 56% are female, and among faculty members, 50% are male and 46% are female [17]. On January 1, 2016 the university implemented a tobacco-free campus policy prohibiting the use of all tobacco products, including cigarettes, cigars, smokeless tobacco, hookah, and e-cigarettes [18]. The policy heavily relies on peer enforcement with the option for progressive disciplinary action if the offender is referred to the student conduct office or Human Resources [18]. All data collection occurred during spring 2016. Research integrity and compliance approval for this study was granted through the university's Institutional Review Board.

Theoretical Framework

The Transtheoretical Model (TTM) recognizes behavior change occurs through a series of stages depending on an individual's readiness to change [19]. As such, the Stages of Change construct depicts the following stages of behavioral readiness: (a) pre-contemplation (does not engage in the behavior and has no intention of doing so); (b) contemplation (does not engage in the behavior, but has thought about it); preparation (does not engage in the behavior but intends on doing so in near future); action (does engage in the behavior and has done so for less than 6 months); and maintenance (does engage in the behavior and has done so for more than 6 months) [19]. With regard to the current study, the behavior of interest was peer enforcement of the campus policy when they witnessed a violation.

Survey Methods

A cross-sectional on-line survey was administered to students, faculty, and staff to assess knowledge of policy and resources, tobacco use observations, stage change regarding policy enforcement, self-efficacy to enforce, and policy impact on perceived campus tobacco use. An invitation to participate in the survey was emailed to all enrolled graduate and undergraduate students (N = 40,123) from the Dean of Students. Likewise, an invitation was emailed

to faculty/staff (N = 7884) from the Provost. Students, faculty, and staff had 2 weeks to complete the survey.

Survey Measures

For policy knowledge, participants responded to the question, "Which of the following is the current tobacco-use policy on this campus?" Response options included three incorrect answers, the correct answer ("The use of ALL tobacco products are prohibited on all CAMPUS property"), and I do not know. For analysis, answers were coded as correct, incorrect, and do not know.

To assess beliefs, participants responded yes or no to two items: "Do you believe the tobacco policy is being enforced by students on campus?" and "Do you believe the tobacco policy is being enforced by faculty and staff on campus?" A third item assessed their belief of the policy impact on the use of tobacco and tobacco-derived products on the university campus with responses being "Yes, I feel tobacco use on campus has declined," "No, I do not feel tobacco use on campus has declined," and "I do not know if tobacco use on campus has declined."

There were multiple questions assessing stage change regarding policy enforcement and self-efficacy to enforce the policy. Participants reported their experience observing smoking, chewing tobacco, and e-cigarette usage on campus in the past 30 days. If participants indicated they had witnessed use, they were further surveyed about how they reacted to the violation to determine their readiness for change. The response options were:

- I did not approach the individual to inform them about the Tobacco and Smoke Free Policy and I don't plan on doing so in the near future.
- I did not approach the individual to inform them about the Tobacco and Smoke Free Policy, but I have thought about it.
- I did not approach the individual to inform them of the Tobacco and Smoke Free Policy, but I intend to start within the next month.
- I have been approaching individuals to inform them of the Tobacco and Smoke Free Policy, but not regularly.
- I have been approaching individuals to inform them of the Tobacco and Smoke Free Policy each time.

Participants reported their sex, race, ethnicity, smoking status, status at the university (student, faculty, staff), college affiliation, and if they were affiliated with the university prior to the policy implementation.

Statistical Analyses

Community attitudes towards policy and enforcement were recorded from survey results and analyzed using SPSS 23 [20]. Contingency table analyses were conducted between campus roles (student, faculty, and staff) and stages of change, enforcement experience, opinions on the policy, and current tobacco use. Chi square tests for independence were performed to determine statistical differences between smokers and non-smokers as well as between students and faculty/staff.

GIS Mapping Technique

Previous studies on enforcement have assessed continued tobacco use by counting cigarette butts found on the ground [21, 22] and GIS mapping [23–25]. Cigarette butt counts give researchers an indication of how many cigarettes have been smoked on campus and provide a direct way to calculate differential impact of tobacco policies across campuses [21]. This strategy is easy, affordable, and makes the evaluation of tobacco policies simple for individuals untrained in evaluation techniques or data collection. However, cigarette butt counts are labor intensive and do not account for all forms of tobacco included in 100% tobacco-free policies [26, 27]. An underutilized approach on college campuses is GIS mapping as it has the potential to observe smoking across large geographic areas. One study used GIS mapping to identify areas of campus with greatest risk of secondhand smoke exposure by using hidden cameras on bicycles to observe smokers in order to expand their observational field within short burst time frames [23]. A similar study used a smartphone application to collect geospatial data in multiple countries with multiple users regarding locations where individuals would be at risk of secondhand smoke exposure [25]. Benefits of GIS mapping include being easy to conduct, having the ability to frequently update results, and the potential of crowdsourcing data collection [24].

This study used ArcGIS Collector [28] and volunteers collected geospatial data on tobacco use on campus. The USF Department of Geographic Information provided the ArcGIS map of the USF-Tampa campus and an additional layer was added to collect observational geospatial data allowing volunteers to add coordinate points and information. The final map was private and could only be accessed through invitation, which was sent to all the volunteers after training, ensuring points added to the map were only from trained volunteers. In order to ensure volunteers knew how and what data to collect using Collector an hour-long training session was held. This training minimized the possibility of volunteers making assumptions during observations.

For data collection a map of USF was divided into equal grid blocks and assigned a number. A random number

generator formula on Microsoft Excel 2013 assigned volunteers each week to three random campus locations [29]. All areas of campus had an equal opportunity of being selected. Participants included anyone observed using cigarettes, cigars, smokeless tobacco, hookah, or e-cigarettes, and since there were no identifying features or direct contact with tobacco policy violators all observations were included. When a volunteer observed a tobacco free violation they saved the violation location and recorded the following information: individual or group, lack of tobacco signage nearby, location description, and any comments that were not assumptive (i.e. gender, campus role, etc.). If cigarette butts were observed, the volunteer would save location and record number of cigarette butts. They could also attach pictures that did not reveal a person's identity. The research team could view the final map allowing them to see all points, information, as well as who added the specific point. There were 72.4 recorded volunteer observation hours recorded by seven volunteers over 6 weeks. Figure 1 provides a visualization of the ArcGIS application used by volunteers.

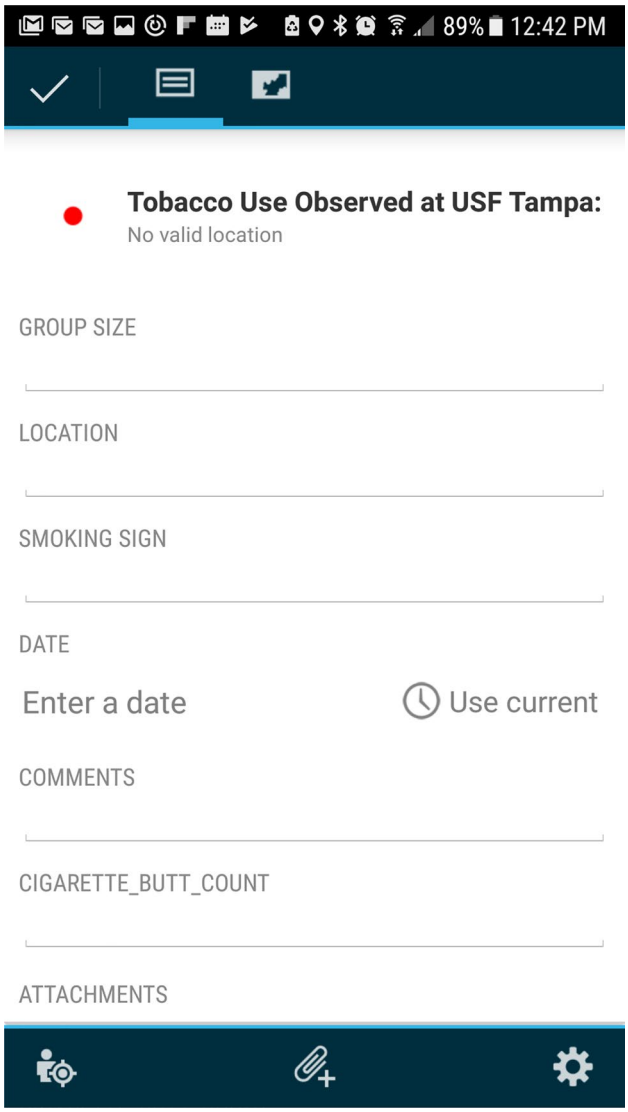

Fig. 1 Visualization of ArcGIS application used by volunteers to collect geospatial points of observed tobacco-free policy violations

Results

Demographics

The survey yielded a 9.3% response rate (n = 5242). After removing incomplete surveys the final sample (n = 4470) for analysis included 200 (4.5%) faculty, 290 (6.5%) staff, and 3980 (89%) students. As depicted in Table 1, the majority of respondents were white, female, non-Hispanic, non-smokers, and affiliated with the university prior to implementation, which is representative of the campus population.

Demographic information was not collected for the ArcGIS observations as it would be assumptive.

Survey

The survey revealed moderate knowledge of the current policy and low beliefs for policy enforcement. Regarding knowledge of policy, 67.5% of respondents correctly identified the USF smoking policy, while 19.6% answered incorrectly, and 12.9% did not know. Community members also expressed a lack of confidence that the policy is being upheld as only 19.6% of survey respondents believed students were enforcing the policy, while 32.8% believed faculty or staff were enforcing the policy. Table 2 details knowledge and beliefs regarding the policy.

Further, approximately half (49.5%) of students, faculty, and staff identified that they were exposed to secondhand smoke following implementation and 74.3% witnessed tobacco use on campus which is illustrated in Fig. 2. Majority of respondents were in the pre-contemplation stage indicating they did not approach the violator to inform them of the policy and had no intention to do so in the future for cigarette use (66.8%), chewing tobacco (79.9%), and e-cigarettes (78.4%), as detailed in Fig. 3. Of those who did not approach smoking violators most had multiple reasons (50.5%), including being unsure if they should address it and being uncomfortable. The survey asked separate, but similar questions for behavior when witnessing tobacco use, behavior when witnessing chewing tobacco use, and behavior when witnessing e-cigarette use. The findings related to behavior when witnessing use were similar for chewing tobacco and e-cigarette use with most participants not approaching violators (72.2% and 72.1% respectively) to enforce the policy. Details for

Table 1 Demographic characteristics of participants (n = 4470)

	Faculty f (%)	Staff f (%)	Students f (%)	Total f (%)
Participants = 5242	200 (4.5%)	290 (6.5%)	3980 (89%)	4470 (100%)
Sex = 4256				
Male	45.1%	24.5%	38.5%	37.9%
Female	54.9%	75.5%	61.5%	62.1%
Ethnicity = 4444				
Non-Hispanic	93.8%	88.9%	83.8%	84.6%
Hispanic	6.2%	11.1%	16.2%	15.4%
Race = 3983				
White	80.3%	75.9%	68.4%	69.5%
AA	2.7%	9.8%	7.1%	7.1%
AI or AN	0%	0%	0.4%	0.4%
Asian	4.8%	2.3%	9.0%	8.4%
Other	9.6%	6.4%	5.4%	5.6%
Multiple races	2.7%	5.6%	9.7%	9.1%
Smoking status = 4424				
Non-smoker	94.8%	94.8%	90.3%	90.8%
Smoker	5.2%	5.2%	9.7%	9.2%
College = (student n = 3960, faculty and staff n = 484)				
AS	41.5%	12.5%	38.7%	31.5%
BCS	17.0%	19.6%	6.6%	9.8%
BUS	9.7%	9.0%	13.6%	11.5%
EDU	5.1%	6.2%	5.8%	5.8%
ENG	10.8%	6.9%	14.2%	11.3%
GS	0%	0.3%	0.5%	0.3%
Honors	2.1%	1.7%	0.1%	1.0%
MS	1.0%	1.7%	0.2%	0.8%
MED	0%	1.4%	2.9%	2.0%
NUR	0.5%	3.8%	1.8%	1.4%
PH	0%	1.4%	3.1%	1.9%
PHARM	0%	1.0%	0.7%	0.7%
More than one college	1.5%	2.1%	5.7%	3.8%
Other	9.2%	38.8%	3.4%	15.1%
Arts	4.1%	2.8%	2.7%	3.0%
Affiliated with University prior to January 2016 = 4467				
Yes	91.4%	86.2%	73.6%	75.2%
No	8.6%	13.8%	26.4%	24.8%

tobacco use, chewing tobacco, and e-cigarette use are in Tables 3 and 4.

There were statistically significant differences between smokers and non-smokers in regard to policy enforcement, beliefs, and knowledge. Nearly 95% of smokers were in pre-contemplation stage of change, or not enforcing the policy and not thinking about doing so, while only 63.9% of non-smokers were in pre-contemplation. Additionally, 31.5% of non-smokers presented in the contemplation stage of change indicating they were thinking about enforcing the tobacco-free policy, compared to 3.7% of smokers. The readiness to change between smokers and non-smokers at the preparation, action, and maintenance stages were roughly the same (χ^2 (5, N = 5242) = 116.98, $p < .001$). Smokers were less likely to believe the tobacco-free campus policy had reduced tobacco use (46.7%) compared to non-smokers (55.3%) (χ^2 (2, N = 5242) = 11.056, $p = .004$). Smokers were also more likely to correctly identify the policy (73.9%) compared to non-smokers (66.8%) (χ^2 (2, N = 5242) = 11.415, $p = .003$). Nearly 24% of smokers believed that students were enforcing the policy, while only 19% of non-smokers believed the policy was being enforced (χ^2 (1, N = 5242) = 5.412, $p = .020$). Along with student enforcement, 39% of smokers believed faculty/staff were enforcing the policy verses 32%

Table 2 Knowledge and beliefs regarding USF smoke and tobacco free policy

	Faculty f (%)	Staff f (%)	Students f (%)	Total f (%)
Knowledge regarding USF smoke and tobacco free policy = 4470				
Smoking is allowed on campus only in designated smoking areas	6.0%	6.2%	9%	8.7%
Smoking not allowed in campus buildings and within 25 feet outside of buildings	0%	0.3%	0.9%	0.8%
Smoking is prohibited everywhere on campus, but smokeless tobacco use is allowed	14.5%	7.6%	10.1%	10.1%
The use of all tobacco products are prohibited on all campus property	74%	80.7%	66.2%	67.5%
I do not know the current tobacco use policy at USF	5.5%	5.2%	13.8%	12.9%
Knowledge of USF policy = 4470				
Correct knowledge	74%	80.7%	66.2%	67.5%
Incorrect knowledge	20.5%	14.1%	20%	19.6%
Don't know	5.5%	5.2%	13.8%	12.9%
Knowledge e-cig considered smoking = 4470				
Yes	78.5%	75.5%	71.7%	72.2%
No	5.5%	7.2%	11.3%	10.7%
Don't know	16%	17.2%	17.1%	17%
Beliefs = 4470				
I believe the policy is being enforced by students on USF campus	22%	20.3%	19.4%	19.6%
I believe the policy is being enforced by faculty/staff on USF campus	22.5%	24.1%	34%	32.8%

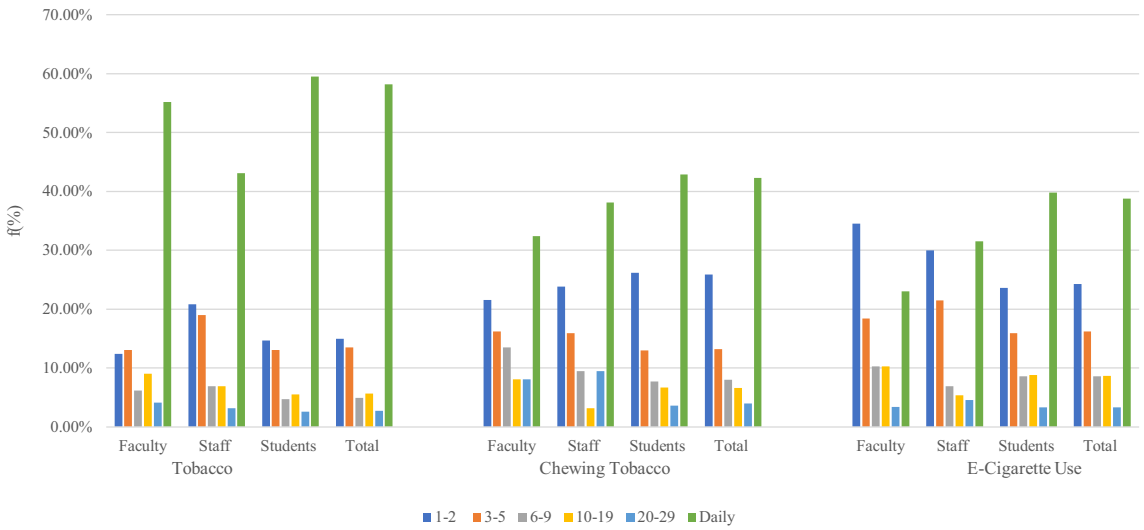

Fig. 2 Number of days tobacco, chewing tobacco and e-cigarette use was observed on campus by faculty, staff, and students

of non-smokers (χ^2 (1, N = 5242) = 8.462, $p = .004$). Table 5 details these differences.

Further, there were statistically significant differences comparing students to faculty and staff. Students were more likely than faculty/staff to be in the pre-contemplation stage of change, 68% and 56.5% respectively. Faculty/staff participants were significantly more likely than students to be in the action stage of change, 11.6% and 1.8% respectively (χ^2 (5, N = 5242) = 134.97, $p < .0001$). Faculty/staff were also more likely to believe the tobacco-free policy reduced tobacco use (64.7%) when compared to students (53.2%) (χ^2 (2, N = 5242) = 147.403, $p < .0001$) and were more likely to correctly identify the policy (78%) (χ^2 (2, N = 5242) = 35.944, $p < .0001$). Students felt as though faculty and staff were enforcing the policy (34%) compared to faculty and staff perception (23.5%) (χ^2 (1, N = 5242) = 21.818, $p < .0001$) and there were no statistically significant differences in perception of student enforcement. Table 6 illustrates these findings.

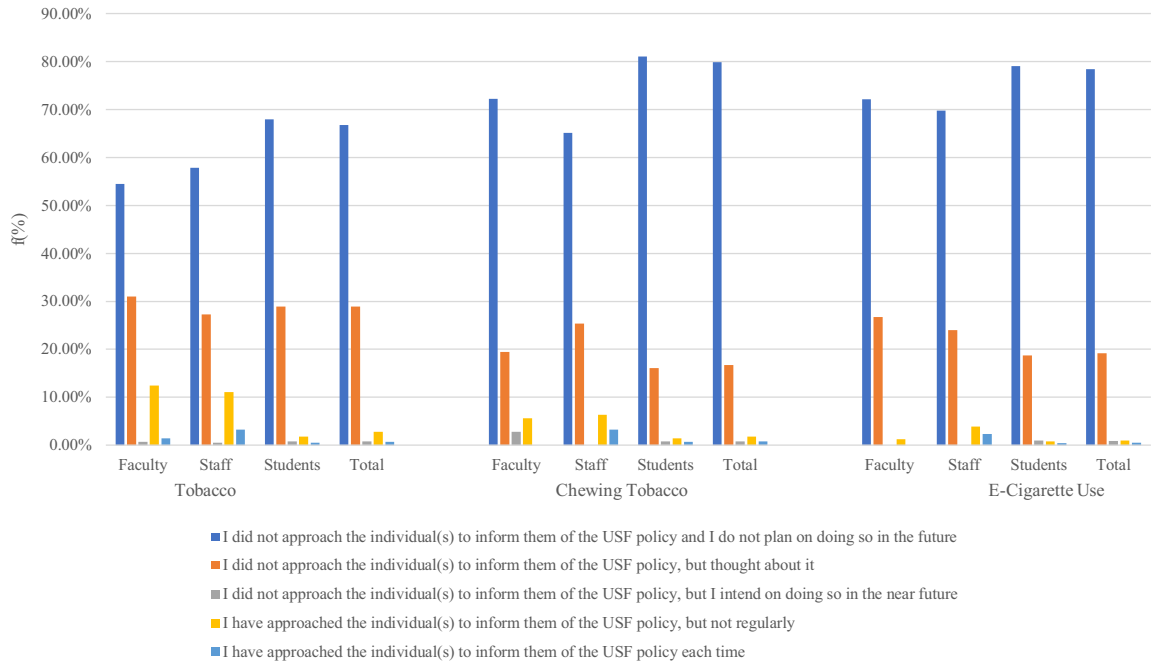

Fig. 3 Respondent behavior when witnessing tobacco, chewing tobacco, and e-cigarette use on campus by faculty, staff, and students

Table 3 Previous 30-day observation of tobacco use violations

	Faculty f (%)	Staff f (%)	Students f (%)	Total f (%)
Exposed to second-hand smoke on USF campus = 4458				
Yes	48.7%	45.5%	49.8%	49.5%
If Exposed, how many days within the last 30 days = 2217				
Yes, 1–2 days	24.5%	30.3%	22.8.4%	23.4%
Yes, 3–5 days	20.4%	15.9%	16.4%	16.5%
Yes, 6–9 days	11.2%	11.4%	9.1%	9.3%
Yes, 10–19 days	11.2%	6.8%	8.0%	8.0%
Yes, 20–29 days	7.1%	3.0%	3.8%	3.9%
Daily	25.5%	32.6%	40.0%	38.9%
Witnessed tobacco use on USF campus within the last 30 days = 4468				
Yes	72.4%	74.5%	74.4%	74.3%
Witnessed chewing tobacco use on USF campus within the last 30 days = 4468				
Yes	18.5%	21.7%	26.1%	25.5%
Witnessed E-cigarette use on USF campus within the last 30 days = 4466				
Yes	43.2%	44.8%	60.5%	58.7%

ArcGIS Mapping

There were 158 observed tobacco free policy violations at USF-Tampa. The mapping of observed violations revealed continued tobacco use on campus. The centralized mean and median suggest that tobacco free policy violations occurred across campus. The directional distribution analysis revealed no clear directional trends indicating that policy noncompliance is not geographically limited. While the map may not have identified any clusters or hotspots the information provides a snapshot of the widespread tobacco policy noncompliance. Figure 4 illustrates these findings.

Discussion

The study evaluated the effectiveness of a large urban university's tobacco free policy one year following implementation filling the void in lack of published evaluations on university tobacco-free policies [7]. From both the geospatial results as well as the survey findings, the current policy is ineffective in reducing tobacco use across campus. Tobacco use was not specific to any location making it difficult to target "hot spots" unlike findings by other tobacco-free studies [21–23].

The survey results revealed fair knowledge of the policy, but there continues to be room for improvement. This is apparent, as more faculty and staff were correctly able to identify the policy than students. As student turnover at universities occurs yearly it would be beneficial to have a comprehensive plan to educate all incoming students on the policy and remind all current students of the policy. Further, as the current policy is built on a peer-enforcement model there is a complete disconnect from what the policy asks of campus members and what they are willing to do. Majority

Table 4 Reasons and factors for informing violators of the USF policy

	Faculty f (%)	Staff f (%)	Students f (%)	Total f (%)
Reasons for not approaching individual(s) to inform them of the USF policy when a tobacco violation was observed = 3270				
Was not sure if the individual was really in violation of the policy	1.5%	1.0%	3.0%	2.8%
Wasn't sure if I had the authority to address the issue	5.1%	6.5%	4.7%	4.9%
Did not know what to say	2.2%	1.0%	0.8%	0.8%
Thought the person would get upset	2.2%	5.5%	1.9%	2.1%
I was not comfortable	14.6%	18.4%	10.5%	11.2%
I notified someone else to address the issue	0.7%	0.0%	0.3%	0.3%
Other	38.7%	28.4%	26.9%	27.5%
More than one reason	35.0%	39.3%	52.0%	50.5%
Factors that would make it more comfortable to approach a tobacco violator = 3321				
Training on the policy and how to approach tobacco users	2.8%	2.8%	1.5%	1.6%
Training on how to deal with uncomfortable situation(s)	0.0%	0.0%	1.4%	1.2%
Observing other peer(s) approach violator(s)	3.4%	7.4%	5.6%	5.7%
More information on the consequences of not following the policy	6.2%	6.9%	7.0%	7.0%
Seeing more tobacco free signage visible across campus	6.9%	13.0%	13.7%	13.4%
Other	42.1%	34.7%	32.5%	33.0%
More than one factor	38.6%	35.2%	38.3%	38.2%
Reasons for not approaching individual(s) to inform them of the USF policy when a chewing tobacco violation was observed = 1119				
Was not sure if the individual was really in violation of the policy	11.4%	1.6%	8.8%	8.5%
Wasn't sure if I had the authority to address the issue	2.9%	9.8%	5.1%	5.3%
Did not know what to say	0.0%	6.6%	2.4%	2.6%
Thought the person would get upset	2.9%	6.6%	1.9%	2.1%
I was not comfortable	14.3%	13.1%	11.2%	11.4%
I notified someone else to address the issue	0.0%	0.0%	0.6%	0.5%
Other	40.0%	32.8%	31.9%	32.2%
More than one reason	28.6%	29.5%	38.1%	37.4%
Factors that would make it more comfortable to approach a chewing tobacco violator = 1142				
Training on the policy and how to approach tobacco users	2.7%	1.6%	3.3%	3.2%
Training on how to deal with uncomfortable situation(s)	0.0%	0.0%	1.2%	1.1%
Observing other peer(s) approach violator(s)	0.0%	6.3%	5.9%	5.7%
More information on the consequences of not following the policy	5.4%	14.3%	8.6%	8.8%
Seeking more tobacco free signage visible across campus	16.2%	4.8%	15.6%	15.1%
Other	45.9%	39.7%	38.7%	39.0%
More than one factor	29.7%	33.3%	26.7%	27.1%
Reasons for not approaching individual(s) to inform them of the USF policy when an E-cigarette violation is observed = 2580				
Was not sure if the individual was really in violation of the policy	8.1%	7.5%	10.7%	10.4%
Wasn't sure if I had the authority to address the issue	5.8%	10.0%	4.1%	4.4%
Did not know what to say	4.7%	2.5%	2.4%	2.5%
Thought the person would get upset	2.3%	1.7%	1.9%	1.9%
I was not comfortable	15.1%	17.5%	11.4%	11.8%
I notified someone else to address the issue	1.2%	0.8%	0.3%	0.4%
Other	36.0%	26.7%	27.5%	27.8%
More than one reason	26.7%	33.3%	41.7%	40.9%
Factors that would make it more comfortable to approach an E-cigarette violator = 2627				
Training on the policy and how to approach e-cigarette users	4.6%	3.1%	2.7%	2.8%
Training on how to deal with uncomfortable situation(s)	0.0%	0.8%	1.2%	1.2%
Observing other peer(s) approach violator(s)	3.4%	4.6%	7.3%	7.0%
More information on the consequences of not following the policy	8.0%	13.1%	8.6%	8.8%

Table 4 (continued)

	Faculty f (%)	Staff f (%)	Students f (%)	Total f (%)
Seeing more tobacco free signage visible across campus	12.6%	13.1%	15.4%	15.2%
Other	44.8%	36.2%	34.5%	34.9%
More than one factor	26.4%	29.2%	30.2%	30.0%

Table 5 Differences between smokers and non-smokers

	Smoker f (%)	Nonsmoker f (%)	Chi-square	*p* Value
Participants (n = 5242)				
Respondent behavior when witnessing tobacco use				
Do not approach individuals about the tobacco free policy and don't plan on doing so in the near future (precontemplation)	94.6%	63.9%	116.983	< .0001
Do not approach individuals about the tobacco-free policy but have thought about it (contemplation)	3.7%	31.5%		
Do not approach individuals about the tobacco-free policy, but intend to start within the next month (preparation)	0.3%	0.8%		
Have been approaching individuals about the tobacco-free policy, but not regularly (action)	0.7%	3.0%		
Have been approaching individuals about the tobacco-free policy each time (maintenance)	0.7%	0.7%		
I believe the tobacco-free policy has reduced tobacco-use				
Yes	46.7%	55.3%	11.056	.004
No	50.3%	40.5%		
Don't know	3.0%	4.1%		
Knowledge regarding smoke and tobacco free policy				
Correct	73.9%	66.8%	11.415	.003
Incorrect	18.0%	19.8%		
Don't know	8.1%	13.4%		
I believe the policy is being enforced by students on campus				
Yes	23.9%	19.1%	5.412	.020
No	76.1%	80.9%		
I believe the policy is being enforced by faculty/staff on campus				
Yes	39.2%	32.1%	8.462	.004
No	60.8%	67.9%		

of students, faculty, and staff stated that they currently do not approach violators about the tobacco-free policy and they do not intend to in the near future for multiple reasons, including they were uncomfortable or they thought the other person would get upset.

A study on college tobacco policy compliance found successful policy implementation includes both education and enforcement [16]. As the current enforcement model is ineffective, supported by the ArcGIS mapping and current stage of change among student, faculty, and staff, it should be reconsidered. As universities implement tobacco-free campus policies they should consider the readiness for their community to change during the policy development stage. While there was strong institutional support for a 100% tobacco-free campus policy, this study finds that student, faculty, and staff enforcement may be ineffective by implementing a policy *without* providing community members with the knowledge and skills to safely and effectively enforce the policy. If the university cannot empower community members to actively enforce the policy, aligning with the action and maintenance stages of the TTM, then outside enforcement may be more effective. This study informed policy revision and environmental changes made to the USF campus. Continued review will be implemented to assess the impact of revised policy enforcement and additional signage.

Limitations

While the location for observation hours were randomized, times were not able to be randomized due to schedule limitations of volunteers, and volunteers were asked to only collect data during daylight hours for safety concerns. There were

Table 6 Differences between students and faculty/staff

	Student f (%)	Faculty/staff f (%)	Chi-square	*p* Value
Participants (n = 5242)				
Respondent behavior when witnessing tobacco use				
Do not approach individuals about the tobacco free policy and don't plan on doing so in the near future (precontemplation)	68.0%	56.5%	134.970	< .0001
Do not approach individuals about the tobacco-free policy but have thought about it (contemplation)	28.9%	28.8%		
Do not approach individuals about the tobacco-free policy, but intend to start within the next month (preparation)	0.8%	0.6%		
Have been approaching individuals about the tobacco-free policy, but not regularly (action)	1.8%	11.6%		
Have been approaching individuals about the tobacco-free policy each time (maintenance)	0.5%	2.5%		
I believe the tobacco-free policy has reduced tobacco-use				
Yes	53.2%	64.7%	147.403	< .0001
No	44.0%	22.3%		
Don't know	2.8%	13.0%		
Knowledge regarding smoke and tobacco free policy				
Correct	66.2%	78.0%	35.944	< .0001
Incorrect	20.0%	16.7%		
Don't know	13.8%	5.3%		
I believe the policy is being enforced by students on campus				
Yes	19.4%	21.0%	0.685	.399
No	80.6%	79.0%		
I believe the policy is being enforced by faculty/staff on campus				
Yes	34.0%	23.5%	21.818	< .0001
No	66.0%	76.5%		

a relatively small number of volunteers to collect violation data in comparison to the size of the campus. The violation map would be more accurate with a greater number of volunteers and volunteer hours. There was a limit to the information available on violators, including campus role or age, as volunteers could not approach violators or collect identifying information. The ArcGIS observations may not take into account violations of smokeless tobacco use as cigarette butts or smoking can be physically seen while smokeless tobacco leaves little observation evidence of use or disposal. Lastly, while this cross-sectional study collected responses from a large sample of community members, it was a convenience sample. The survey was sent via email and there may be differences among those who completed it and those who did not.

Conclusion

There are myriad strategies for enforcement and as more institutions evaluate the effectiveness of their policy, the best practices should emerge [16, 22, 30]. With 68% of university presidents identifying enforcement issues as a major institutional barrier to the effectiveness of tobacco-free campus policies, this is an area for additional research [31]. This evaluation successfully identifies if and where tobacco use is continuing on campus and sheds light on community perception regarding the policy and the stages of change towards enforcement. While the evaluation was specific to the University of South Florida's Tampa campus, the methods used for evaluation could be used at any higher learning institution with a tobacco-free policy. The evaluation techniques are easily replicable for use on other college campuses in order to determine smoking patterns and policy violations via geospatial data collection and beliefs and perceptions by survey to community members. With rapidly increasing numbers of smoke- and tobacco-free universities, new and innovative evaluation tools are needed so institution leaders can efficiently evaluate their implementation.

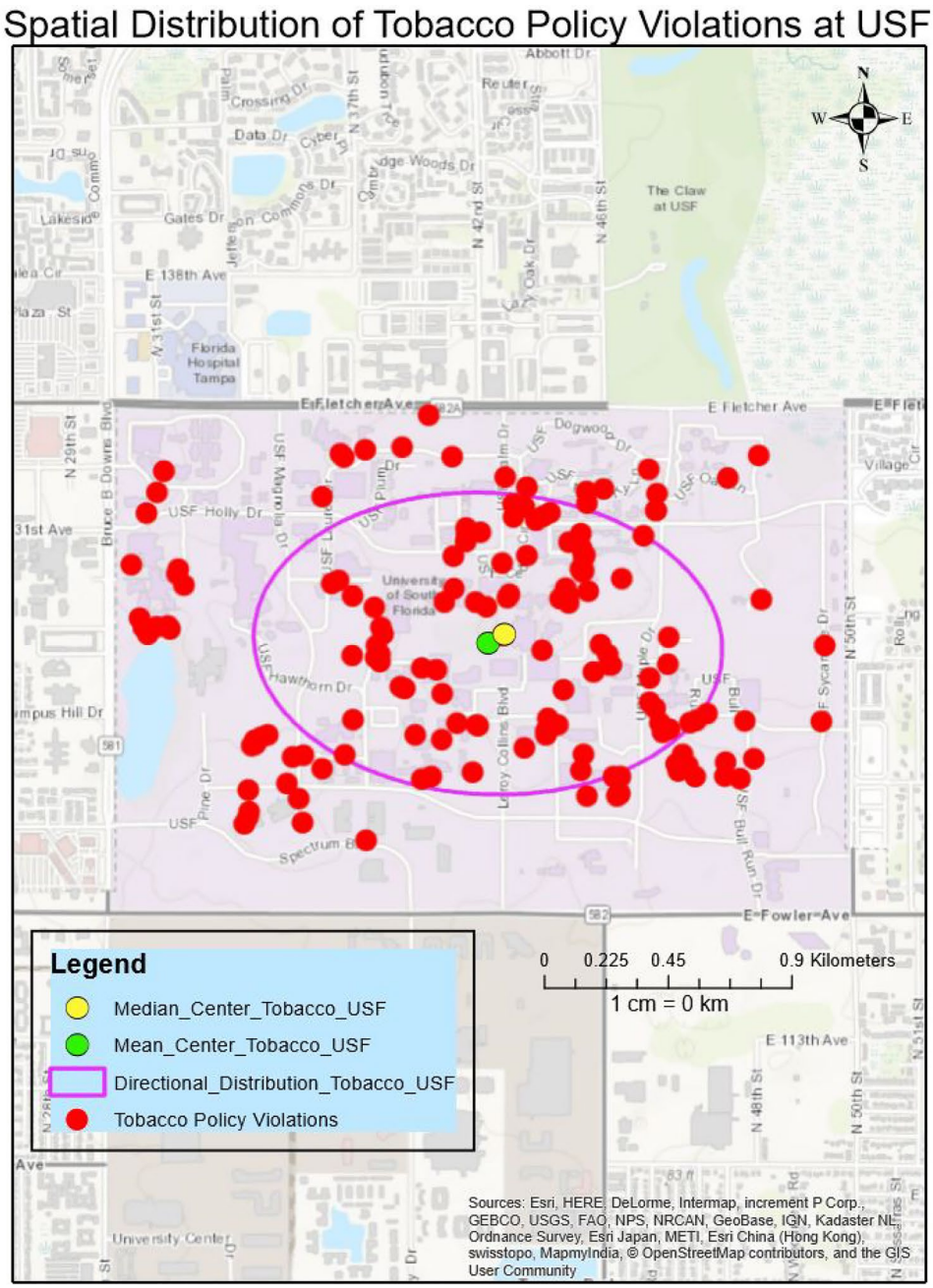

Fig. 4 Spatial distribution map of tobacco-free policy violations observed on USF main campus

Compliance with Ethical Standards

Conflict of interest The authors have no conflict of interest to disclose.

Ethical Approval This study was performed according to legal and ethical guidelines of the US and approval was granted by the Institutional Review Board of the university.

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