

CO NAAQS Review: Draft Risk and Exposure Assessment

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Role of Risk and Exposure Assessment versus Role of Policy Assessment

- Risk and Exposure Assessment (REA)
 - Concise quantitative assessment focused on methods, key results, and uncertainties associated with estimating population exposure and dose
- Policy Assessment
 - Staff analysis of policy options based on integration and interpretation of information in the ISA and REA



Overview of Presentation

- Review of Modifications Made
- Overview of Modeling Approach
- Example Use of REA Results with Policy Assessment
- Results
 - COHb estimates
 - Single and Multiple COHb Dose Level Occurrences per Year For CHD Population
 - Ambient/Endogenous CO Contributions
 - Microenvironmental Contribution to Exposures
 - Uncertainty Characterization



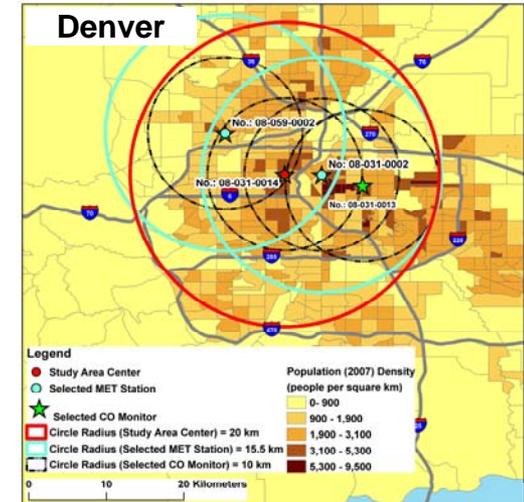
Modifications to Approach Used in 2nd Draft CO REA

- Expanded
 - modeling domains
 - number of microenvironments modeled
 - at-risk population
 - air quality scenarios
- Implemented
 - mass-balance model in all indoor microenvironments
 - commuting algorithm, alternative air quality districts
 - mapping of microenvironments, alternative air quality districts
- Improved representation of
 - variability in estimated microenvironmental concentrations
 - spatial heterogeneity in estimated outdoor concentrations



Overview of Approach Used for 2nd Draft CO REA

- Study Areas
 - Bulk of Denver and Los Angeles CMSAs
- Air Quality
 - Ambient CO monitors in Denver (4) & Los Angeles (10)
 - CO from indoor sources were not included
- Simulated Population
 - Census tracts within 10 km radius of monitor locations
 - Adults with diagnosed and undiagnosed coronary heart disease (CHD)
- Air Quality Scenarios
 - Unadjusted 2006 Air quality (As Is)
 - Adjusted Air Quality (1995 Denver; 1997 LA)
 - Just meeting current 8-hour CO NAAQS of 9 ppm (9.4)
 - 2nd highest annual 8-hour average of 5 ppm (5.4)
 - 99th percentile daily maximum 8-hour average of 5.0 ppm
 - 99th percentile daily maximum 1-hour average of 8.0 ppm
- Output
 - Number and percent of persons at/above COHb benchmarks



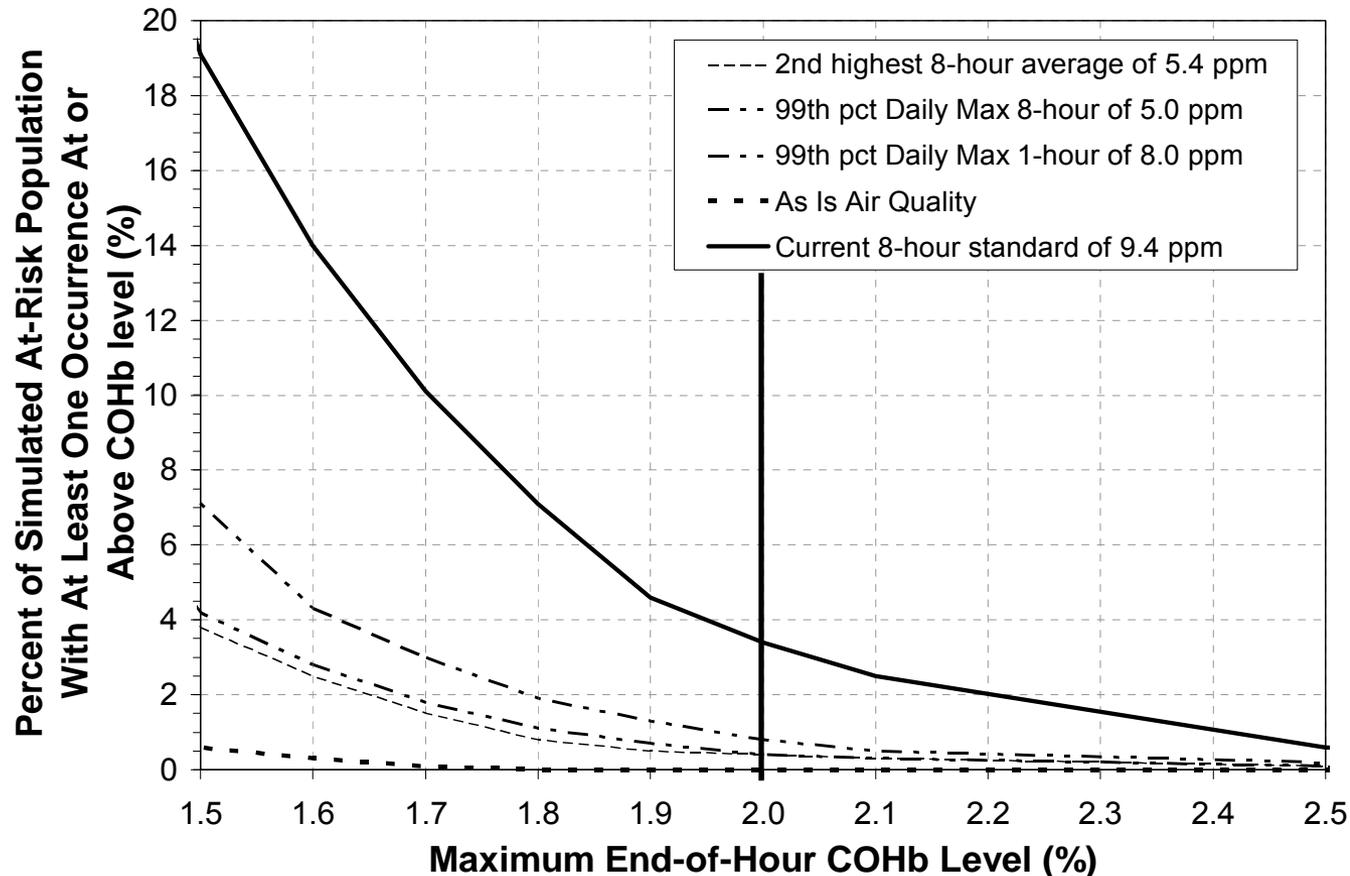
Array of Alternative Standard Forms and Levels Informed by REA Scenarios

| Denver Design Values | | | | |
|--|--------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| Averaging Time | 8-hour | | 1-hour | |
| | Form | | Form | |
| Air Quality Scenario | 2 nd highest ¹ | 99 th percentile daily max | 2 nd highest ¹ | 99 th percentile daily max |
| | | | | |
| As Is | 3.1 | 2.8 | 4.6 | 4.5 |
| Current 8-hour Standard (9 ppm) ² | 9.4 | 7.2 | 16.2 | 13.3 |
| 2 nd highest 8-hour Average (5 ppm) ² | 5.4 | 4.1 | 9.3 | 7.7 |
| 99 th percentile daily max 8-hour (5.0 ppm) | 6.5 | 5.0 | 11.2 | 9.2 |
| 99 th percentile daily max 1-hour (8.0 ppm) | 5.6 | 4.3 | 9.7 | 8.0 |
| Notes: | | | | |
| ¹ This is the form of the current standards. | | | | |
| ² Note that the rounding convention allows for concentrations of up to the given standard level plus 0.4 ppm. | | | | |

| Los Angeles Design Values | | | | |
|--|--------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|
| Averaging Time | 8-hour | | 1-hour | |
| | Form | | Form | |
| Air Quality Scenario | 2 nd highest ¹ | 99 th percentile daily max | 2 nd highest ¹ | 99 th percentile daily max |
| | | | | |
| As Is | 5.6 | 5.1 | 8.2 | 7.4 |
| Current 8-hour Standard (9 ppm) ² | 9.4 | 8.2 | 11.8 | 11.6 |
| 2 nd highest 8-hour Average (5 ppm) ² | 5.4 | 4.7 | 6.8 | 6.7 |
| 99 th percentile daily max 8-hour (5.0 ppm) | 5.7 | 5.0 | 7.2 | 7.1 |
| 99 th percentile daily max 1-hour (8.0 ppm) | 6.5 | 5.7 | 8.1 | 8.0 |
| Notes: | | | | |
| ¹ This is the form of the current standards. | | | | |
| ² Note that the rounding convention allows for concentrations of up to the given standard level plus 0.4 ppm. | | | | |



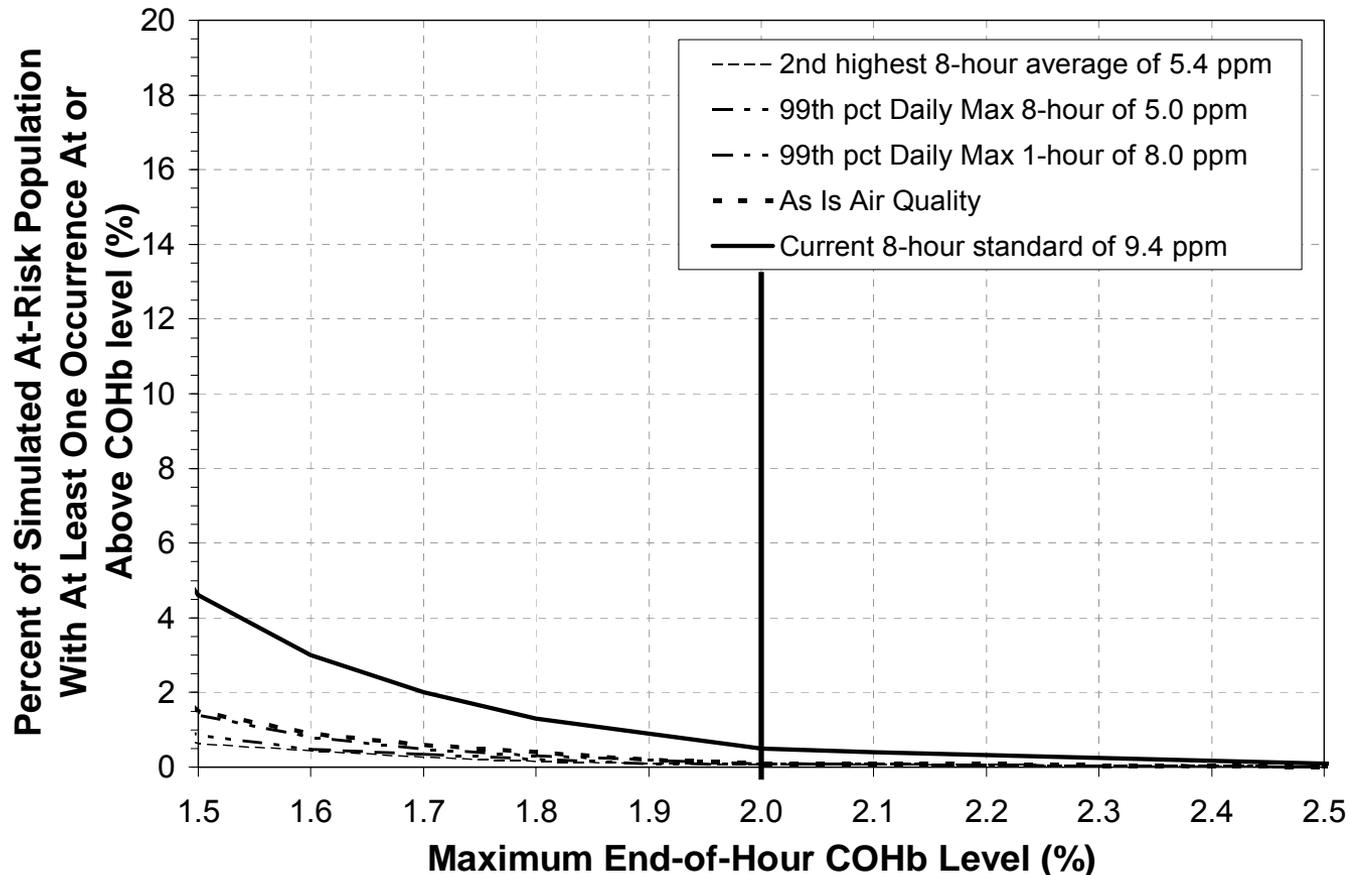
Results: Maximum End-of-Hour COHb for CHD Persons in Denver, All Air Quality Scenarios



- Variation in population COHb levels reflect variation in the ambient CO concentrations used in exposure scenarios.



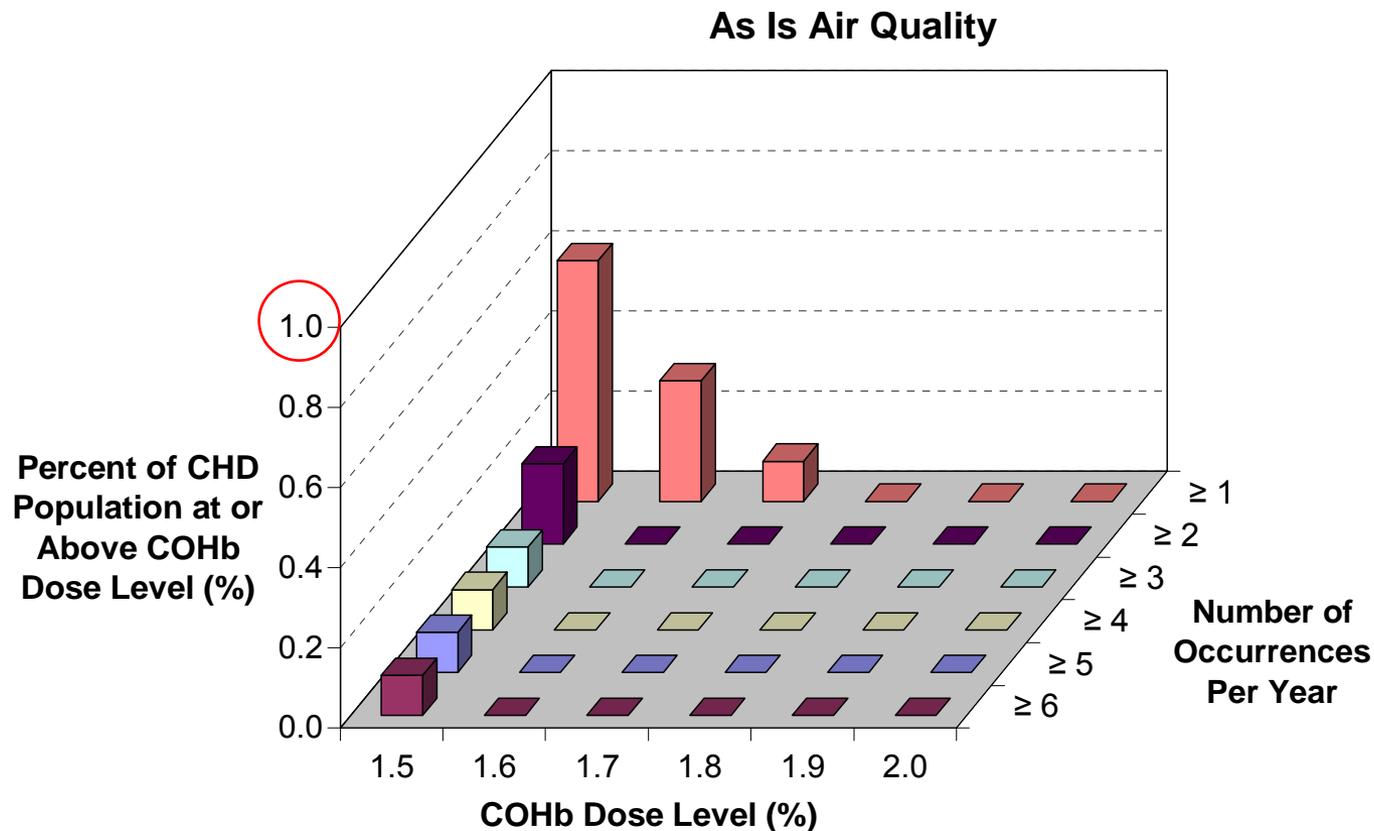
Results: Maximum End-of-Hour COHb for CHD Persons in Los Angeles, All Air Quality Scenarios



- Population COHb level estimates for all Los Angeles scenarios are lower than for Denver.
- Scenarios for *as is* air quality and just meeting potential alternative standards were each associated with fewer than 1% of CHD persons experiencing most COHb benchmark levels.



Results: Multiple COHb Dose Level Occurrences per Year to CHD Persons in Denver, *As Is* Air Quality

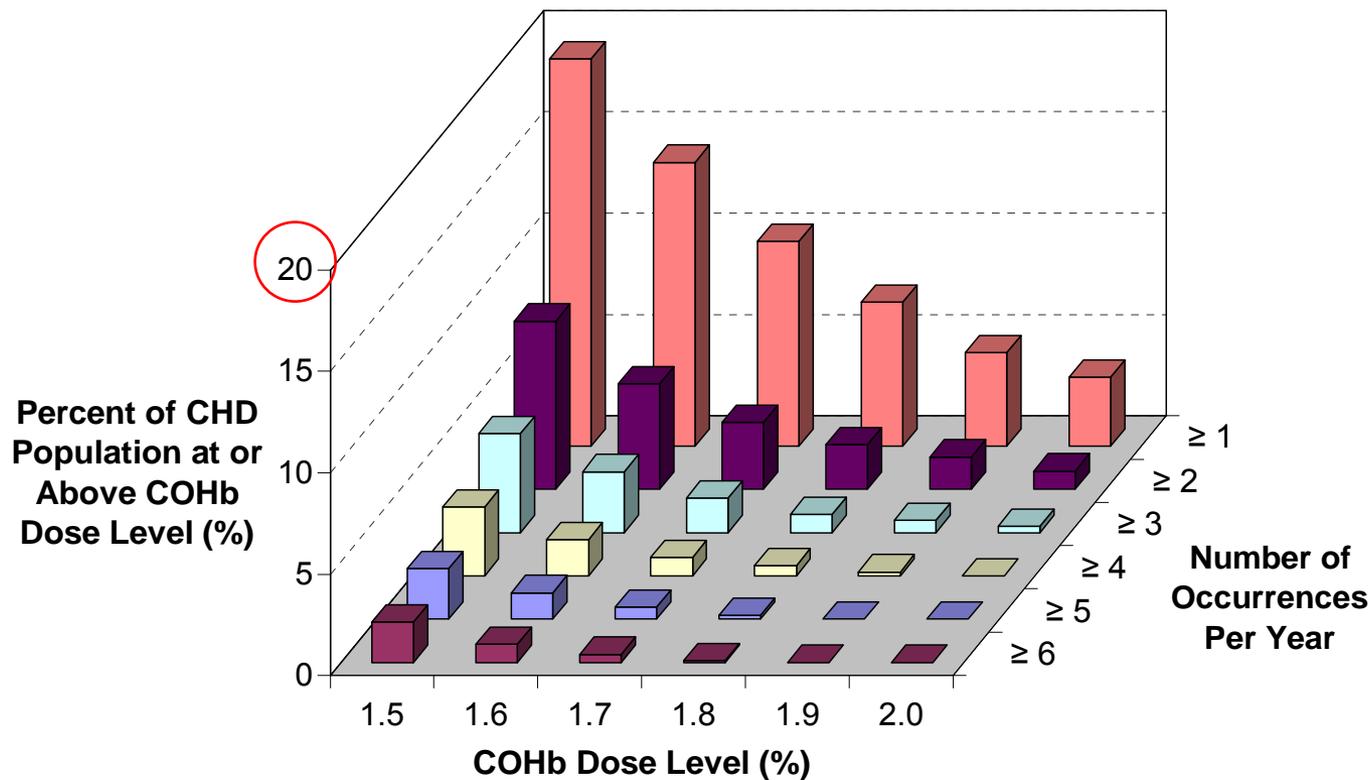


- As observed earlier, when considering *as is* air quality very few persons (< 1%) experienced a single occurrence of COHb levels above 1.5%, with even fewer having 2 or more occurrences in a year.



Results: Multiple COHb Dose Level Occurrences per Year to CHD Persons in Denver, Current 8-Hour Standard

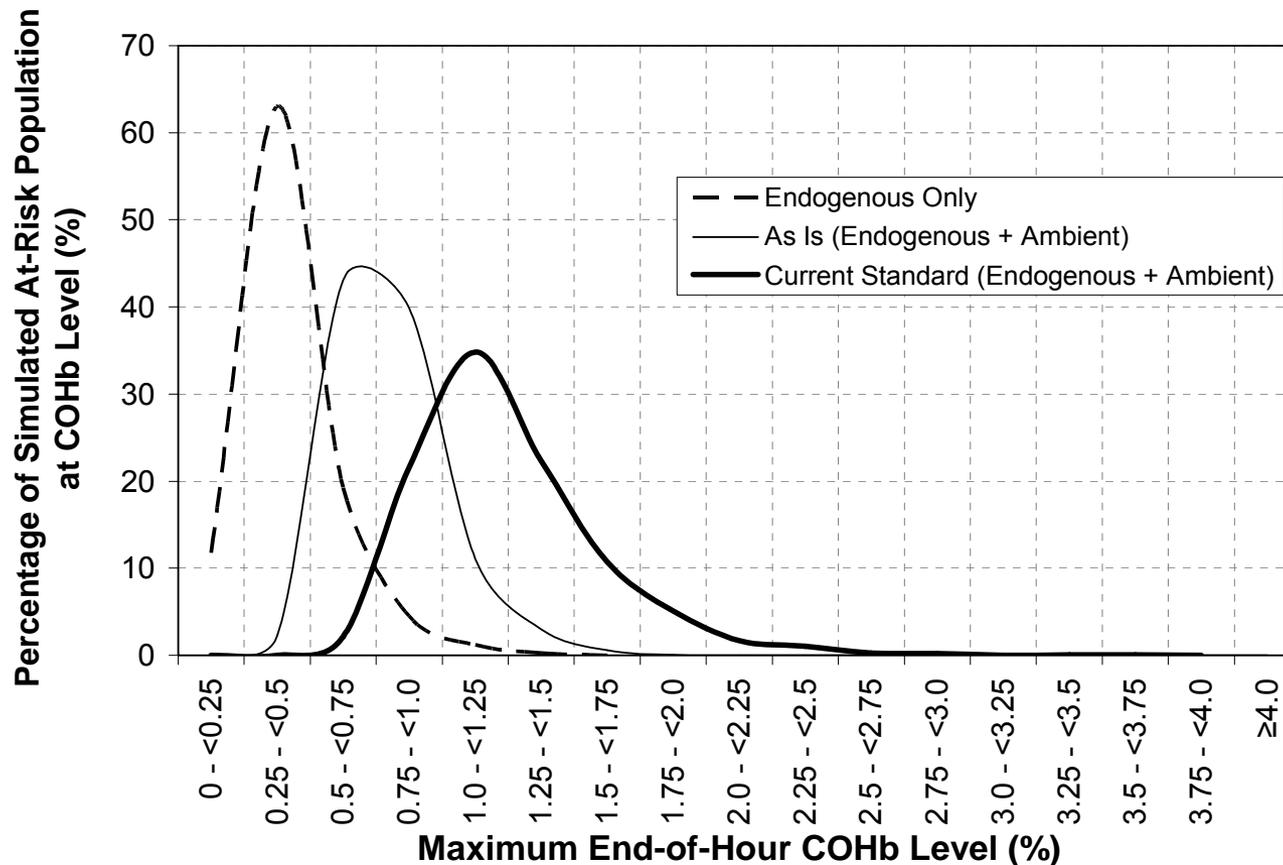
Air Quality Just Meeting the Current 8-hour Standard



- Most persons were estimated to experience a single occurrence at or above a selected COHb dose level per year.
- Very few persons experienced 2 or more COHb dose levels at or above 2.0%.



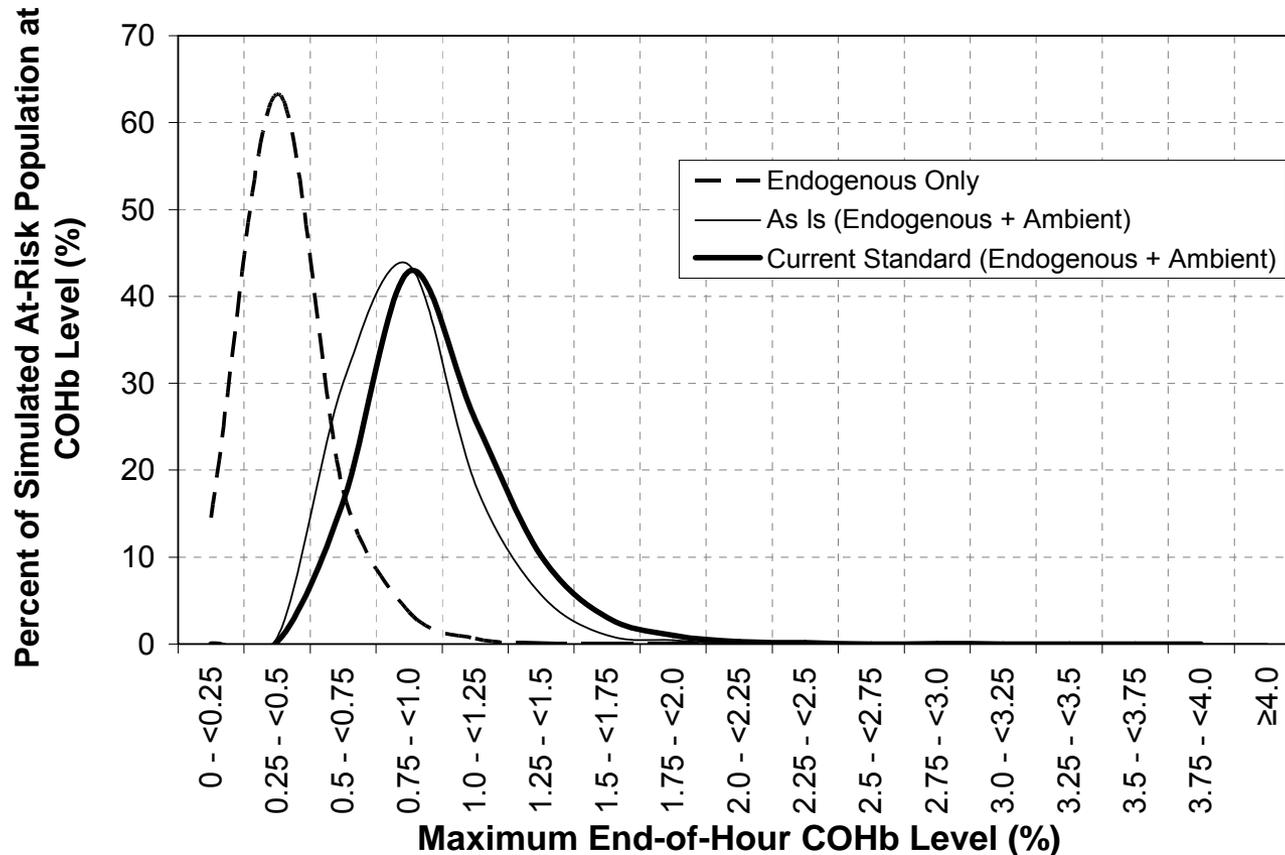
Results: Maximum End-of-Hour COHb for CHD Persons in Denver (Endogenous Contribution)



- Most CHD persons (95%) were estimated to have a maximum end-of-hour COHb contribution from endogenous CO production of less than 1.0%.
- Ambient exposure dominates maximum end-of-hour COHb levels at and above 1.0%.



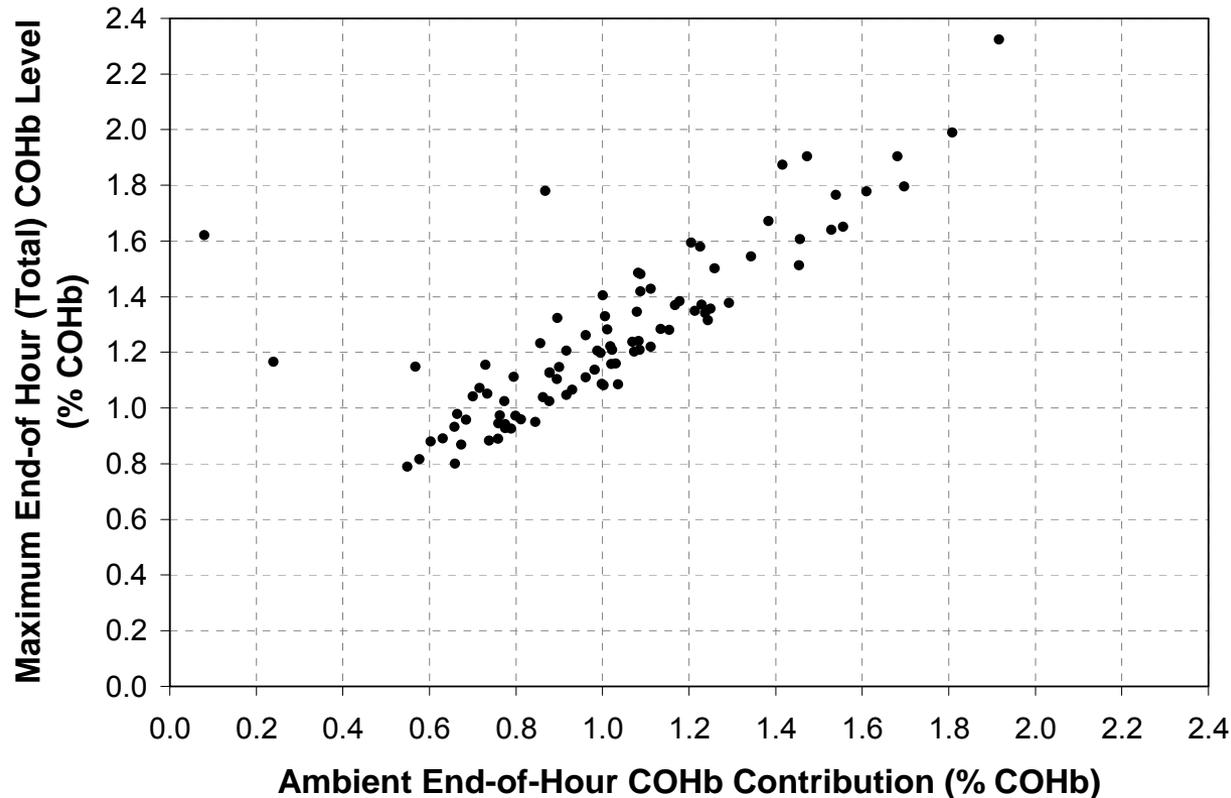
Results: Maximum End-of-Hour COHb for CHD Persons in Los Angeles (Endogenous Contribution)



- The distribution of maximum end-of-hour COHb resulting from endogenous CO production in Los Angeles CHD population is similar to that in Denver.
- Ambient exposure also dominates maximum end-of-hour COHb levels at and above 1.0%.



Results: Ambient Contribution to Maximum End-of-Hour COHb for 92 Randomly Selected Persons in Denver (using 1995 air quality adjusted to just meet current standard)

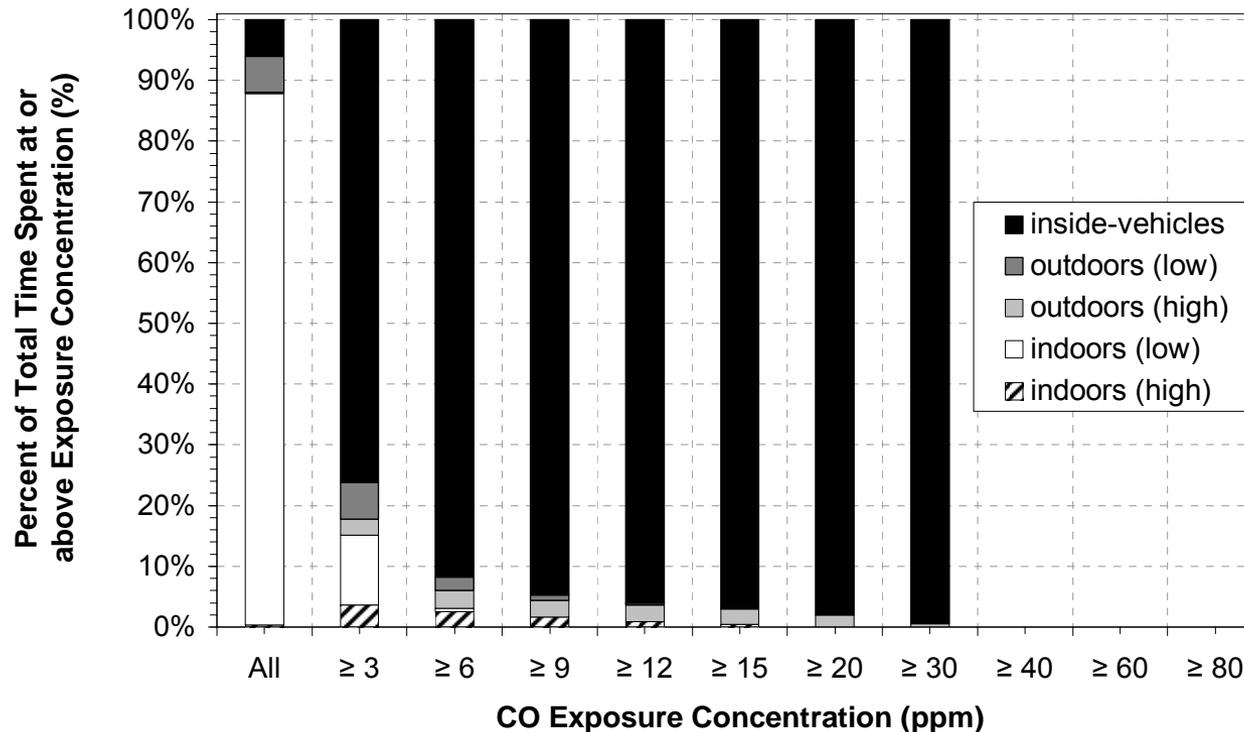


- For the majority of simulated individuals, the maximum end-of-hour COHb level is driven by ambient exposure.
- This also indicates, however, that a few individuals could have a large portion of their maximum end-of-hour COHb level contributed by endogenous CO production.



Results: Microenvironmental Contributions to Population Exposures in Denver, As Is Air Quality

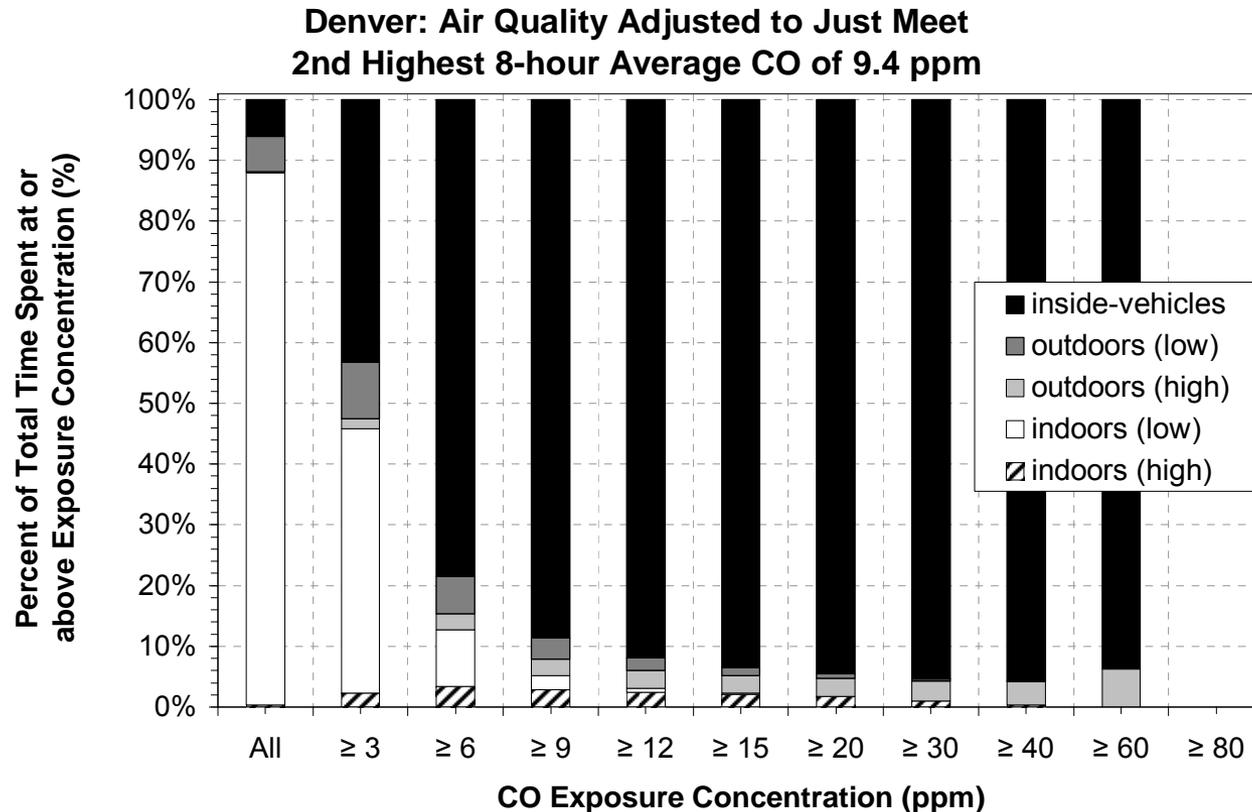
Denver: 2006 As Is Air Quality



- Of the total time the population experienced an exposure concentration at or above 3 ppm,
 - 75% of the time it occurred while in an in-vehicle microenvironment.
 - Just over 10% of the time it occurred in a "low" concentration indoor microenvironment.



Results: Microenvironmental Contributions to Population Exposures in Denver, Current 8-hour Standard



- **Of the total time the population experienced an exposure concentration at or above 3 ppm,**
 - **Just over 40% of the time it occurred while in an in-vehicle microenvironment and also while in a "low" concentration indoor microenvironments.**



Characterization of Uncertainty in the Assessment Results

- Approach
 - Identify sources that may influence exposure/dose estimates
 - Qualitatively rate magnitude and direction of influence and the state of the knowledge-base for identified sources
- Results for 14 identified sources
 - Direction of influence: bi-directional or unknown (12 sources), under (1), or over (1)
 - Magnitude of influence: medium (1) , low-medium (5), low (8 sources)
 - Knowledge-base: medium (8), low (6)
- Conclusions
 - Results represent best estimates of CO exposure for simulated population and exposure scenarios considered given time and data available
 - Six sources of uncertainty were identified for potentially improving the uncertainty characterization or representation in the exposure and dose assessment, given time and data availability
 - Spatial and temporal representation of ambient/outdoor concentrations
 - Use of historical data to represent alternative air quality scenarios
 - Representativeness of activity pattern data base
 - Representativeness of longitudinal profiles
 - Microenvironmental algorithm and input data
 - Physiological factors used to represent simulated at-risk population



Risk and Exposure Assessment Summary

- Overview of Charge for CASAC Review

- Background on assessing ambient CO exposure and risk
- Air quality considerations
- Characterization of exposure, dose and potential risk
 - Modified approach
 - Additional air quality scenarios
 - New outputs and analyses
- Characterization of variability and uncertainty

