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Should California Have Banned Red Dye 3? An Economic Cost-Benefit Analysis

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Should California Have Banned **Red Dye 3**? *An Economic Cost-Benefit Analysis*

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Background

- Red Dye 3 is one of the 9 synthetic dyes commonly found in food, beverages, and medications
- The FDA banned Red Dye 3 in cosmetics in 1990 because of cancer concerns but continues to allow Red Dye 3 in consumable products
- California passed the "California Food Safety Act" on October 7, 2023, which banned four food additives including Red Dye 3
- A cost-benefit analysis is an especially useful tool to determine the overall impact of a policy like the ban of Red Dye 3
- This research considers the societal costs and benefits experienced by all California residents and California-headquartered food manufacturers

Examples of food products that contain Red Dye 3

Benefits

1. *Reduced Risk of Thyroid Cancer*

- The presence of tumors in male rats led the FDA to ban Red Dye 3 in cosmetics
- Humans have a 1/100,000 (0.001%) chance of developing thyroid cancer from Red Dye 3
- One study revealed that adults are willing to pay $206.46 per month to eliminate their risk of cancer
- Individuals have a 40% of developing some type of cancer

$$\frac{\$206.46}{40\%} = \frac{\$X}{0.001\%}$$

X = $0.005 per month → $0.06/year/adult, $0.12/year/child → Total Benefit: **$2.89 Million**

The progression of calculating total benefit from the reduced risk of thyroid cancer

2. *Decrease in ADHD Symptoms*

- Multiple studies show that artificial food dyes worsen ADHD symptoms such as inattentiveness, impulsivity, and hyperactivity
- ADHD and Asthma are comparable
- Parents are willing to pay an average of $125.57 per month for a hypothetical watch that would reduce asthma symptoms in their child by 50%
- If each risk factor for ADHD is equally weighted, elimination of Red Dye 3 would reduce ADHD symptoms by 1.59%

$$\frac{\$125.57}{50\%} = \frac{\$X}{1.59\%}$$

X = $3.99 per month → $23.94/year/adult, $47.88/year/child → Total Benefit: **$1.15 Billion**

The progression of calculating total benefit from a decrease in ADHD symptoms

Costs

1. *Cost for Food Manufacturers to Reformulate Products With an Alternative*

- 53 California-headquartered food companies use Red Dye 3 in a total of 119 products

Aggregate Cost for California-Headquartered Manufacturers to Alter a Dye =
$(mg \times price_{dye} \times count_{sold} \times number_{products}) + (number_{products} \times reformulation)$

mg	$price_{dye}$	$count_{sold}$	$number_{products}$	reformulation
2.403	$0.000000463/mg for Red Dye 3 $ 0.000014308/mg for beet dye	1,150,900.9	119	$39,790

The estimated values for each component of the equation above

- Total Cost: **$4.74 Million** in year 1 of implementation and **$4,556.50** for subsequent years (non-discounted)

2. *Civil Liability Fines*

- Non-adherence to the "California Food Safety Act" can result in a maximum fine of $5,000 for a first violation and $10,000 for subsequent violations
- The overall compliance rate for several USDA-regulated industries was 98.7% between 2021 and 2022
- At *most*, 1 company is expected to not comply per year (1.3% × 53 = 0.69)
- Total Cost: **$5,000** per year (non-discounted)

3. *Added Time to Inspect Food Manufacturers for Red Dye 3*

- Inspecting for Red Dye 3 would likely be added to annual inspections, adding time to each inspection
- An added 2 hours is estimated to cost an additional $48 per inspection if the hourly rate is $24 for an inspector ($24 × 2)
- The FDA did 13,305 food manufacturer inspections in 2023
- California accounts for 15.68% of U.S. food manufacturing plants

$$13{,}305 \times 15.68\% = 2{,}086 \text{ inspections per year in California}$$

$$2{,}086 \times \$48 = \$\mathbf{100{,}128} \text{ added cost per year (non-discounted)}$$

Results

Total Benefits (Year 1):	Total Costs (Year 1):
$1.16 Billion	$4.84 Million
Net Gain Over 20 Years: $14.4 Billion	
Total Benefits (Years 2-20)	Total Costs (Years 2-20)
$1.16 Billion	$109 Thousand

Summary of the non-discounted total costs and benefits as well as the overall NPV, discounted at 5% over 20 years

Sensitivity Analysis

- 375,361 products from California-headquartered food manufacturers would need to contain Red Dye 3 for the NPV to break-even at 0 (Ceteris paribus)
  - 119 products is the baseline
- A $0 WTP for a decrease in ADHD symptoms would still yield a positive NPV of over $30 million (Ceteris paribus)
  - $1,152,891,881.40 WTP is the baseline

Conclusions

- Banning Red Dye 3 *is* socially optimal for the state of California based on the results of this analysis
- One limitation is that this cost-benefit analysis only accounted for costs and benefits directly related to the state of California, while the "California Food Safety Act" has implications for the entire nation
- More research could be done to locate more precise estimates, which would solidify the NPV
- Banning Red Dye 3 is a step in the right direction, but it does not imply that banning other artificial dyes would be socially optimal

Sources

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