VapeSafe: Device and Multi-Factor App to Prevent Nicotine Poisoning via Real-Time Behavioral Analysis and Alternate Compound Identification

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There has been a 200-fold increase in nicotine poisoning-related hospitalizations over the past decade which can be attributed to the rising popularity of vaping. This study investigates how emotional and physical manifestations of nicotine poisoning can be detected to develop a real-time intervention framework named VapeSafe. The e-cigarette abuse indicators selected for monitoring are extreme mood swings and elevated vital signs. By collecting 3.6-million tweets and training 6 Artificial-Intelligence models, a dual-model-based algorithm to detect an emotional fluctuation was built and evaluated. The final algorithm had a 96.0% accuracy and was implemented into the VapeSafe app to monitor a teen's outgoing SMS messages for an extreme mood swing. Next, a personalized noninvasive vital sign measurement method was developed by training a regression model from National-Heart-Lung-and-Blood-Institute data. The app calculates a comprehensive score based on these emotional/physical indicators of nicotine abuse, and if the score surpasses a threshold, the VapeSafe device intervenes by switching from releasing traditional e-cigarette liquid to a safer compound. Two experimental compounds, vanillin and menthol, were evaluated for potential lung damage and thermal degradation. Through creation of synthetic lung tissue and analysis of tissue permeation, this study concludes that vanillin caused a significantly lower amount of lung damage in comparison to vape liquid. Additionally, GC/MS analysis displayed that vanillin has low thermal degradation potential. Therefore, this study establishes that vanillin is a viable alternate compound. VapeSafe is the first framework to detect e-cigarette abuse in real-time and intervene, presenting a novel solution to prevent nicotine poisoning.

Awards Won:
Third Award of $1,000