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Cotinine Testing as a Component of Screening for Tobacco use in a Pediatric Hospital

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Abstract

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Keywords

Cotinine, tobacco use, nicotine use, pediatric, nicotine replacement therapy, vaping

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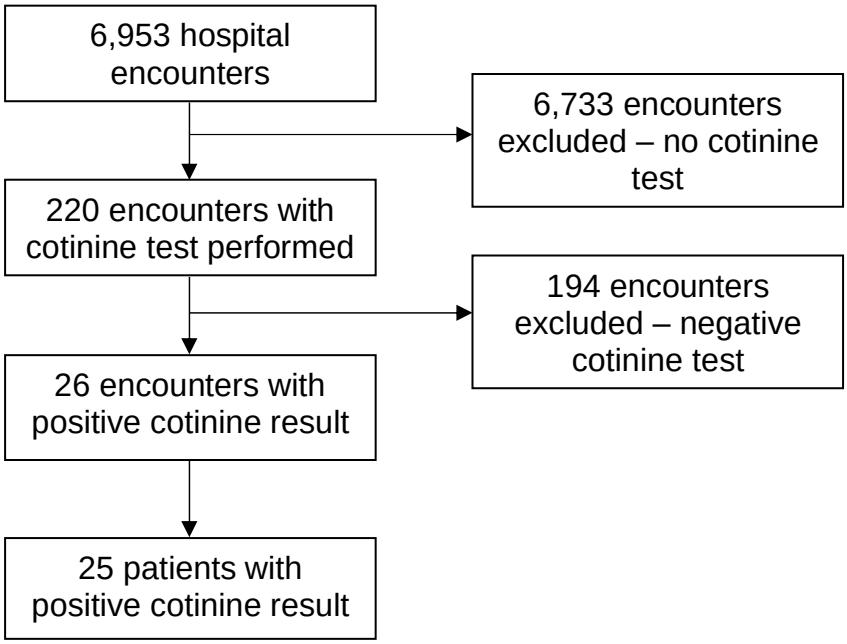
Introduction

Tobacco use remains the leading cause of morbidity and mortality in the United States (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2014). Despite a historically low combustible cigarette smoking prevalence of 1.6% among adolescents in 2022, electronic nicotine delivery systems (ENDS) remained the most commonly reported tobacco product with 9.4% reporting use in the past 30-days (Park-Lee, 2022). ENDS pose significant health concerns and increase risk of future cigarette use despite adolescents' perceptions of lower risk (Walker et al., 2022).

The last decade has seen an increased focus on identifying and treating high-risk substance use. Screening for tobacco use, including ENDS use, remains integral to this goal (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2014). However, guidelines for screening have

Figure 1

Flowchart of patient selection process



largely focused on outpatient settings (Jenssen et al., 2023). Inpatient hospital encounters present an opportunity for intervention. Prior research has shown that screening for tobacco use in pediatric hospital encounters was infrequent and not standardized (Alexander et al., 2021).

Biomarkers can further guide and corroborate screening efforts. Specifically, cotinine is a widely used nicotine metabolite that can be measured in patients' urine to determine nicotine exposure and has a half-life of about 16 hours (Benowitz et al., 2020). To date, no studies to our knowledge have assessed the correlation between a positive cotinine test and screening for tobacco use in the pediatric inpatient setting. The existing literature in pediatric settings focuses on interventions for caregivers who smoke in the home (Jawed & Jassal, 2021; Mahabee-Gittens et al., 2020; Wilson et al., 2022)

The aim of this study was to assess documented nicotine use history, withdrawal, and intervention with nicotine replacement therapy (NRT) for patients admitted to a quaternary children's hospital who tested positive for cotinine on a urine drug screen. This knowledge will assist in identifying gaps and opportunities for screening and treating pediatric patients for nicotine use while admitted to the hospital. While much is known about screening and treating adult patients for combustible cigarette use, this study represents a novel population with the unique challenge of increasing use of ENDS.

Methods

This was a retrospective cohort study of patients admitted to a quaternary, urban children's hospital between January 2020 and January 2022. Inclusion criteria were age ≥11 years and positive nicotine exposure, defined as having urine cotinine levels >500 ng/ml using enzyme-multiplied immunoassay technique. This cutoff value was determined based on the institution's standard laboratory testing and threshold values. The hospital admission associated with the positive urine cotinine finding was reviewed by two individuals (AE, AG). If needed, an arbitrator (AB) was available to settle discrepancies.

Table 1
Characteristics of cotinine-positive hospital encounters

Tobacco use documentation		
Tobacco use history documented	25	(96%)
Nicotine replacement therapy prescribed	7	(27%)
Withdrawal symptoms documented	4	(15%)
Primary admission diagnoses		
Suicidal ideation with intentional ingestion	14	(54%)
Overdose	6	(23%)
Seizure or seizure-like activity	5	(19%)
Respiratory failure	3	(12%)
Other	3	(12%)

This study was approved by the Nationwide Children's Hospital Institutional Review Board (STUDY00002449).

The electronic medical records (EMRs) of eligible patients were reviewed for documentation of tobacco product use history and whether this history aligned with the present cotinine results. Documentation of nicotine-related withdrawal symptoms and prescription of NRT was also abstracted from the EMR. Sociodemographic information including age and sex were recorded as well as the primary admission diagnosis. Descriptive statistics included count (percentage) for categorical variables and mean (standard deviation) for continuous variables.

Results

A total of 6,953 hospital admissions were screened. There were 220 admissions during which the patient was tested for cotinine, resulting in 26 positive results (12%) over this two-year period (Figure 1). The patients in these 26 encounters had a mean age of 15.8±1.1 years (range 13–17) and 14 (54%) were identified as female. Most patients were admitted for overdose or intentional ingestion (Table 1).

Of these encounters, 25 (96%) had a tobacco product use history documented by a health care provider, and eight (32%) had incongruent documentation – e.g. notes stating, "no nicotine use". Signs of nicotine withdrawal were documented in four (15%) of these 26 encounters, and NRT was prescribed during seven encounters (27%) (Figure 2). Among the four patients with documented nicotine withdrawal, two (50%) were prescribed NRT.

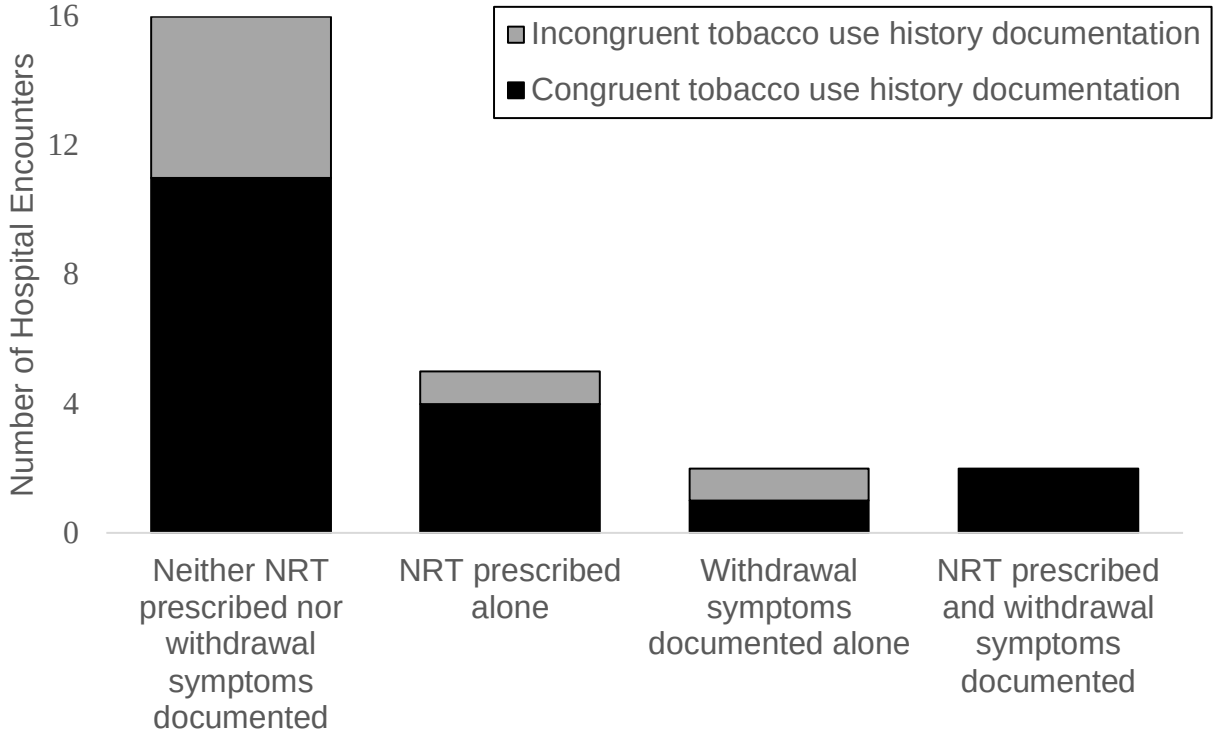
Discussion

Screening for and treating nicotine dependence is vital in adolescents because not only does nicotine use have many health consequences, but use in adolescents also increases the risk of other substance use later in life (Lewinsohn et al., 1999). The cotinine-positive hospitalized population represents perhaps the youth at highest risk for substance use disorders, as we found that many of these patients were admitted for overdose or ingestion. Even in this high-risk cohort, 1 in 3 had missing or incongruent tobacco use screening documentation.

This study is limited by retrospective review, and thus provider intent and patient motives are not known. The data from the EMR are limited by provider-dependent documentation, and historical data that are not updated regularly. Ordering of cotinine testing is likely biased based on patient presentation at admission and resulted in a small sample size that may not be

Figure 2

Nicotine replacement therapy (NRT) prescription and presence of withdrawal symptom documentation by congruence of tobacco history (N=26 admissions from 25 eligible patients).



representative of the general adolescent population. The low frequency of cotinine testing and selection bias for those who did receive testing should be considered when interpreting the results. The institution's cotinine cutoff of >500 ng/mL may have also affected the sample size as other tests may be able to detect cotinine at lower levels. Additionally, cotinine detection is a send-out test, and takes several days to result, so results are often not known to influence provider assessment at admission.

This study illustrates missed opportunities to engage high-risk patients in addressing tobacco use. Integration of standardized screening tools and risk-based cotinine screening into the pediatric inpatient setting may help trigger further assessment to link patients to care and should be the focus of future efforts in this area.

Implications for Health Behavior Research

As the landscape of tobacco and nicotine use continues to change, healthcare providers must be equipped to address this issue, especially in the pediatric setting. While established screening tools exist to assess for combustible tobacco use in adults, it may be more challenging for providers to determine an adolescent's level of dependence to an ENDS. Future research should focus on the development and implementation of validated screening tools for assessing adolescent nicotine dependence in an inpatient setting. Additionally, health behavior practitioners and clinicians are advised to standardize nicotine screening across pediatric admissions, not just those

who are deemed "high risk". A team-based approach utilizing other hospital-based professionals such as pharmacists, social workers, and health educators to make interventions after a positive screening could help take the burden off the screening provider and increase access to care. However, more research is needed in this area.

Another challenge to addressing nicotine in the pediatric setting is the lack of evidence to support pharmacotherapy in this patient population. Additionally, while NRT is considered the safest medication for treating nicotine use disorders in pediatrics, NRT is dosed based on combustible cigarette use and limited guidance is available for dosing NRT in patients who use ENDS (American Academy of Pediatrics, 2024). As this chart review demonstrated, initiation of NRT for patients who screened positive for cotinine was limited. Research is needed to determine the efficacy of NRT when treating pediatric patients with nicotine use disorders and universal guidance for healthcare providers is needed to promote confidence in using NRT for patients who use ENDS especially in the pediatric setting.

This chart review also revealed the challenges of using a biomarker to aid in the assessment of nicotine dependence. While a cotinine level can be helpful, it does not determine whether a patient is using combustible products, ENDS, or NRT. More research is needed on the utility and feasibility of using biomarkers to address nicotine use during inpatient encounters.

Lastly, while this chart review identified gaps and areas for improvement when screening for and treating nicotine use during pediatric inpatient admissions, it is limited by its small sample size. These methods should be repeated in a larger sample size to determine if results are replicated.

Discussion Questions

This chart review found that cotinine screening was inconsistent and infrequent among inpatient pediatric patients and was performed most frequently in patients who were admitted for intentional ingestion or overdose. How does provider bias play a role in screening for substance use behaviors in pediatrics?

This chart review found the use of NRT to be low during pediatric inpatient stays. What resources do providers need to increase their confidence in utilizing NRT in pediatric patients?

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