**States with recreational marijuana have lower rates of vaping associated lung injury**

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## Introduction

In the past six months, over 1,600 cases of e-cigarette or vaping associated lung injury (EVALI) have been reported to the CDC. The specific cause of EVALI is unknown, but most patients report using e-cigarettes to consume tetrahydrocannabinol (THC), the primary psychoactive component of marijuana. The CDC and others have hypothesized that black-market THC products may cause EVALI[1,2].

Some states have legalized marijuana and THC-containing products for recreational use. Many other states allow purchases for qualifying medical purposes. In the remaining states, all forms of consumption and distribution are illegal, and those who use THC likely obtain it from the black market. If black market THC products are responsible for EVALI, then case rates may be lower in recreational marijuana states.

## Methods

To examine this hypothesis, we compared EVALI case rates across states with different marijuana regulations and across states with differing rates of e-cigarette use. We obtained EVALI data from the CDC[2], e-cigarette prevalence from BRFSS[3], and population data from SEER[4]. We defined the EVALI case rate as the mid-point of the CDC reported range divided by the state population. We classified states as medical marijuana states if they had a medical marijuana law by January 2019, but no recreational dispensaries. We classified states as recreational marijuana states if they had a recreational law and at least one recreational dispensary by January 2019: Alaska, Washington, Colorado, Oregon, Nevada, California, and Maine.

## Results

Exhibit 1A shows the number of reported EVALI cases per 1 million population in each state. We sorted states by the EVALI rate and found that recreational marijuana states have significantly fewer EVALI cases/million than other states. The average recreational marijuana state had 1.7 EVALI cases/million. In contrast, the EVALI case rate was 8.8 cases/million in medical marijuana states and 8.1 cases/million in prohibition states. This means that recreational marijuana states have 7.1 ($p < .001$) fewer cases/million than medical marijuana states, and 6.4 ($p = .004$) fewer cases/million than prohibition states. The difference in the EVALI case rate between medical and prohibition states is not statistically significant. Exhibit 1B shows that the prevalence of e-cigarette use does not significantly differ between recreational, medical, and prohibition states.

In addition, exhibit 2 indicates that there is no association between EVALI cases rate and the prevalence of e-cigarette in each state. We also used multivariate regression to estimate the association between the EVALI case rate and marijuana laws after adjusting for the prevalence of e-cigarette use. The results confirm our earlier findings. Average EVALI case rates are 7.5 cases/million lower in recreational marijuana states ($p < .001$). There is no significant relationship between EVALI and medical marijuana (coef = 0.3, $p = .92$) or e-cigarette use (coef = -1.3, $p = .20$).

**Discussion**

The data suggests EVALI cases are concentrated in states where consumers do not have legal access to recreational marijuana dispensaries. One possible inference from our results is that the presence of legal markets for marijuana has helped mitigate the EVALI outbreak in some parts of the country. The statistical analysis in this note is limited in that these are simple cross-sectional comparisons of case rates, which do not attempt to adjust for the possibility of confounding by other factors that might explain differences in EVALI case rates. Nevertheless, the data from the outbreak so far suggest that further restrictions on the legal market for marijuana could lead to more EVALI. Recent proposals to ban e-cigarette products are not supported by the data and seem to raise concerns about the unintended public health consequences of black markets for recreational drugs[5,6].

Exhibit 1

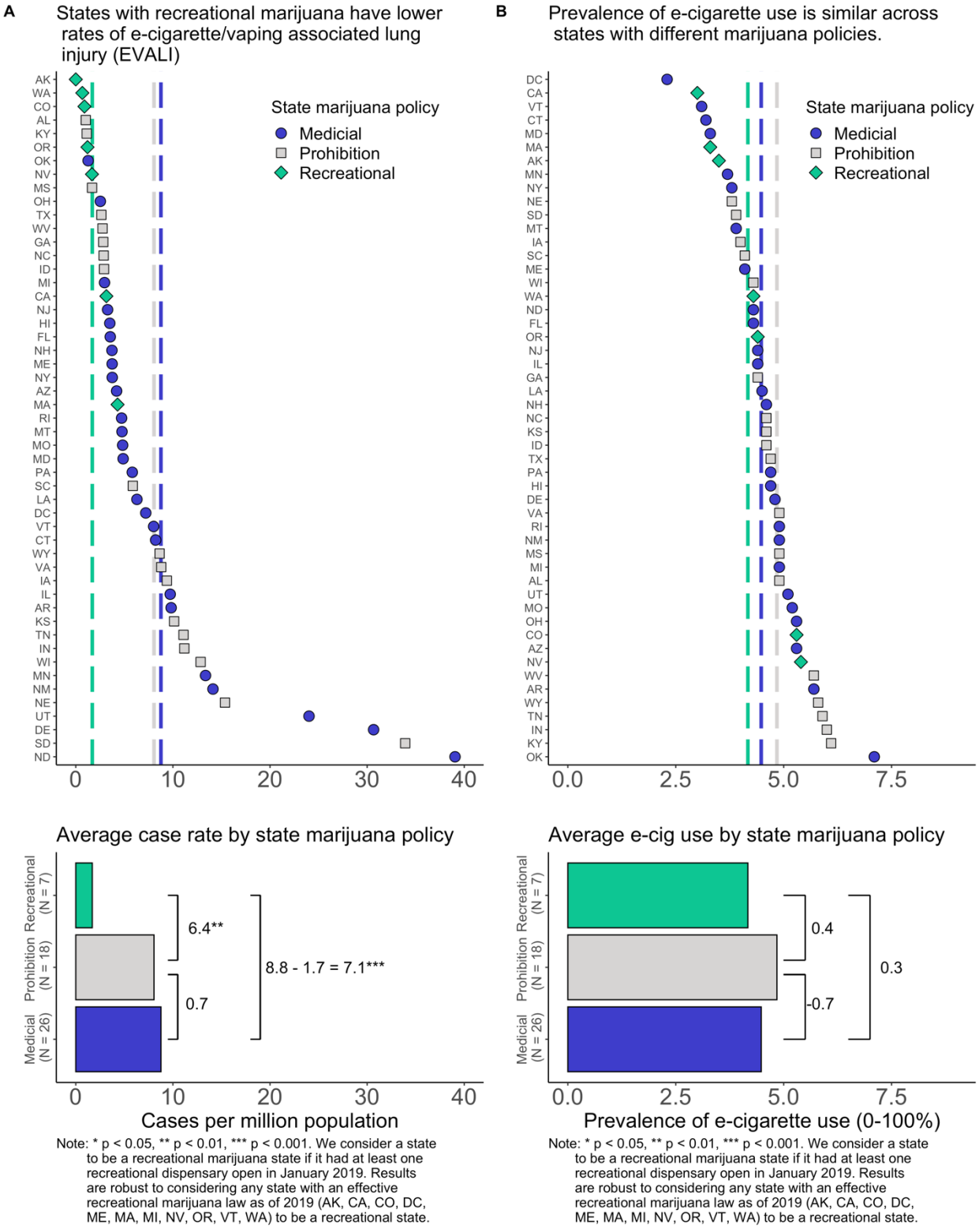
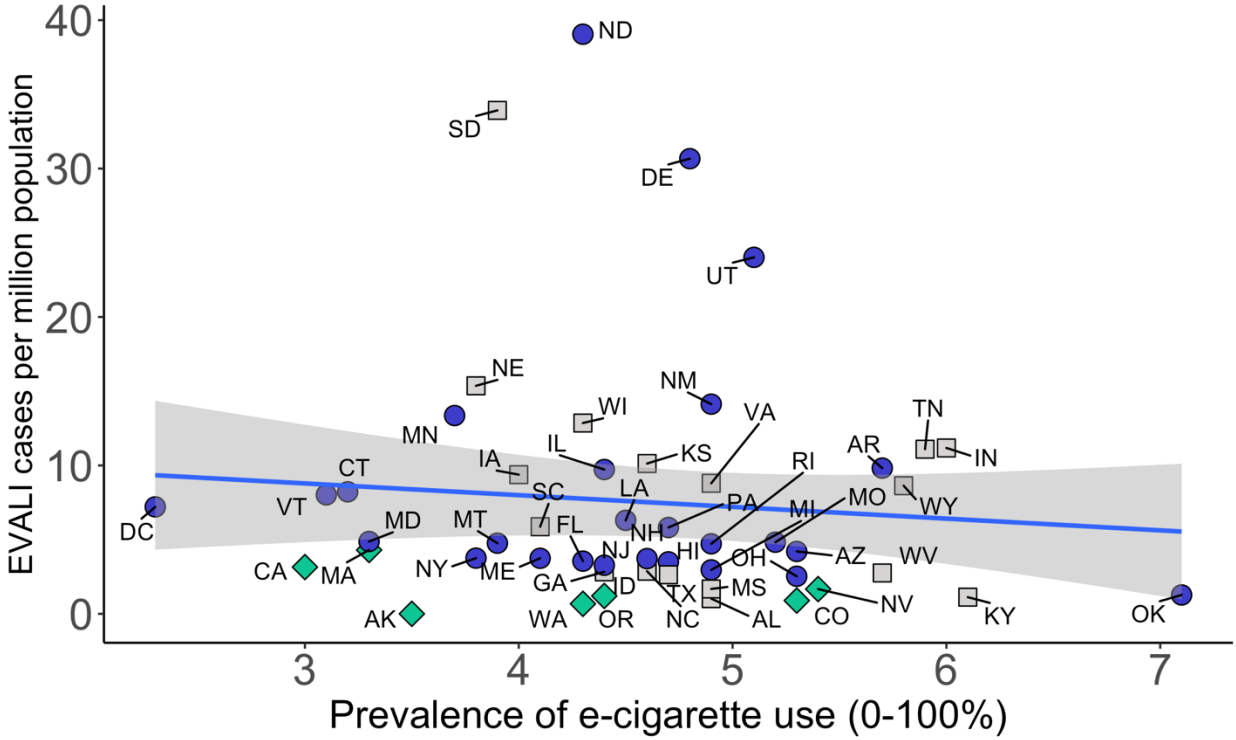

A
States with recreational marijuana have lower rates of e-cigarette/vaping associated lung injury (EVALI)
State marijuana policy
Medicial
Prohibition
Recreational
AK WA CO AL KY OR OK NV MS OH TX WV GA NC ID MI CA NJ HI FL NH ME NY AZ MA RI MT MO MD PA SC LA DC VT CT WY VA IA IL AR KS TN IN WI MN NM NE UT DE SD ND
0 10 20 30 40
B
Prevalence of e-cigarette use is similar across states with different marijuana policies.
State marijuana policy
Medicial
Prohibition
Recreational
DC CA VT CT MD MA AK MN NY NE SD MT IA SC ME WI WA ND FL OR NJ IL GA LA NH NC KS ID TX PA HI DE VA RI NM MS MI AL UT MO OH CO AZ NV WV AR WY TN IN KY OK
0.0 2.5 5.0 7.5
Average case rate by state marijuana policy
Prohibition Recreational (N = 7)
Prohibition (N = 18)
Medicial (N = 26)
6.4**
0.7
8.8 - 1.7 = 7.1***
0 10 20 30 40
Cases per million population
Note: * p < 0.05, ** p < 0.01, *** p < 0.001. We consider a state to be a recreational marijuana state if it had at least one recreational dispensary open in January 2019. Results are robust to considering any state with an effective recreational marijuana law as of 2019 (AK, CA, CO, DC, ME, MA, MI, NV, OR, VT, WA) to be a recreational state.
Average e-cig use by state marijuana policy
Prohibition Recreational (N = 7)
Prohibition (N = 18)
Medicial (N = 26)
0.4
-0.7
0.3
0.0 2.5 5.0 7.5
Prevalence of e-cigarette use (0-100%)
Note: * p < 0.05, ** p < 0.01, *** p < 0.001. We consider a state to be a recreational marijuana state if it had at least one recreational dispensary open in January 2019. Results are robust to considering any state with an effective recreational marijuana law as of 2019 (AK, CA, CO, DC, ME, MA, MI, NV, OR, VT, WA) to be a recreational state.

Exhibit 2

There is no discernable relationship between EVALI case rate and e-cigarette use




Note: Best fit line is displayed in blue with a slope of -0.8 and a robust standard error of 0.9 (p-value of 0.36). 95% confidence interval is denoted by gray shaded area. Results are robust to weighting by state population.

**References**

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