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Sentinel Surveillance of Vaping and Emerging Nicotine Product Use among University Students: Protocol for a Longitudinal Cohort

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Study protocol

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Abstract

Background

The rapid evolution of nicotine delivery systems is reshaping substance use patterns among young adults globally. In Australia, despite strict tobacco control policies, the proliferation of disposable vapes, nicotine pouches, and other nicotine products remains a concern, particularly among young adults. National surveys provide valuable insights but lack the frequency and granularity needed to detect emerging products and behavioural shifts in young people, aged 18–25. Agile, context-specific surveillance systems are urgently required to identify evidence for actionable interventions.

Method

This protocol describes a sentinel surveillance programme to monitor vaping and emerging nicotine product use among university students aged 18–25 years in Melbourne, Australia. Semesterly cross-sectional surveys will be conducted at selected campus events and health service clinics, supported by trained Student Wellbeing Champions. Survey instruments will be updated twice yearly to capture emerging trends. A longitudinal cohort will enable twice yearly follow-up to examine behavioural trajectories and psychosocial determinants. Data will include prevalence, emerging products, attitudes, and campaign exposure using validated instruments adapted from national studies.

Discussion

The study introduces a novel application of sentinel surveillance within a university setting, addressing a critical gap in Australia's monitoring systems. By embedding surveillance within health promotion initiatives, the programme will generate timely, actionable evidence to inform cessation strategies, policy evaluation, and harm-reduction efforts. The approach is scalable and aligns with global priorities for adaptive nicotine control surveillance to support public health action on youth and young adult vaping.

Background

Over the past decade, worldwide nicotine consumption has changed dramatically (1). The use of electronic cigarettes (e-cigarettes), and other non-combustible nicotine products (e.g., nicotine pouches, gummies), have surged, driven by aggressive marketing, flavour diversification, and youth-targeted digital promotion (2, 3). These products have introduced new forms of nicotine dependence, increased dual use with combustible tobacco, and heightened exposure to unregulated substances, creating significant public health concerns (4). This rapid diversification has outpaced traditional monitoring systems, leaving critical gaps in policy and prevention efforts.

International surveillance data show a rise in vaping prevalence, particularly among young adults. In the United States, the *Behavioural Risk Factor Surveillance System* (BRFSS) reported that in 2021, 18.6% of adults aged 18–24 used e-cigarettes, with 9% reporting daily use, higher than in previous survey years (5). Similarly, in England, exclusive use of a single nicotine product category tripled, and multiple-product use doubled between 2013 and 2023 (6). Comparable trends have been observed across Malaysia, (7) Canada, (8), the United Arab Emirates (9), and Australia (10, 11).

Young adults show the highest prevalence of e-cigarette use (1). Social media and youth-oriented digital marketing strongly influence initiation and continuation among young people (3). Product diversification, flavours, and marketing innovation also drive use (12). Prevalence is highest among males and often characterised by dual or multiple product use (5, 13–15). There are strong associations between vaping and concurrent substance use (5), including cannabidiol use (16).

Understanding of the harms associated with e-cigarette use and dual use is increasing. Risks include nicotine addiction, poisoning, and toxicity from inhalation (including seizures) (17). Adverse effects on cardiovascular health (blood pressure, heart rate) and lung function have also been reported (17, 18). Non-smoking young people who use e-cigarettes are about three times as likely as non-users to start tobacco smoking and to become regular smokers (17). Daily e-cigarette use has been associated with elevated risks of myocardial infarction, stroke, and depressive symptoms in adult cohorts (19, 20). Among young adults, vaping has been linked to sleep deprivation and chronic stress (21), highlighting psychosocial and physical health impacts. These findings underscore that vaping among youth and young adult cohorts is not a benign behaviour; it is consistently associated with stress, sleep disturbance, and other psychosocial risk factors that are particularly pronounced in these age groups (4).

Together this evidence highlights a need for adaptive surveillance models capable of detecting emerging nicotine products and behavioural shifts in real time. Public health surveillance aims to systematically collect, analyse, and interpret data for action (22). Internationally, survey-based programs such as BRFSS (United States), (5) ITC (International Tobacco Control Surveys), (7) and CHMS (Canadian Health Measures Survey) (8) have been instrumental in tracking smoking and vaping trends. However, these nationally representative systems are often cross-sectional and infrequent. They rarely disaggregate data for specific high-risk groups such as university students, First Nations youth, or LGBTQIA + communities and cannot account for policy influences across jurisdictions (23). Their infrequency and lack of granularity render them ill-suited to monitoring fast-moving trends among high-risk subgroups (22, 24).

In Australia, data from nationwide surveys as the *National Drug Strategy Household Survey* (10) and Generation Vape studies (25) provide prevalence estimates from cross-sectional, national samples, but they are blunt tools that lack the capacity to identify emerging products or rapid shifts in device use. They don’t provide setting-specific prevalence or behavioural data, limiting their utility in settings like universities (13). One longitudinal study, the Child to Adult Transition Study 2015 to 2023, offers rare

insight into the progression of e-cigarette use, dual use, and transitions to smoking in Australia (26), however, the scarcity of repeated-measures data constrains timely policy and health promotion responses.

To address these gaps, sentinel surveillance offers a pragmatic solution, able to provide timely, context-specific data while avoiding the resource demands of full-scale cohorts (22, 27). Unlike national surveys that seek population representativeness, sentinel systems focus on repeated data collection from strategically selected sites to detect emerging trends (27, 28). They have proven effective for both infectious disease monitoring and behavioural surveillance, offering agility and local relevance (27, 28). This approach aligns with contemporary calls for embedded monitoring systems that integrate prevention with research (24).

This need is particularly acute in jurisdictions like Australia, where regulatory frameworks are stringent but enforcement remains porous. In Australia, nicotine vaping products can only be legally purchased in pharmacies (ostensibly for smoking cessation (29)), but enforcement challenges persist due to online and illicit supply chains that undermine control efforts. Recent data suggest adolescent vaping prevalence in Australia has plateaued, with Generation Vape wave 8 reporting 85.4% never vaped and frequent use falling from 5.7% to 4.3% (11). Australia's prescription and pharmacy based regulatory model, tightened further in 2024, has achieved only partial success in limiting access to e-cigarettes and other nicotine products, as online and social channels continue to distribute unregulated products (30). Consequently, young adults in Australia are highly exposed to e-cigarettes that circumvent formal regulatory and safety restrictions (31).

In Australia, more than half (54%) of all school leavers enrol in a university course within one year of completing secondary education (32), making universities an ideal setting for sentinel surveillance and research involving young adult populations. At Monash University, Australia's largest university, a survey of 1094 students across four metropolitan campuses, found that 13.1% of young adult respondents currently used e-cigarettes, with 7.6% reporting daily use and 26.8% reporting ever use (13). These findings demonstrate both the feasibility of campus-based surveillance and the urgency for targeted monitoring to inform health promotion and cessation strategies. Australian universities offer unique opportunities for prevention and cessation support through health services and wellbeing programmes. However, the absence of granular, real-time data on vaping patterns and uptake of emerging nicotine products limits institutions' capacity to tailor interventions, evaluate campaign reach, and contribute effectively to harm-reduction efforts.

Aims and objectives

This study aims to 1) establish a sentinel surveillance system to monitor patterns of use, emerging nicotine products, and key behavioural determinants (e.g., attitudes, intentions, perceived risks). Among Monash University students aged 18–25 years, and 2) develop a longitudinal cohort enabling twice

yearly data collection to detect trends in nicotine product use, social attitudes toward vaping, and predictors of initiation and cessation over time.

Findings will provide timely, context-specific evidence to inform policy development, enable rapid identification of emerging nicotine products, and support tailored cessation strategies through university health services and wellbeing programmes. By embedding surveillance within Monash's health promotion infrastructure, this protocol addresses the need for adaptive, youth-centred monitoring that can keep pace with the dynamic nicotine market and support proactive public health responses.

Methods

Study Design

This study adopts a sentinel surveillance framework informed by principles of behavioural epidemiology and health promotion evaluation (33). Sentinel surveillance is a targeted, systematic approach to data collection from selected sites or subpopulations, enabling early detection of emerging public health issues and timely response (22, 27). This design was chosen over a full cohort approach due to its feasibility, cost-efficiency, and ability to provide timely, context-specific data on emerging products.

The surveillance will be embedded within the VicHealth-funded UNCLOUD campaign, which aims to reduce vaping-related harm among young adults through peer-to-peer awareness, education, and prevention and cessation messaging. Integrating ongoing data collection within a health promotion initiative aligns with the core principles of contemporary public health surveillance, which emphasises systematic, continuous collection, analysis and interpretation of data to guide timely prevention and control action (34).

A repeated cross-sectional design will be used, together with the capacity for longitudinal linkage to assess population trends and changes in individual attitudes and behaviours over time. This mixed temporal structure balances feasibility with analytical depth, providing both cross-sectional and cohort-level insights.

Ethics approval and consent to participate

The study was reviewed and approved by the Monash University Human Research Ethics Committee (MUHREC) on 21 August 2025**.**

Setting and Participants

The programme will be implemented across Monash Universities metropolitan campuses in Victoria, Australia. Monash is Australia's largest university with a student population of ~83,000 students enrolled across four metropolitan campuses (35). These campuses represent diverse faculties and demographics, providing a robust sampling frame for students aged 18–25 years.

This population is prioritised due to the high prevalence of nicotine and vaping product use among young adults (13) and its significance as a developmental stage characterised by experimentation, stress exposure, and health behaviour formation. University campuses offer accessible environments for data collection and health promotion, supported by existing wellbeing and clinical infrastructure.

The sentinel surveillance system will collect data at multiple time points (waves) between Semester 2 2025 and Semester 1 2028. Each wave will involve a short, anonymous online survey distributed at high engagement student events (e.g., those organised by student representative bodies, Monash Residential Services, Monash Sport) and through University Health Service (UHS) clinics. Each event or clinic site will function as a sentinel data collection point (examples of events are included in Table 1).

Participant Groups

Group 1: Campus-based participants
Students will be approached by trained *Student Wellbeing Champions* during campus events in collaboration with student unions and other stakeholders. Sentinel sites will be selected based on event type, expected attendance, and faculty representation to maximise coverage. Students will be invited to complete a short online survey accessed via QR codes displayed at engagement stalls or provided during roving discussions.

Group 2: Clinic-based participants
Eligible students attending Monash University Health Services will be invited by nursing staff to complete the same online survey while waiting for their appointment, including those attending for vaccination requirements related to clinical placements.

Participants in Group 1 will receive a $5 cafe voucher on survey completion, while the health service will receive $5 for each patient recruited (Group2). Both groups may opt into a prize draw for a $250 e-gift card each semester by providing a valid email address and consenting to future follow up.

Eligibility Criteria

- Enrolled Monash University student
- Aged 18–25 years
- Able to provide informed consent
- Access to a mobile device or computer to complete the survey

Participation is voluntary and will not affect access to university health or support services. Completion of surveys is not linked to course credit or academic requirements.

Sample Size

Based on prior surveys using similar methodology (3), we anticipate a minimum of 500 completed surveys per semester. Over six planned waves, the cumulative dataset will exceed 3,000 observations, enabling robust analysis of trends and subgroup comparisons. We expect approximately 50% of participants to enrol in the longitudinal cohort contributing several thousand additional data points over time. Retention strategies will include reminder emails and entry into additional prize draws for follow-up completion.

Data Collection

A brief, structured online 'pulse' survey will be used to collect data (see *Supplementary File 1*). The survey will be created and administered using Qualtrics™, and completed on a smartphone. Pilot testing indicates completion typically takes less than three minutes, making it ideal for field work and campus events. The survey will capture:

1. **Demographics:** age, gender, Indigenous status, residency status, and faculty of enrolment
2. **Nicotine product use:** current and past 30-day use of e-cigarettes, heated tobacco, pouches, and other products
3. **Product awareness:** exposure to emerging products (e.g., disposable vapes, gummies)
4. **Attitudes and intentions:** perceived risk, intention to quit or initiate use
5. **Campaign exposure:** recognition and perceived influence of the UNCLOUD campaign video
6. **Unique Participant ID:** six-digit random identifier auto-generated by Qualtrics to enable de-identified longitudinal linkage

The survey was adapted from validated instruments used in the *Generation Vape* and *ITC Australia* studies and pilot tested with a small sample of students to ensure clarity, accessibility, and logical flow.

Data Management and Confidentiality

Data will be stored on secure Monash University servers, accessible only to the research team. Identifiers will be encrypted and stored separately from survey responses to maintain confidentiality. All data will be de-identified at point of collection. Unique participant IDs will enable longitudinal linkage without storing personal identifiers. Email addresses for prize draws and follow-up will be stored in a separate password protected file.

Data from each survey wave will be exported from Qualtrics into SPSS (version 29) and Stata (version 18) for analysis. The final dataset will include responses from all sentinel sites, with each record representing one participant per wave. Participants who provide consent to recontacted will be assigned a unique, de-identified code to allow longitudinal linkage across waves.

Data preparation

Prior to analysis, data will be checked for completeness, consistency, and duplicate entries. Variables will be cleaned and recoded to ensure comparability across waves. Responses will be categorised into key behavioural indicators such as current (past 30 day) use of nicotine or other emerging products. Campaign awareness, perceived risks, and attitudes toward vaping will also be summarised. Missing or incomplete responses will be documented. Complete case analysis will be used for descriptive summaries; for longitudinal models, multiple imputation or maximum likelihood estimation will be considered under missing at random assumptions. Sensitivity analyses will assess potential bias due to attrition. Analyses will remain adaptive to data characteristics and emerging trends, with alternative statistical approaches considered as appropriate.

Descriptive analysis

Descriptive statistics will summarise sample characteristics and vaping behaviours. Frequencies and proportions will be calculated for categorical variables (e.g., gender, age group, faculty, campus), while means and standard deviations will describe continuous measures such as age or perception scores. For non-normally distributed, medians and interquartile ranges will be reported, and non-parametric tests will be applied where appropriate. Prevalence estimates for current (past 30 day) vaping and emerging product use will be reported with 95% confidence intervals for each wave. Visual summaries (e.g., stacked bar charts, line graphs, heatmaps) will illustrate product diversification and trends over time.

Comparative analysis

Differences in key outcomes including current vaping, susceptibility, campaign awareness, and attitudes, will be examined across socio-demographic groups using chi-square tests for categorical variables. Independent t-tests or Mann–Whitney U tests will be applied for continuous variables, depending on distribution. Ordinal outcomes (e.g., frequency of use, attitudes) will be analysed using appropriate non-parametric or ordinal regression methods where assumptions for parametric tests are not met. For multiple comparisons, adjusted p-values (e.g., Bonferroni) will be applied. Susceptibility will be classified using validated intention, curiosity, and willingness-to-try items.

Multivariable analysis

Predictors of current vaping, susceptibility, and product diversification will be assessed using multivariable logistic regression models. Adjusted odds ratios and 95% confidence intervals will be reported. For product type (e.g., exclusive vaping vs dual use vs multiple products), multinomial logistic regression will be employed. Predictor variables will be selected based on theoretical relevance and bivariate associations ($p<0.20$). Multicollinearity will be assessed using Pearson correlations for

continuous variables, Spearman rank correlations for ordinal variables, and Cramér's V or Phi coefficients for categorical predictors. Variance Inflation Factors (VIFs >5 or Tolerance <0.2) will indicate potential collinearity. Corrective strategies such as removing correlated variables or combining conceptually similar predictors will be applied as needed.

Trend analysis across waves

Repeated cross-sectional comparisons will assess changes in vaping prevalence, attitudes, and campaign awareness across waves. Regression models will evaluate whether changes are statistically significant over time. Results will be presented as trends with graphical summaries showing progression between Semester 2, 2025, and Semester 1, 2028.

Longitudinal analysis

For participants completing surveys in multiple waves, longitudinal analyses will explore changes in vaping behaviour and campaign exposure. Incidence of vaping in cases among non-users will be determined, and risk factors for initiation assessed. Mixed-effects models will account for repeated measures within individuals, including random intercepts for participants and fixed effects for time and demographic co-variates. Mixed-effects logistic regression will be used for binary outcomes (e.g., current use), and linear mixed models for continuous outcomes (e.g., attitude scores). Analyses will be conducted using Stata (version 18.)

Emerging Product Detection

Free-text responses will be coded using a dynamic framework to capture new products. A flag variable will indicate "new product reported" to track innovation trends across waves.

Reporting

A descriptive summary of key findings will be provided at the end of each semester on the study website (https://www.monash.edu/medicine/sphpm/general-practice/amplifying-the-uncloud-campaign) and reported to key stakeholders. Findings of comparative analyses, multivariable analyses, trend analyses, and longitudinal analyses will be presented at relevant conferences and published in peer reviewed literature. Reporting will follow STROBE guidelines.

Discussion

This protocol presents a novel application of sentinel surveillance to monitor vaping and emerging nicotine product use among young adults in a university setting. By embedding surveillance within health promotion initiatives, the study generates timely, actionable evidence. It operationalises principles of

behavioural epidemiology and translational public health to address a critical gap in monitoring systems, which currently lack the frequency and contextual specificity needed to detect rapid shifts in product use and attitudes among high-risk populations.

The proposed sentinel surveillance system offers several strengths, including timeliness, feasibility, and integration with an existing health promotion initiative. Semesterly data collection enables rapid identification of emerging nicotine products and behavioural shifts often missed by infrequent national surveys. Embedding surveillance within the UNCLOUD campaign enhances visibility, trust, and translational impact by linking evidence generation with immediate prevention action. In addition, a Community of Practice with other partners funded through this scheme provides a pathway for rapid dissemination and coordinated responses to emerging threats to young people's health.

However, limitations must be acknowledged. Reliance on self-reported data introduces potential recall and social desirability bias, while recruitment at campus events and clinics may lead to self-selection and underrepresentation of students who do not engage with these settings. Incentives could also influence participation patterns. These risks will be mitigated through the option of anonymous data collection, multi-site sampling across diverse faculties, and comparison with national datasets to assess representativeness. Longitudinal retention challenges will be addressed through reminder strategies, regular contact, and additional incentives for follow-up completion.

Findings from this surveillance system will have direct implications for policy, health promotion, and service delivery. By generating timely, context-specific data, the study will enable Monash University Health Services, VicHealth, and other partners like Quit Victoria, to tailor cessation strategies and evaluate harm-reduction campaigns in real time. At a broader level, the data could inform national policy under Australia's prescription-based regulatory framework, providing evidence to assess enforcement gaps and anticipate emerging product trends.

Beyond the university setting, this model demonstrates scalability and adaptability. Sentinel surveillance can be replicated across other tertiary institutions, drawing on the collective impact model, and Community of Practice, advanced by VicHealth. Such an approach aligns with global calls for agile, locally embedded monitoring systems capable of responding to the rapidly evolving nicotine market and supporting proactive public health action (24).

This programme will generate a rich dataset that extends beyond prevalence monitoring to explore behavioural trajectories and psychosocial determinants of vaping among young adults. The design is flexible and adaptive, allowing for incorporation of new threats into future survey waves. The longitudinal cohort will enable identification of risk factors for initiation and cessation, informing the design of targeted interventions and digital health strategies.

The study addresses a key gap in Australia's public health monitoring and, internationally, contributes to the growing discourse on adaptive surveillance systems for nicotine and vaping products. By demonstrating the feasibility of sentinel surveillance in a university setting, the study offers a replicable

model for other jurisdictions seeking agile, context-specific approaches to youth nicotine monitoring. These innovations align with World Health Organisations (WHO) recommendations for strengthening tobacco control surveillance and support global efforts to mitigate the health and social harms associated with vaping (36).

Conclusion

Despite Australia's strong tobacco control framework, nicotine and vaping product use among young adults remains high, driven by product diversification, digital marketing, and social normalisation. This protocol introduces a sentinel surveillance system embedded within a health promotion initiative to generate timely, context-specific data. Findings will inform cessation strategies, policy evaluation, and harm-reduction efforts. The approach is scalable, offering a template for other tertiary institutions and aligning with global priorities for adaptive nicotine control surveillance.

Declarations

No relevant conflicts to declare.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The project was conceptualised and funding gained by CB, MS, HW, SK, KT, IR.

MA drafted the initial version of the study protocol. IP prepared the first draft of the manuscript. CB and MS provided substantial input and feedback into the study design. HW, SK, KT, and IR provided critical feedback and review of the study protocol. All authors read and approved the final manuscript.

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Generative Artificial Intelligence (GenAI) tools were used to support the development of this manuscript in accordance with Monash University guidelines for responsible research practice. Specifically, custom configured AI Agents within Microsoft365 were employed to assist with data analysis planning and manuscript editing. GenAI was used to improve clarity, conciseness, and alignment with scientific writing conventions and journal author guidelines. All content was reviewed, verified, and approved by the authors to ensure accuracy and integrity.

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Tables

Table 1

Examples of Sentinel Sites

Event	Campus	Date	Type	Estimated Attendees*
One World Festival	Parkville	Aug 2025	Student Festival	300
Monash Student Association Breakfast Club	Clayton	26 Aug 2025	Wellbeing Event	100
Monash Student Union Mid-week BBQ	Caulfield	17 Sep 2025	Student Association Event	350
Monash Residential Services Food Festival	Clayton	18 Sep 2025	Pop-up Stall	1500
University Health Services clear the air Vaping awareness week	Clayton	7 Oct 2025	Health Promotion Event	150
Pancake Breakfast	Peninsula	10 Oct 2025	Student Wellbeing	100
Total				2,500

* Estimated number of attendances based at these events in Semester 2 2025 – personal communication Monash Student Association.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1S22025Survey.pdf