Thirdhand Smoke Pollution and Exposure on the San Diego Blue Line Trolley

Ileana Andrade[1], Georg E. Matt, PhD[1,2], Lydia Greiner, DrPH[2], Sarah Lavallee, PhD[2], Gunnar Wooldridge, BA[2]
[1]San Diego State University, [2]Center for Tobacco and the Environment

BACKGROUND & INTRODUCTION

What is Thirdhand Smoke?

- Thirdhand smoke (THS) is the toxic chemical residue left behind after secondhand smoke disappears into the air.[1]
- THS can stick to surfaces, and these hazardous chemicals can later re-emit back into the air, creating ongoing exposure to THS.
- Individuals can be exposed to THS through dermal uptake, consuming contaminated items, and by breathing in polluted air.[1]

Why study the San Diego Blue Line Trolley?

- Few studies have examined THS within public transportation settings.
- Previous studies have examined urinary cotinine levels as a marker of THS as well as investigated the presence of "No Smoking" signage in public transportation settings. [2,4]

Policy Context:

- Smoking is prohibited on platforms and vehicles per MTS policies and CA state laws within 25 ft of stations.[3]
- The Blue Line serves diverse communities and riders of all ages and backgrounds.

RESEARCH QUESTIONS

- What measurable levels of nicotine are present in the air and on surfaces within trolley cars and on trolley platforms?
- Do trolley riders pick up nicotine on their hands while riding the trolley?
- Are trolley riders using/disposing of commercial tobacco products on trolley platforms?

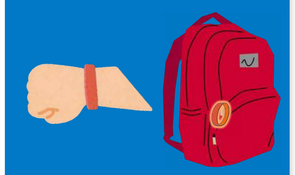
METHODS

DATA COLLECTION

Research staff traveled on the Blue Line Trolley from San Ysidro to La Jolla on two separate days, during peak ridership times in the early morning and afternoon.

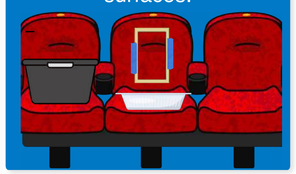
AIR SAMPLES

Silicone wristbands measured airborne nicotine for 3-hour periods.



SURFACE SAMPLES

Cotton rounds (containing ascorbic acid) were used to assess nicotine on the backs of trolley seats, which are low-contact surfaces.



HAND WIPE SAMPLES

Cotton rounds (containing ascorbic acid) were evaluated for dermal uptake before and after travel.

ANALYSIS

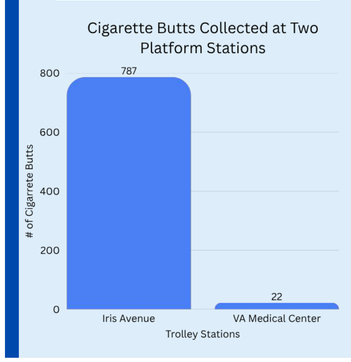
Field blanks were collected for each sample type, allowing us to deduct any background nicotine already present on the sampling materials. Samples were processed at the Hoh Environmental Health Laboratory and analyzed for nicotine using isotope-dilution liquid chromatography-tandem mass spectrometry (LC/MS–MS).

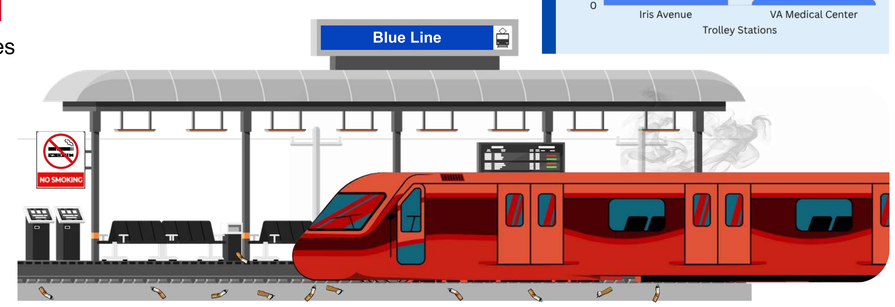
RESULTS

Surface Samples

Surface nicotine levels measured 0.66 µg/m² on both collection days, assessing low-touch surfaces.

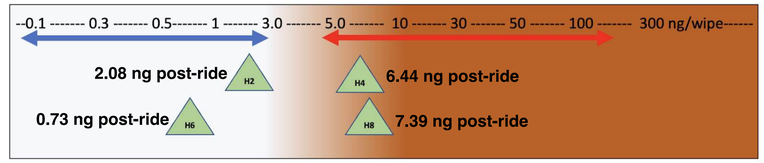
Tobacco Product Waste





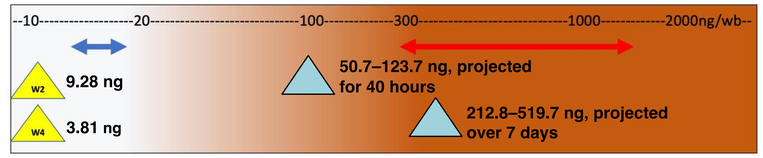
Hand Wipe Samples:

Figure 1: Observed **hand nicotine levels** (nanograms of nicotine per hand wipe; green triangles) with reference levels from hands of children living in protected nonsmokers homes (blue) and smoker homes (red).



Air Samples (Wristbands):

Figure 2: Observed **wristband nicotine samples in wristbands worn by team members** (nanograms of nicotine per wristband; yellow triangles) with reference levels from children of nonsmokers (blue) and smokers who smoke indoors (dark red).



DISCUSSION

Nicotine was found in all the samples collected

Widespread Contamination: THS contamination is widespread and persistent on the San Diego Blue Line Trolley.

Occupational & Rider Hazard: While a single ride's exposure is relatively low, MTS staff and frequent riders may be exposed at levels comparable to non-smokers living with a smoker.

Policy & Action Needed: This research highlights the urgent need for public education and better enforcement of smoke-free and vape-free policies within public transportation.

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REFERENCES

1. Jacob, P., 3rd, Benowitz, N. L., Destaillats, H., Gundel, L., Hang, B., Martins-Green, M., Matt, G. E., Quintana, P. J., Samet, J. M., Schick, S. F., Talbot, P., Aquilina, N. J., Hovell, M. F., Mao, J. H., & Whitehead, T. P. (2017). Thirdhand Smoke: New Evidence, Challenges, and Future Directions. *Chemical research in toxicology*, *30*(1), 270–294. https://doi.org/10.1021/acs.chemrestox.6b00343
2. Klein, E. G., Kennedy, R. D., & Berman, M. (2014). Tobacco Control Policies in Outdoor Areas of High Volume American Transit Systems. *Journal of Community Health*, *39*(4), 660–667. https://doi.org/10.1007/s10900-014-9873-3
3. Olson, M. (2015, October 15). *MTS Bans E-Cigarettes on all Buses, Trolleys, Bus Stops and Transit Centers.* San Diego Metropolitan Transit System. https://www.sdmts.com/inside-mts/media-center/news-releases/mts-bans-e-cigarettes-all-buses-trolleys-bus-stops-and
4. Zhang, S., Qiao, S., Chen, M., Xia, Y., Hang, B., & Cheng, S. (2015). A investigation of thirdhand smoke pollution in 3 types of places of Nanjing, 2014. *Zhonghua Yu Fang Yi Xue Za Zhi [Chinese Journal of Preventive Medicine]*, *49*(1), 31–35. https://pubmed.ncbi.nlm.nih.gov/25876492/