

Wastewater-based epidemiology

Monitoring use prevalence of combustible cigarettes
and new generation tobacco and nicotine products on a
population level

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Introduction

Wastewater-based epidemiology (WBE)

What is WBE?

- Analysis of wastewater to determine the exposure to chemicals or pathogens in a population
- Systematic monitoring of population health by analyzing biomarkers in wastewater to detect diseases, drug consumption, and other health indicators at the community level



Non-invasive



Population-level



Early-warning



Real-time data

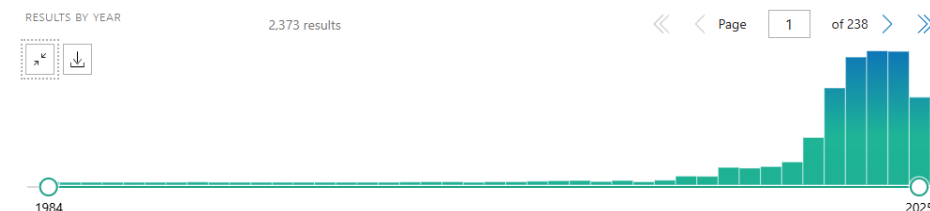


Wastewater-based epidemiology (WBE)

- WBE gained lots of interest during Covid-19 outbreak
- COVID-19: Implementation of WBE as early warning system in 72 countries / 4,648 sites



Pubmed Search: WBE (2,373 results)



Pubmed Search: WBE + Covid (1,322 results)



Wastewater-based epidemiology (WBE)



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WBE in the context of THR?



Wastewater-based epidemiology (WBE)



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WBE in the context of THR?



Methods

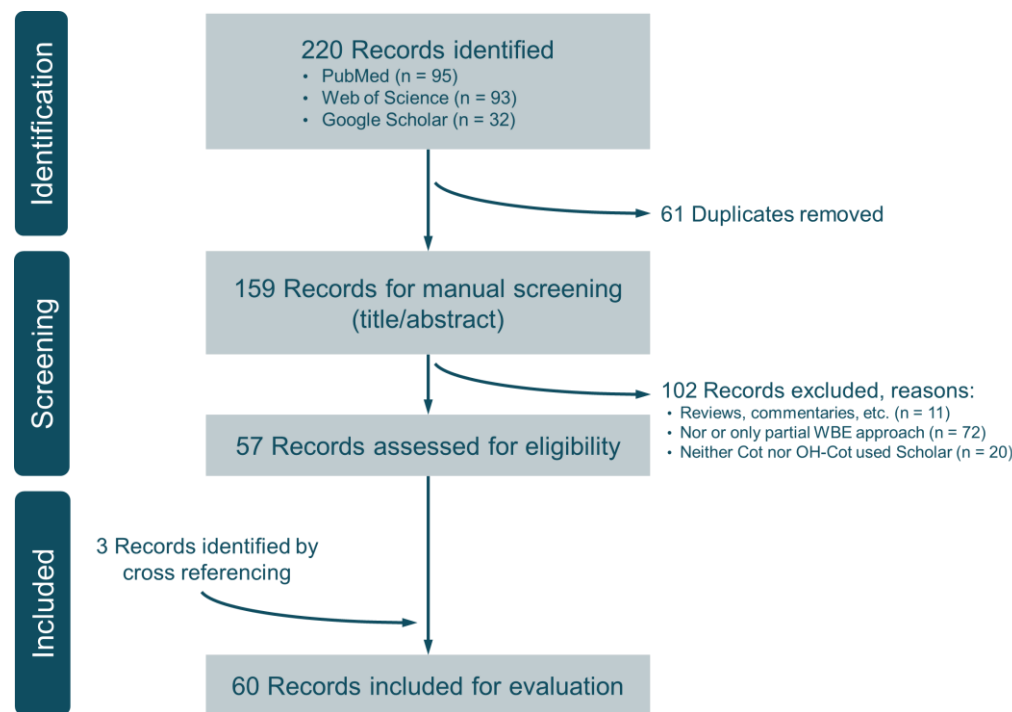
Literature review - Methodology

Systematic review to examine the potential of **WBE** in the context of **THR**

Objectives

- 1 Identify and evaluate studies that apply WBE to assess tobacco/nicotine use
- 2 Provide a perspective view on the application of WBE for monitoring THR by differentiating the use of combustible cigarettes and new generation tobacco/nicotine products
- 3 Perform Monte Carlo Simulations applying input variables retrieved in this review

Systematic review following PRISMA guidelines
Search term: ((“wastewater-based epidemiology”) AND (“tobacco” OR “cigarettes” OR “nicotine”))

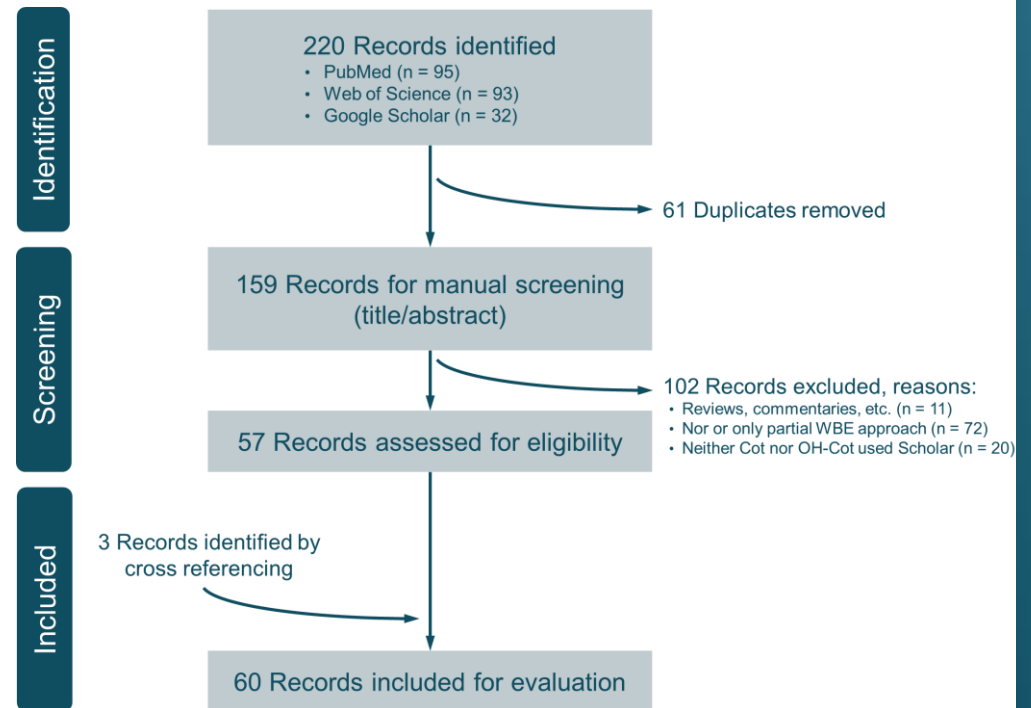


Results

Literature review - Results

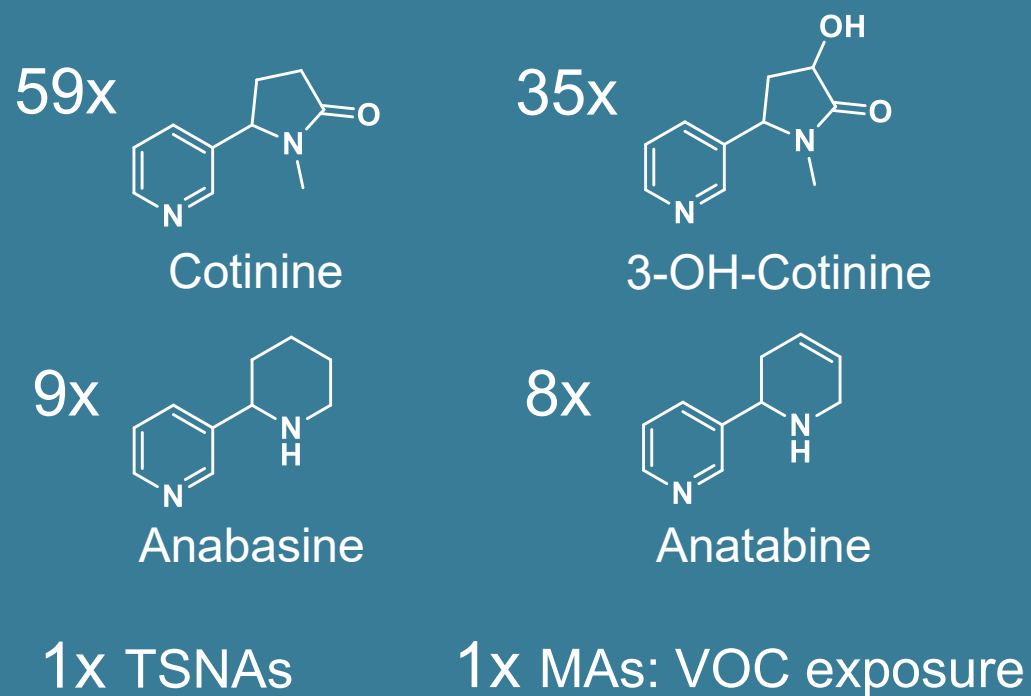
- 60 studies included in the review
- Years of sampling: 2009 – 2023
- Different types of investigations:
 - Time trend investigations
 - Effects of workdays/weekends and special events
 - Comparison of WBE-derived data with classical use prevalence methods (surveys, sales data, etc)
 - Further aspects like population size estimation with additional biomarkers, type of wastewater sampling, analysis of biomarkers of potential harm

Systematic review following PRISMA guidelines
Search term: ((“wastewater-based epidemiology”)
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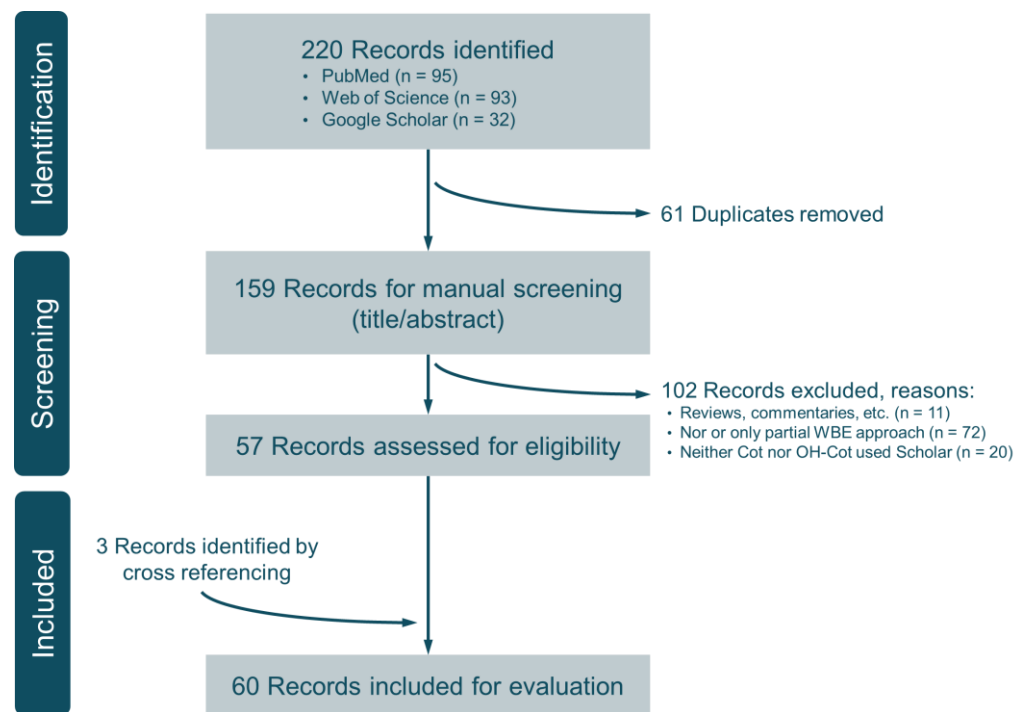


Literature review - Results

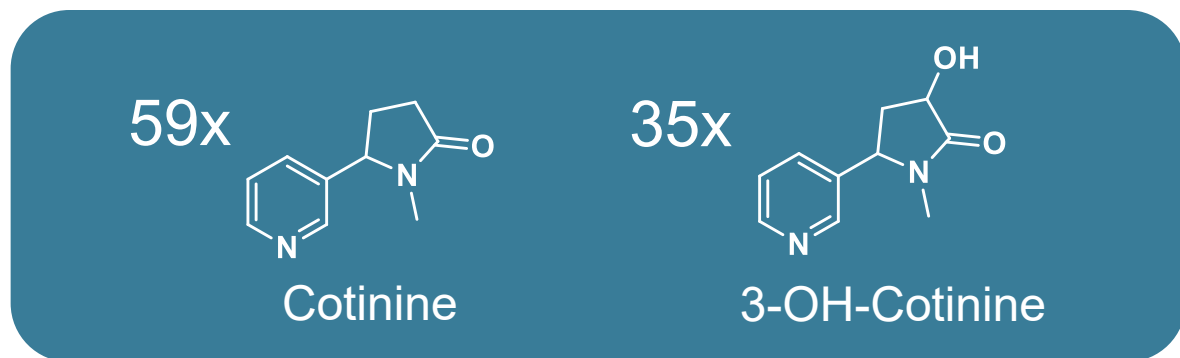
- Years of sampling: 2009 – 2023
- Biomarkers of exposure used in the studies:



Systematic review following PRISMA guidelines
Search term: ((“wastewater-based epidemiology”
AND (“tobacco” OR “cigarettes” OR “nicotine”))



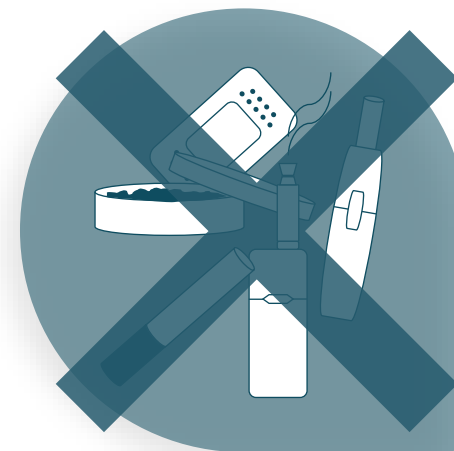
Literature review - Results



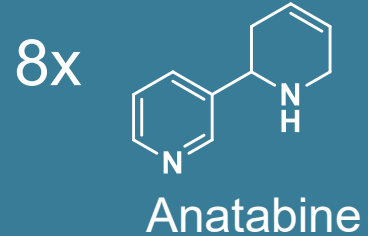
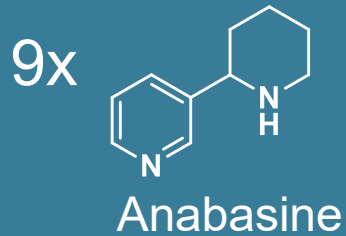
- WBE derived nicotine consumption data back-calculated from Cotinine and 3-OH-Cotinine
- Mostly in fair agreement with results obtained from classical approaches like surveys or sales data



- Discrepancies arise from lacking specificity of the BoE
- Cot/3-OH-Cot capture nicotine use
- Cannot discriminate between products



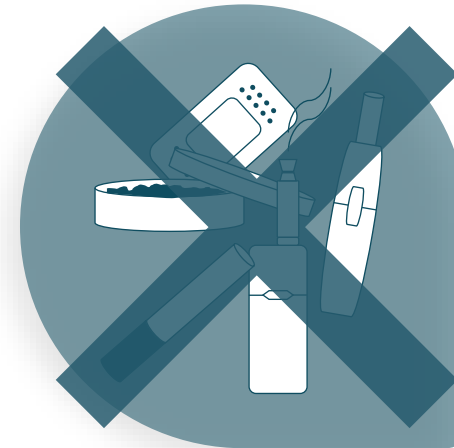
Literature review - Results



- Proves suitable in WBE
- AB indicates changes in use prevalence of nicotine products
- Partial differentiation between products possible



- AB/AT less frequently used
- AB suggested as specific indicator for the use of tobacco-containing products
- AB decrease faster than Cot in WW over time
- Indicates replacement of tobacco products (CC, HTP...) with tobacco-free products (EC, pouches...)



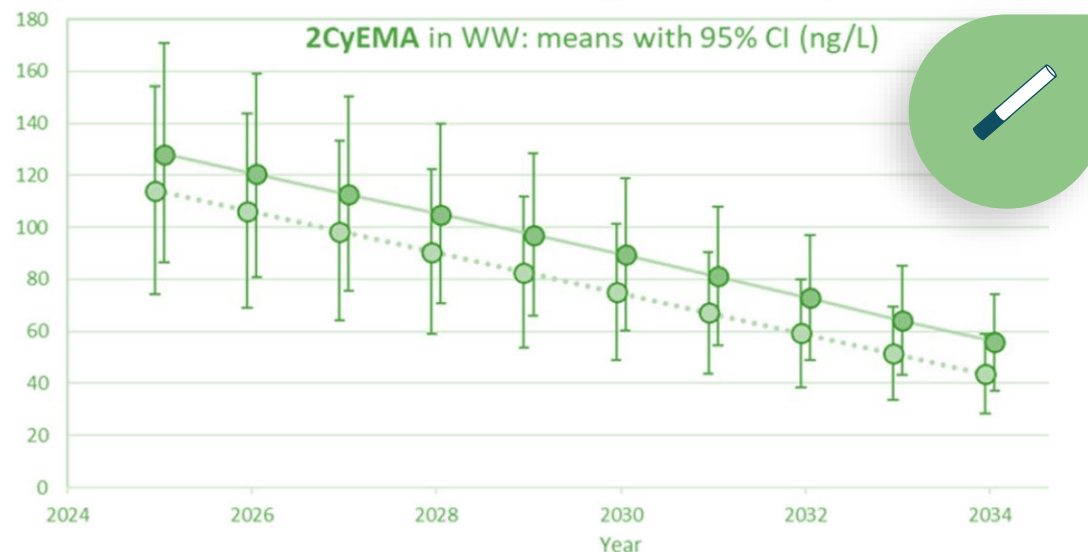
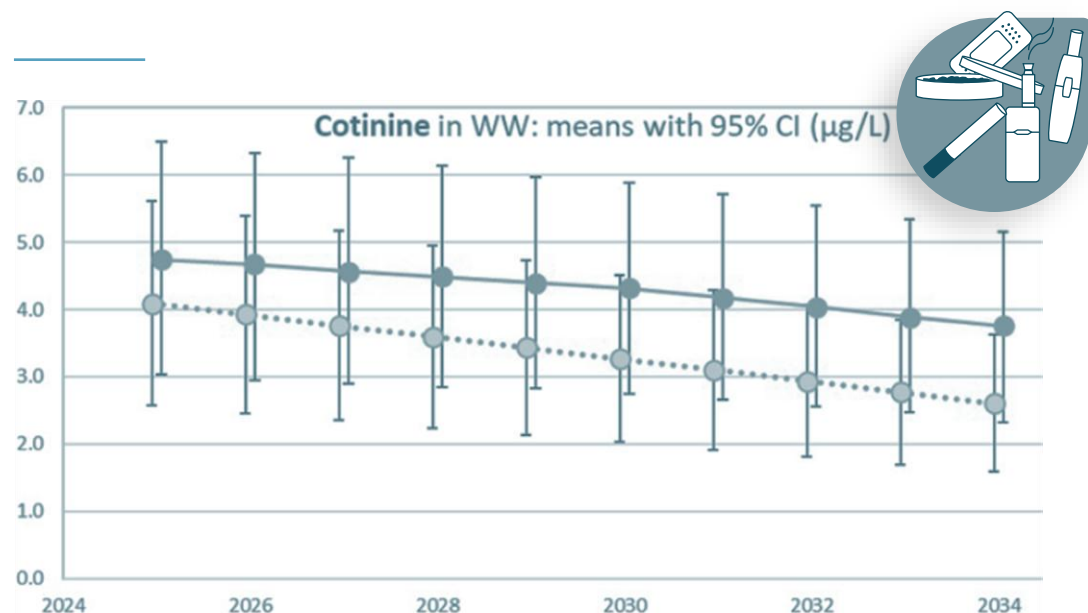
Literature review - Results



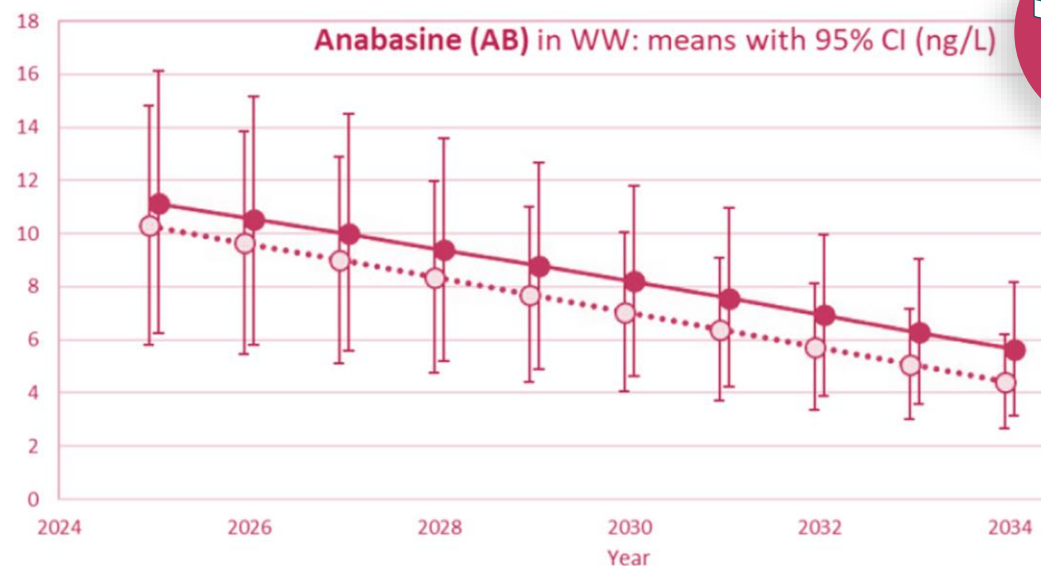
- WBE based on cotinine and anabasine suited to monitor changes in product use patterns
- More biomarkers in wastewater needed to differentiate between products for robust use monitoring by WBE in the context of THR

- 2CyEMA (or CEMA): mercapturic acid specific to acrylonitrile
- Highly specific to smoking of combustible cigarettes
- Monte Carlo simulations (MCS): 10-year time course for cotinine, AB, 2CyEMA

Monte Carlo simulations



- Scenario 1: non-users, CC, EC, HTP, ONP, NRT users
- Scenario 2: Scenario 1 + Dual user group of CC+EC



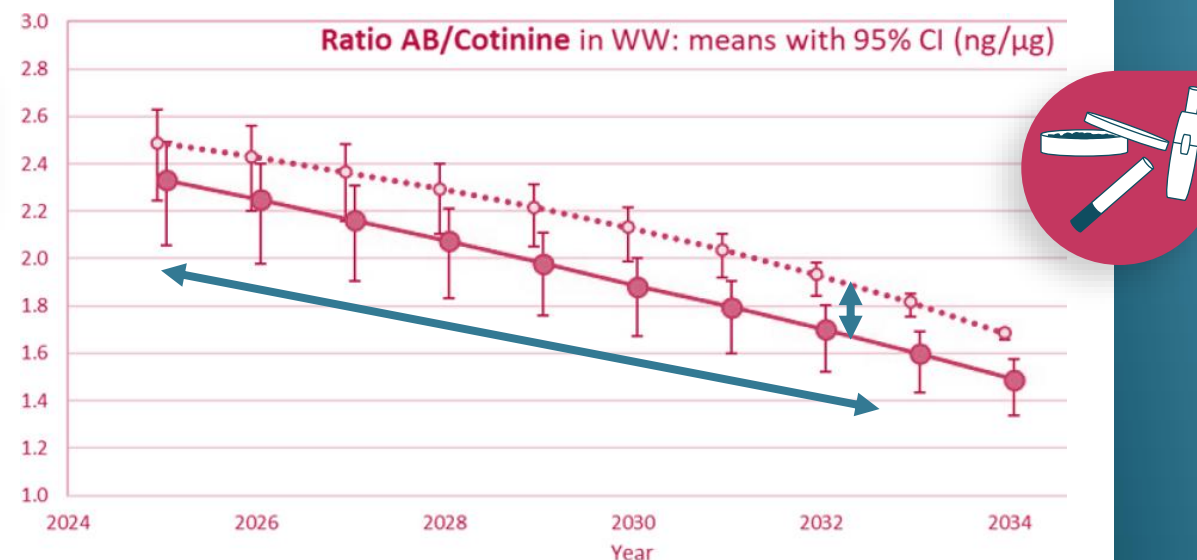
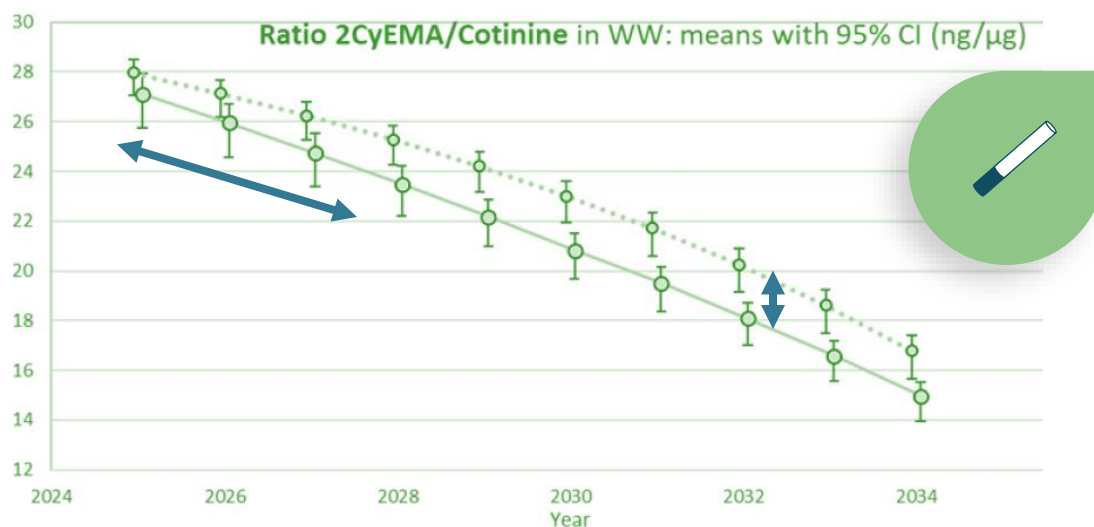
No significant difference between the 2 scenarios



Stronger decrease for AB/2CyEMA vs Cotinine

Monte Carlo simulations

- Scenario 1: non-users, CC, EC, HTP, ONP, NRT users
- Scenario 2: Scenario 1 + Dual user group of CC+EC



- Ratios of 2CyEMA/Cot and AB/Cot reduce variability in WBE results
 - Declining trends are more pronounced & highly significant for both scenarios
 - Biomarker ratios also show significant differences between the scenarios
- Applying suitable biomarkers in WBE reflect changes in use patterns over time**

Conclusion & Outlook



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Conclusion & Outlook

- Future research shall characterize further use-specific biomarkers in wastewater
 - PG as vaping-specific BoE
 - Further mercapturic acids for determination of HTP use
- Accurate characterization of candidate biomarkers in WW needed (i.e., stability, urinary excretion kinetics)
- Cot/AB suited biomarkers of nicotine & tobacco use in WBE
- 2CyEMA promising candidate to discriminate CC from other nicotine products
- WBE can answer various research questions in the context of THR with the suggested BoE
 - Monitor influence of special events on use habits like festivals or seasonal effects
 - Generation of accurate consumption data & monitor use prevalence in a cost-efficient way



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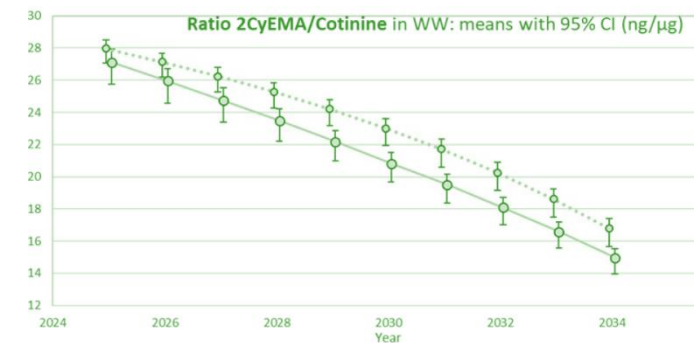


Contributions to Tobacco & Nicotine Research
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Wastewater-Based Epidemiology (WBE): Potential Application for Assessing the Use of Conventional and New Generation Tobacco and Nicotine Products *

by

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Conclusion & Outlook



WBE: A powerful measure to deduce the success of THR measures in large populations

Acknowledgment

