



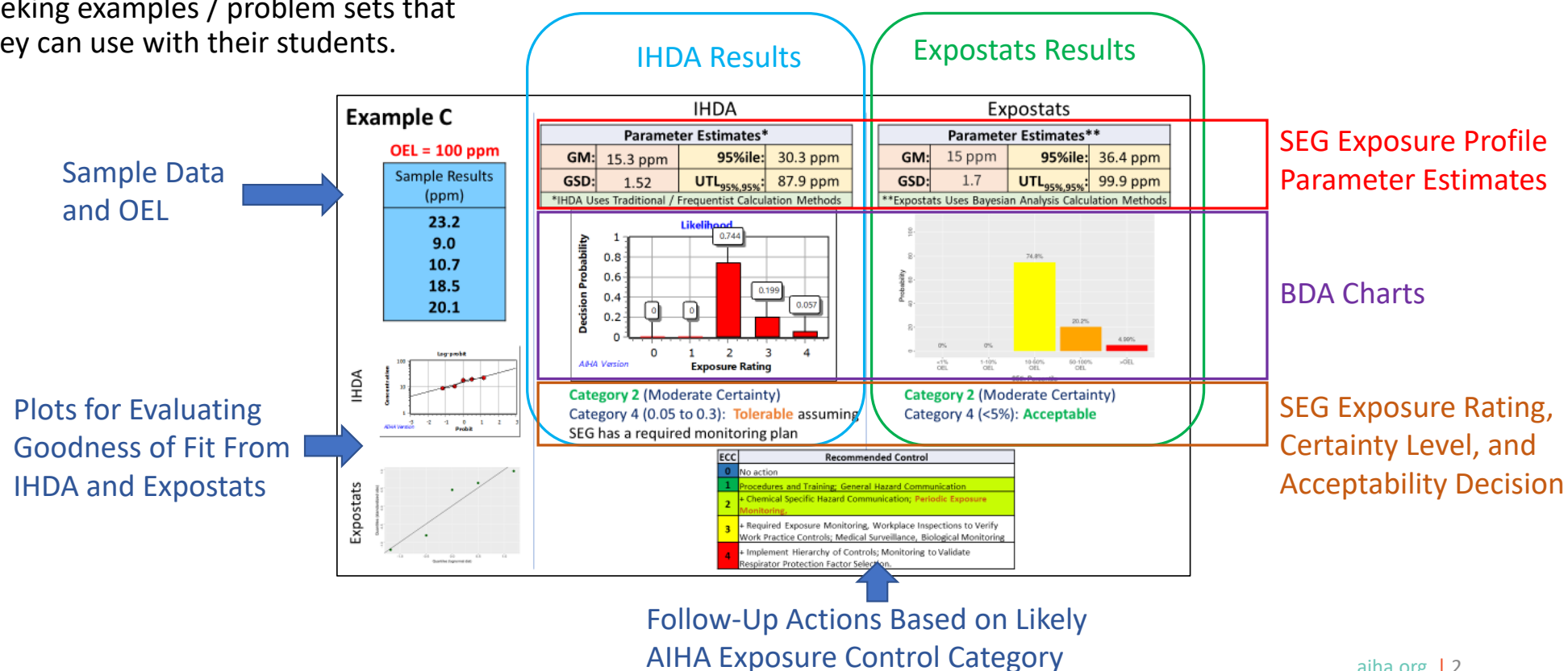
HEALTHIER WORKPLACES | A HEALTHIER WORLD

# **AIHA VIDEO SERIES: MAKING ACCURATE EXPOSURE RISK DECISIONS**

## **Worked Examples Using IHDA-AIHA and Expostats**

# Worked Examples

- Data Sets with solutions for those seeking more practice.
- Slides can be used by instructors seeking examples / problem sets that they can use with their students.



# Reminder: Steps in Data Analysis and Interpretation\*

## 1. Enter Data Into Appropriate Statistical Tool

## 2. Evaluate the Goodness-of-fit

## 3. Review Descriptive and Inferential Statistics

Compare...

- the “decision statistic” (e.g., sample 95<sup>th</sup> percentile) to the OEL.
- the 95%UCL to the OEL.

## 4. Assign a Final Rating and Certainty Level

- **Final Rating:** Compare the sample 95<sup>th</sup> percentile to the Exposure Control Categories (ECCs) and select a category.
- **Certainty Level:** Compare the 95%UCL to the ECCs:

Hewett's  
ROT

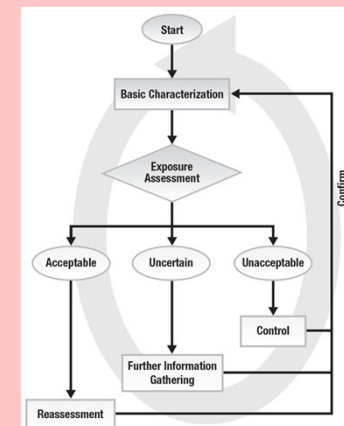
- Low certainty if  $\geq 2$  categories above the chosen ECC
- Medium certainty if only 1 category above
- High certainty if within chosen category

## 5. Document the Analysis and Recommendations

Recommend controls and/or PPE; work practice evaluation; additional sampling; surveillance sampling, etc.

### \*After Executing a Carefully Defined Monitoring Plan:

- Defined decision statistic
- Well defined SEG
- Appropriate OEL
- Well described exposure question
- Appropriate sampling strategy
- Valid and appropriate monitoring method
- Validated analytical method



# Reminder: Steps in Data Analysis and Interpretation\*

1. Enter Data Into Appropriate Statistical Tool
2. Evaluate the Goodness-of-fit
3. Review Descriptive and Inferential Statistics

Compare...

- the “decision statistic” (e.g., sample 95<sup>th</sup> percentile) to the OEL.
- the 95%UCL to the OEL.

## 4. Assign a Final Rating and Certainty Level

- **Final Rating:** Compare the sample 95<sup>th</sup> percentile to the Exposure Control Categories (ECCs) and select a category.
- **Certainty Level:** Compare the 95%UCL to the ECCs:
  - Low certainty if  $\geq 2$  categories above the chosen ECC
  - Medium certainty if only 1 category above
  - High certainty if within chosen category

Hewett's  
ROT

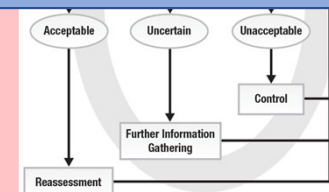
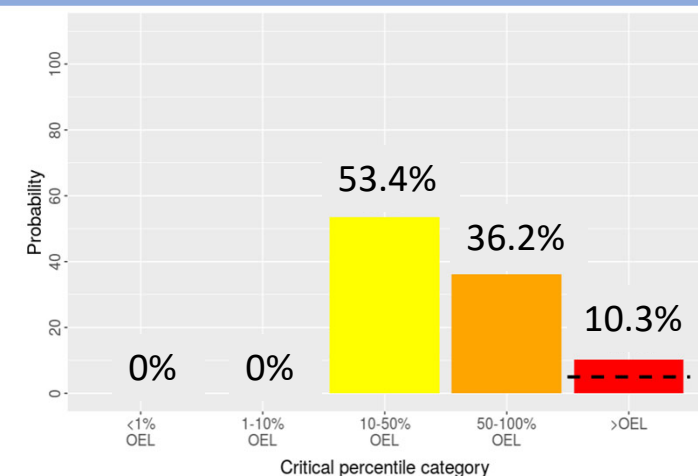
## 5. Document the Analysis and Recommendations

Recommend controls and/or PPE; work practice evaluation; additional sampling; surveillance sampling, etc.

**\*After Executing a Carefully Defined Monitoring Plan:**

- Defined decision statistic

**Use BDA to Further Inform Final Rating and Certainty Decision**



# Reminder: Steps in Data Analysis and Interpretation

## BDA Charts to Assign a Final Rating and Certainty Level

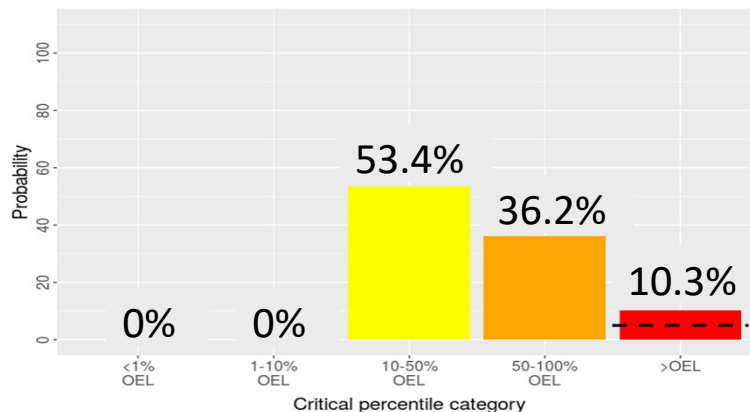
- **Final Exposure Rating**

- Exposure Control Category (ECCs) = category with highest bar

- **Certainty Level Rules of Thumb**

- Low Certainty – decision probability is  $< 0.5$
- Medium Certainty – decision probability is between 0.5 and 0.75
- High Certainty – decision probability is greater than 0.75.

Rules of thumb  
are *guidelines*,  
not bright lines.



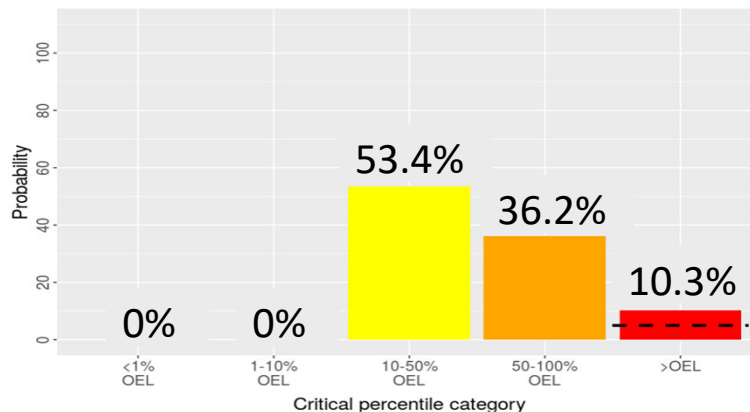
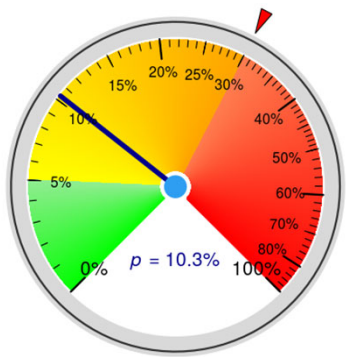
Category 2  
(Medium Certainty)

# Reminder: Steps in Data Analysis and Interpretation

## Checking Likelihood of Category 4 (95%ile > OEL)

- If  $ECC \leq 3$ , check Category 4:

- Large Category 4 decision probabilities indicate that the true 95th percentile may exceed the OEL and therefore should be a cause for concern whenever the SEG is unlikely to be reevaluated for an extended period.
- As a rule-of-thumb, Category 4 decision probabilities up to 0.30 are tolerable, provided the SEG is regularly checked as part of an ongoing monitoring strategy.
  - < 0.05 – **acceptable**
  - 0.05-0.3 – **tolerable**, assuming the SEG has a required monitoring plan
  - > 0.3 – **problematic**, particularly if the SEG has no monitoring plan.



**Category 2**  
**(Medium Certainty)**

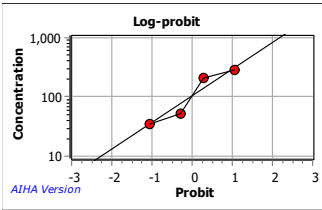
**Tolerable** assuming  
SEG has a required  
monitoring plan

Example A

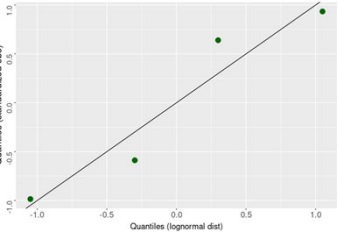
OEL = 500 ppm

| Sample Results (ppm) |
|----------------------|
| 292                  |
| 53                   |
| 34                   |
| 210                  |

IHDA

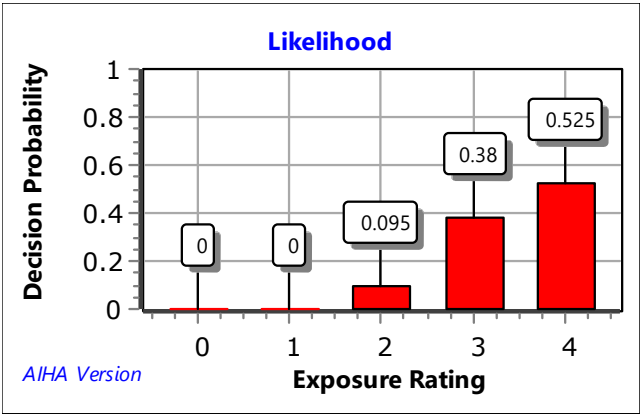


Expostats



IHDA

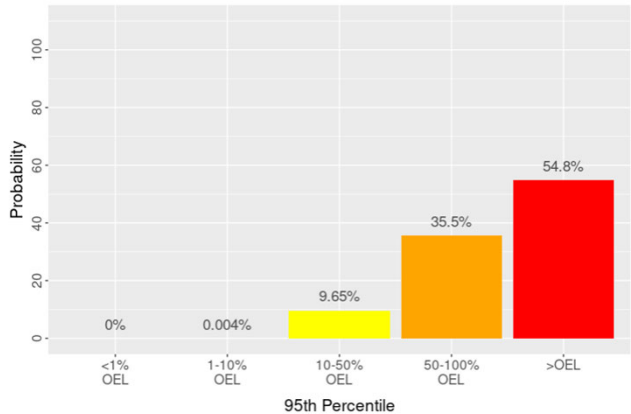
| Parameter Estimates*                                     |         |                          |            |
|----------------------------------------------------------|---------|--------------------------|------------|
| GM:                                                      | 103 ppm | 95%ile:                  | 570 ppm    |
| GSD:                                                     | 2.8     | UTL <sub>95%,95%</sub> : | 21,900 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |         |                          |            |



Category 4 (Moderate Certainty)  
Unacceptable

Expostats

| Parameter Estimates**                                  |         |                          |          |
|--------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                    | 100 ppm | 95%ile:                  | 547 ppm  |
| GSD:                                                   | 2.8     | UTL <sub>95%,95%</sub> : | 3450 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |         |                          |          |



Category 4 (Moderate Certainty)  
Unacceptable

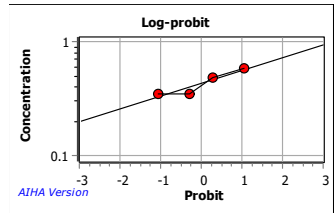
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example B

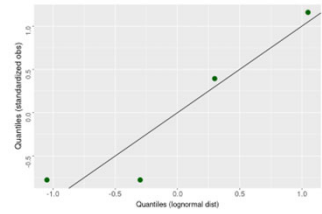
OEL = 20 ppm

| Sample Results (ppm) |
|----------------------|
| 0.35                 |
| 0.59                 |
| 0.48                 |
| 0.35                 |

IHDA

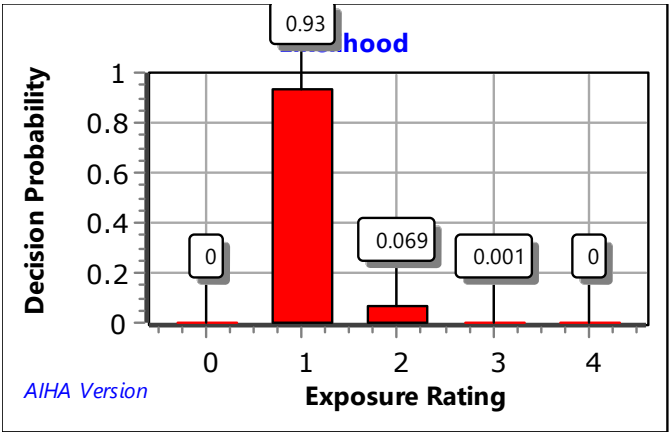


Expostats



IHDA

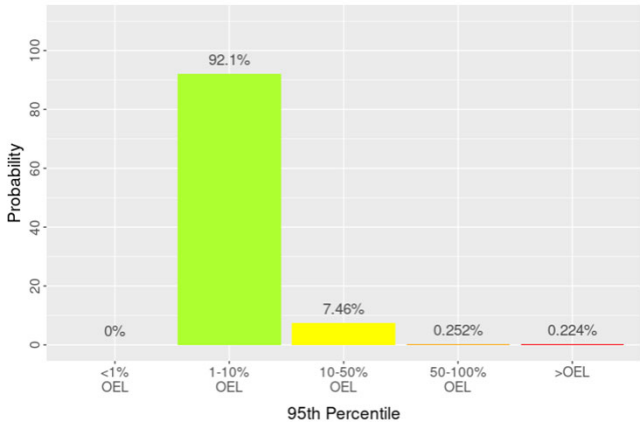
| Parameter Estimates*                                     |      |                          |          |
|----------------------------------------------------------|------|--------------------------|----------|
| GM:                                                      | 0.43 | 95%ile:                  | 0.66 ppm |
| GSD:                                                     | 1.29 | UTL <sub>95%,95%</sub> : | 1.61 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |      |                          |          |



Category 1 (High Certainty)  
Category 4 (<0.05): Acceptable

Expostats

| Parameter Estimates**                                  |          |                          |          |
|--------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                    | 0.43 ppm | 95%ile:                  | 0.86 ppm |
| GSD:                                                   | 1.45     | UTL <sub>95%,95%</sub> : | 2.49 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |          |                          |          |



Category 1 (High Certainty)  
Category 4 (<5%): Acceptable

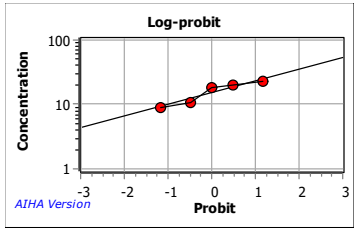
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example C

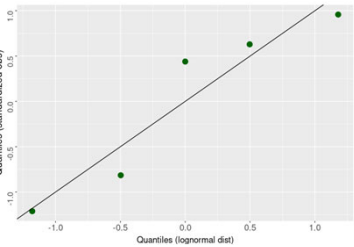
OEL = 100 ppm

| Sample Results (ppm) |
|----------------------|
| 23.2                 |
| 9.0                  |
| 10.7                 |
| 18.5                 |
| 20.1                 |

IHDA

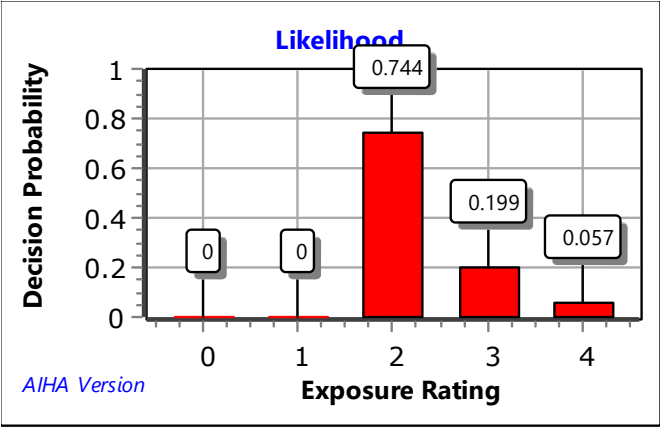


Expostats



IHDA

| Parameter Estimates*                                     |          |                          |          |
|----------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                      | 15.3 ppm | 95%ile:                  | 30.3 ppm |
| GSD:                                                     | 1.52     | UTL <sub>95%,95%</sub> : | 87.9 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |          |                          |          |

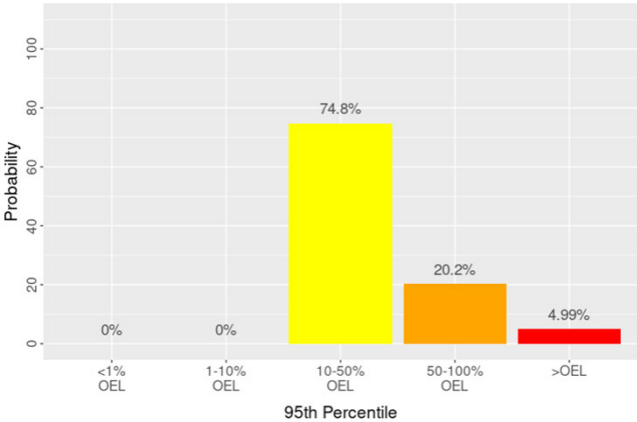


Category 2 (Moderate Certainty)  
Category 4 (0.05 to 0.3): **Tolerable** assuming  
SEG has a required monitoring plan

| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; <b>Periodic Exposure Monitoring,</b>                                                      |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Expostats

| Parameter Estimates**                                  |        |                          |          |
|--------------------------------------------------------|--------|--------------------------|----------|
| GM:                                                    | 15 ppm | 95%ile:                  | 36.4 ppm |
| GSD:                                                   | 1.7    | UTL <sub>95%,95%</sub> : | 99.9 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |        |                          |          |



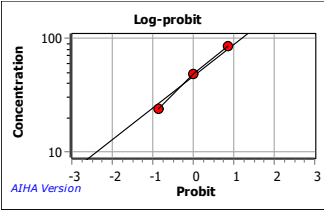
Category 2 (Moderate Certainty)  
Category 4 (<5%): **Acceptable**

Example D

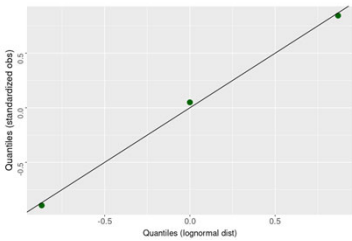
OEL = 100 ppm

| Sample Results<br>(ppm) |
|-------------------------|
| 86                      |
| 24                      |
| 48                      |

IHDA

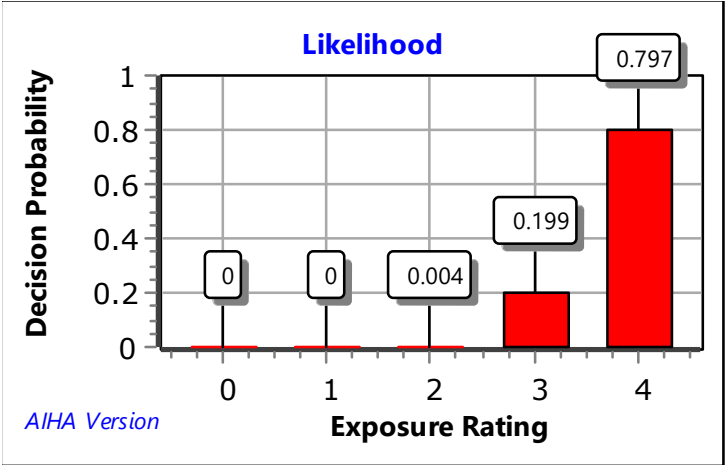


Expostats



IHDA

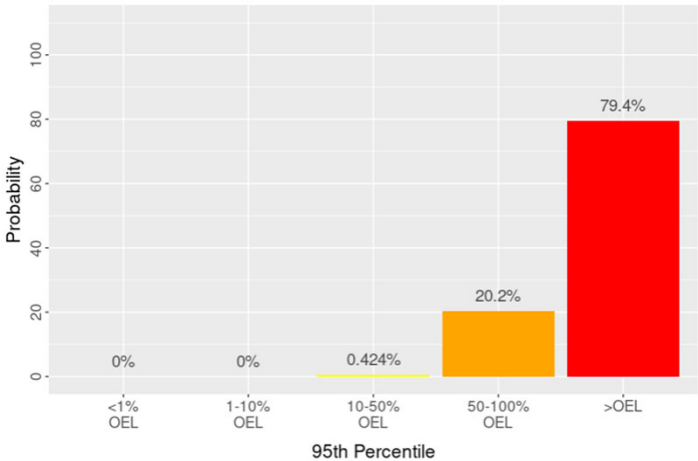
| Parameter Estimates*                                     |          |                          |          |
|----------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                      | 46.3 ppm | 95%ile:                  | 132 ppm  |
| GSD:                                                     | 1.894    | UTL <sub>95%,95%</sub> : | 6160 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |          |                          |          |



Category 4 (High Certainty)  
Unacceptable

Expostats

| Parameter Estimates**                                  |        |                          |         |
|--------------------------------------------------------|--------|--------------------------|---------|
| GM:                                                    | 46 ppm | 95%ile:                  | 156 ppm |
| GSD:                                                   | 2.1    | UTL <sub>95%,95%</sub> : | 951 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |        |                          |         |



Category 4 (High Certainty)  
Unacceptable

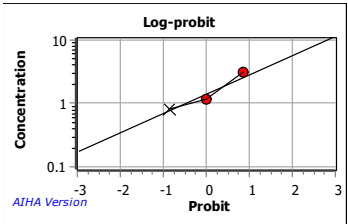
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example E

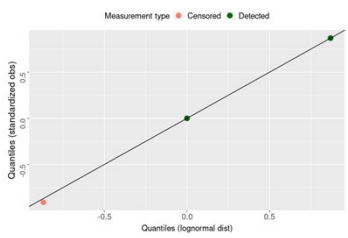
OEL = 50 ppm

| Sample Results (ppm) |
|----------------------|
| 1.14                 |
| <0.8                 |
| 3                    |

IHDA



Expostats

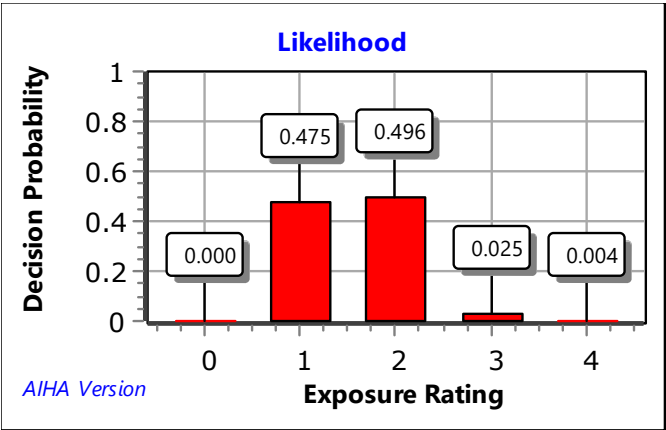


IHDA

| Parameter Estimates*† |          |                          |          |
|-----------------------|----------|--------------------------|----------|
| GM:                   | 1.26 ppm | 95%ile:                  | 5.14 ppm |
| GSD:                  | 2.35     | UTL <sub>95%,95%</sub> : | 877      |

\*IHDA Uses Traditional / Frequentist Calculation Methods

†IHDA-AIHA CDA used substitution with DL/sqrt(2)

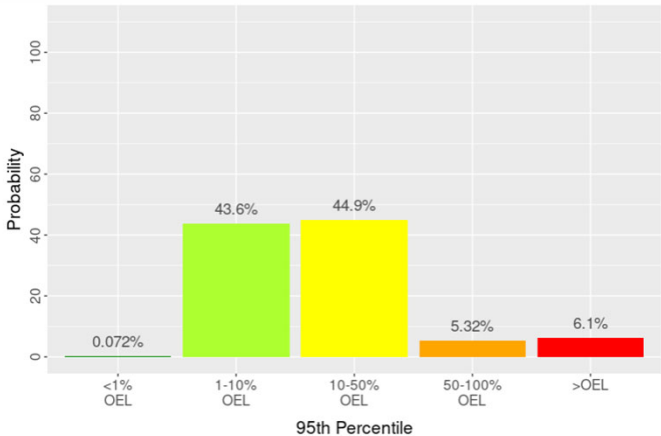


Category 2 (Low Certainty)  
Category 4 (<0.05): Acceptable

Expostats

| Parameter Estimates** |         |                          |          |
|-----------------------|---------|--------------------------|----------|
| GM:                   | 1.1 ppm | 95%ile:                  | 5.71 ppm |
| GSD:                  | 2.8     | UTL <sub>95%,95%</sub> : | 61.5 ppm |

\*\*Expostats Uses Bayesian Analysis Calculation Methods



Category 2 (Low Certainty)  
Category 4 (5 to 30%): Tolerable assuming SEG has a required monitoring plan

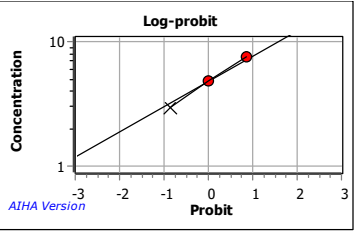
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example F

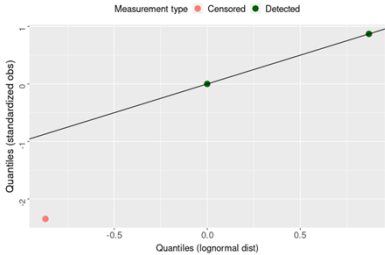
OEL = 500 ppm

| Sample Results<br>(ppm) |
|-------------------------|
| 7.6                     |
| <3                      |
| 4.9                     |

IHDA



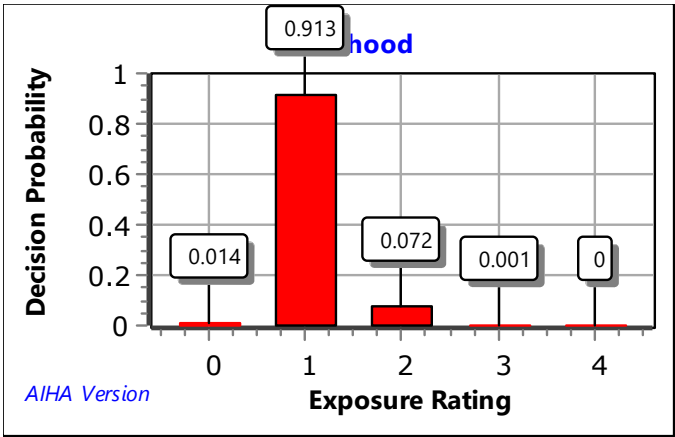
Expostats



IHDA

| Parameter Estimates*†                                    |         |                          |          |
|----------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                      | 4.3 ppm | 95%ile:                  | 12.5 ppm |
| GSD:                                                     | 1.9     | UTL <sub>95%,95%</sub> : | 614 ppm  |
| *IHDA Uses Traditional / Frequentist Calculation Methods |         |                          |          |

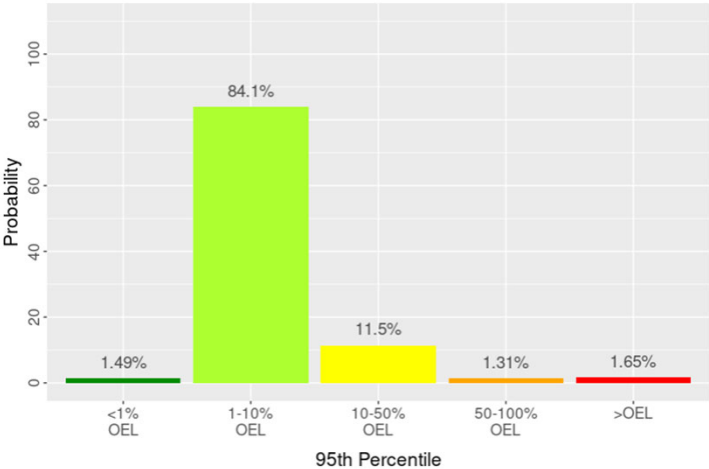
†IHDA-AIHA CDA used substitution with DL/sqrt(2)



Category 1 (High Certainty)  
Category 4 (<0.05): Acceptable

Expostats

| Parameter Estimates**                                  |         |                          |          |
|--------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                    | 3.9 ppm | 95%ile:                  | 15.8 ppm |
| GSD:                                                   | 2.4     | UTL <sub>95%,95%</sub> : | 143 ppm  |
| **Expostats Uses Bayesian Analysis Calculation Methods |         |                          |          |



Category 1(High Certainty)  
Category 4 (<5%): Acceptable

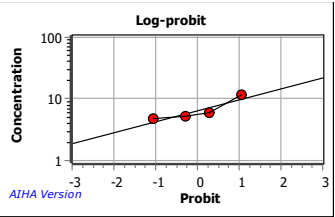
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example G

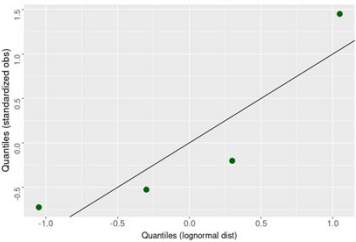
OEL = 100 ppm

| Sample Results (ppm) |
|----------------------|
| 11.80                |
| 4.77                 |
| 5.93                 |
| 5.18                 |

IHDA



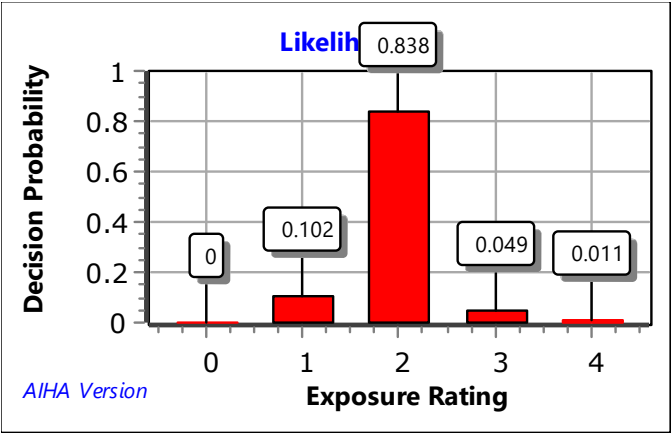
Expostats



IHDA

| Parameter Estimates* |         |                          |          |
|----------------------|---------|--------------------------|----------|
| GM:                  | 6.5 ppm | 95%ile:                  | 12.7 ppm |
| GSD:                 | 1.5     | UTL <sub>95%,95%</sub> : | 53.9 ppm |

\*IHDA Uses Traditional / Frequentist Calculation Methods

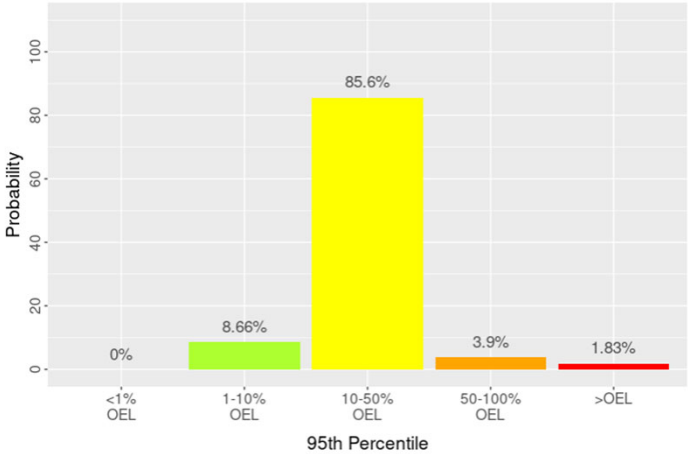


Category 2 (High Certainty)  
Category 4 (<0.05): **Acceptable**

Expostats

| Parameter Estimates** |         |                          |          |
|-----------------------|---------|--------------------------|----------|
| GM:                   | 6.4 ppm | 95%ile:                  | 15.9 ppm |
| GSD:                  | 1.8     | UTL <sub>95%,95%</sub> : | 54.4 ppm |

\*\*Expostats Uses Bayesian Analysis Calculation Methods



Category 2 (High Certainty)  
Category 4 (<5%): **Acceptable**

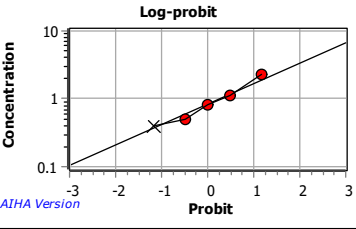
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example H

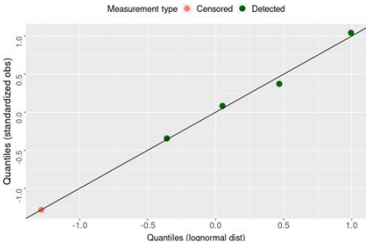
OEL = 5 ppm

| Sample Results (ppm) |
|----------------------|
| <0.4                 |
| 2.3                  |
| 1.1                  |
| 0.8                  |
| 0.5                  |

IHDA



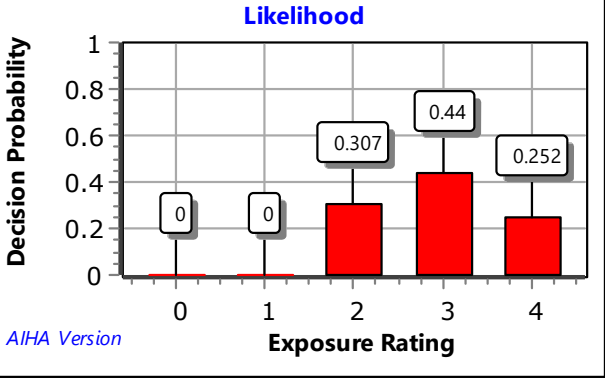
Expostats



IHDA

| Parameter Estimates*†                                    |           |                          |          |
|----------------------------------------------------------|-----------|--------------------------|----------|
| GM:                                                      | 0.771 ppm | 95%ile:                  | 3.34 ppm |
| GSD:                                                     | 2.438     | UTL <sub>95%,95%</sub> : | 32.7 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |           |                          |          |

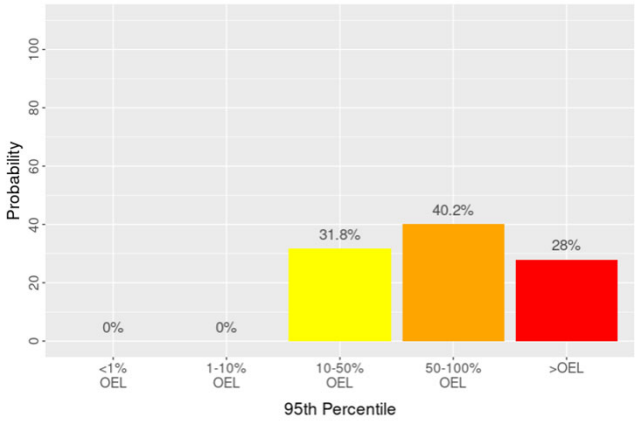
†IHDA-AIHA CDA set at LPR (log-probit regression)



Category 3 (Low Certainty)  
Category 4 (0.05 to 0.3): **Tolerable** assuming SEG has a required monitoring plan

Expostats

| Parameter Estimates**                                  |          |                          |          |
|--------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                    | 0.75 ppm | 95%ile:                  | 3.3 ppm  |
| GSD:                                                   | 2.5      | UTL <sub>95%,95%</sub> : | 16.1 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |          |                          |          |



Category 3 (Low Certainty)  
Category 4 (5 to 30%): **Tolerable** assuming SEG has a required monitoring plan

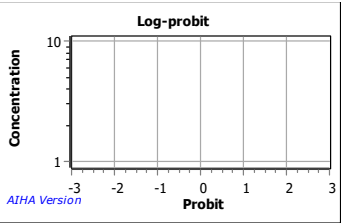
| ECC | Recommended Control                                                                                                                         |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                                   |
| 1   | Procedures and Training; General Hazard Communication                                                                                       |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                                     |
| 3   | + <b>Required Exposure Monitoring</b> , Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                           |

# Example I

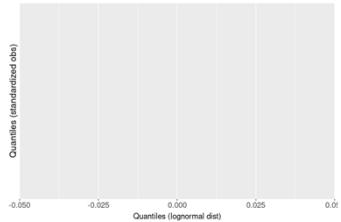
OEL = 50 ppm

|                      |
|----------------------|
| Sample Results (ppm) |
| 32                   |

IHDA

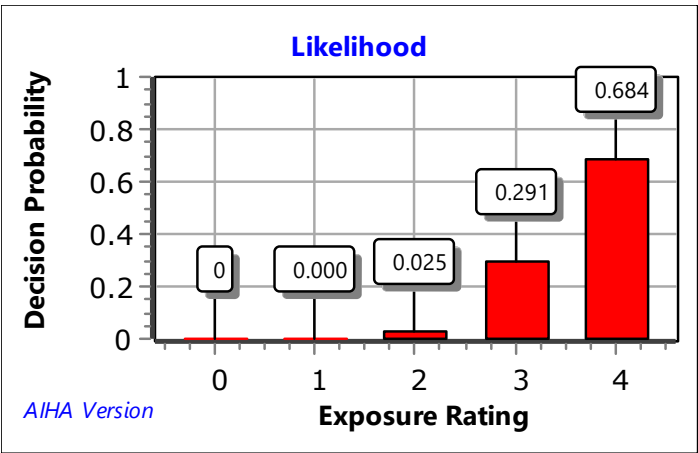


Expostats



## IHDA

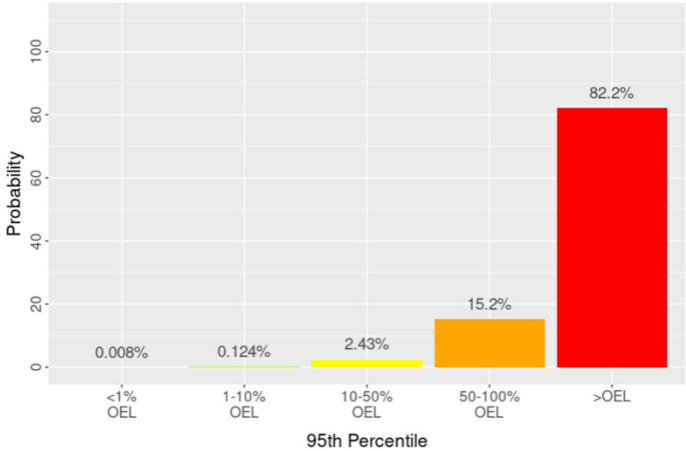
| Parameter Estimates*                                     |   |                          |   |
|----------------------------------------------------------|---|--------------------------|---|
| GM:                                                      | ? | 95%ile:                  | ? |
| GSD:                                                     | ? | UTL <sub>95%,95%</sub> : | ? |
| *IHDA Uses Traditional / Frequentist Calculation Methods |   |                          |   |



Category 4 (Moderate Certainty)  
Unacceptable

## Expostats

| Parameter Estimates**                                  |        |                          |          |
|--------------------------------------------------------|--------|--------------------------|----------|
| GM:                                                    | 32 ppm | 95%ile:                  | 111 ppm  |
| GSD:                                                   | 2.3    | UTL <sub>95%,95%</sub> : | 3810 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |        |                          |          |



Category 4 (High Certainty)  
Unacceptable

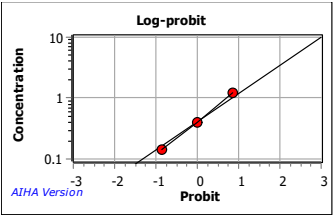
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example J

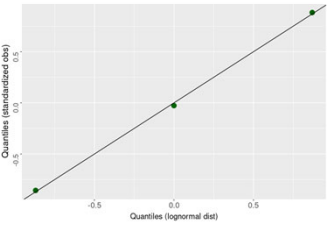
OEL = 5 ppm

| Sample Results<br>(ppm) |
|-------------------------|
| 0.14                    |
| 0.39                    |
| 1.2                     |

IHDA

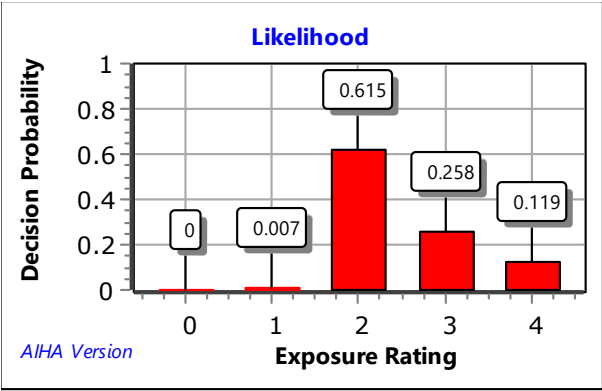


Expostats



IHDA

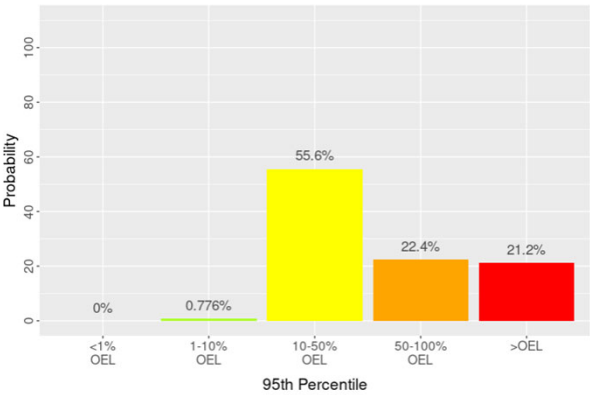
| Parameter Estimates*                                     |         |                          |          |
|----------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                      | 0.4 ppm | 95%ile:                  | 2.36 ppm |
| GSD:                                                     | 2.9     | UTL <sub>95%,95%</sub> : | 1510 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |         |                          |          |



Category 2 (Moderate Certainty)  
Category 4 (0.05 to 0.3): **Tolerable** assuming  
SEG has a required monitoring plan

Expostats

| Parameter Estimates**                                  |         |                          |          |
|--------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                    | 0.4 ppm | 95%ile:                  | 2.17 ppm |
| GSD:                                                   | 2.8     | UTL <sub>95%,95%</sub> : | 19.7 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |         |                          |          |



Category 2 (Moderate Certainty)  
Category 4 (5 to 30%): **Tolerable** assuming  
SEG has a required monitoring plan

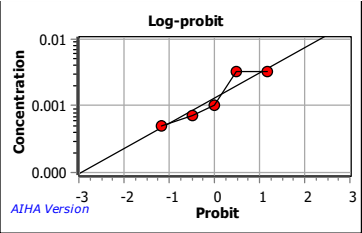
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; <b>Periodic Exposure Monitoring,</b>                                                      |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example K

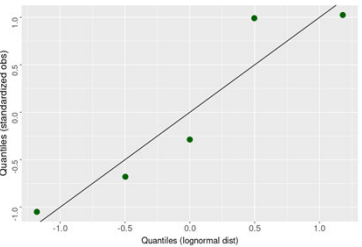
OEL = 1 ppm

| Sample Results (ppm) |
|----------------------|
| 0.0032               |
| 0.0005               |
| 0.0033               |
| 0.0010               |
| 0.0007               |

IHDA

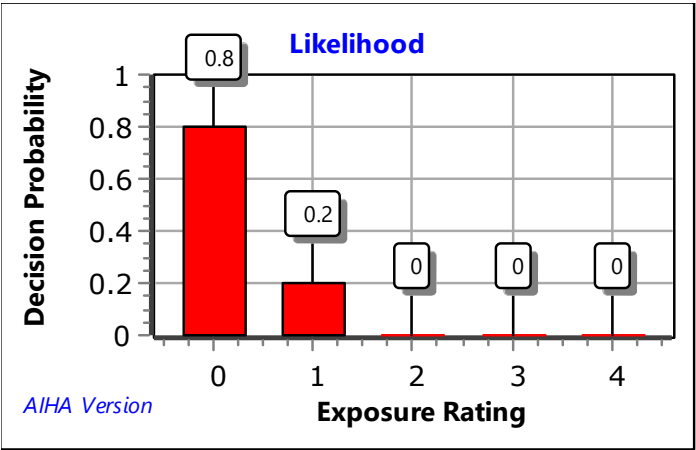


Expostats



IHDA

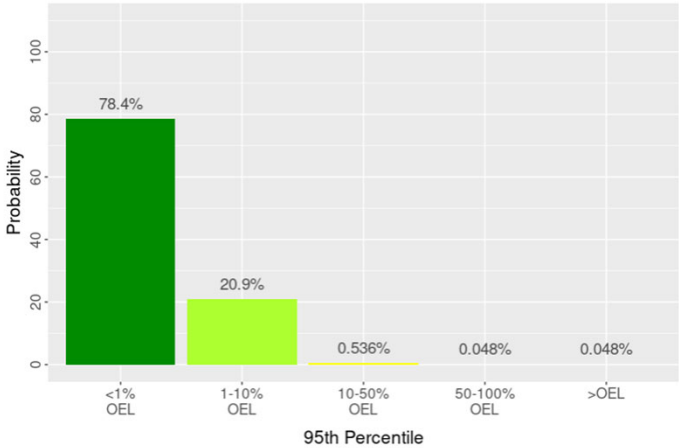
| Parameter Estimates*                                     |            |                          |            |
|----------------------------------------------------------|------------|--------------------------|------------|
| GM:                                                      | 0.0013 ppm | 95%ile:                  | 0.0055 ppm |
| GSD:                                                     | 2.93       | UTL <sub>95%,95%</sub> : | 0.051 ppm  |
| *IHDA Uses Traditional / Frequentist Calculation Methods |            |                          |            |



Category 0 (High Certainty)  
Category 4 (<0.05): **Acceptable**

Expostats

| Parameter Estimates**                                  |            |                          |            |
|--------------------------------------------------------|------------|--------------------------|------------|
| GM:                                                    | 0.0013 ppm | 95%ile:                  | 0.0056 ppm |
| GSD:                                                   | 2.5        | UTL <sub>95%,95%</sub> : | 0.025 ppm  |
| **Expostats Uses Bayesian Analysis Calculation Methods |            |                          |            |



Category 0 (High Certainty)  
Category 4 (<5%): **Acceptable**

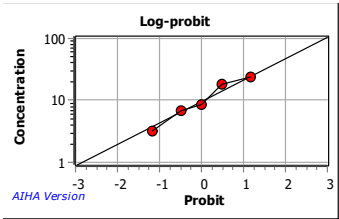
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example L

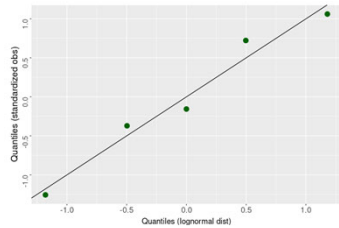
OEL = 50 ppm

| Sample Results (ppm) |
|----------------------|
| 8.36                 |
| 3.20                 |
| 6.93                 |
| 24.2                 |
| 18.0                 |

IHDA



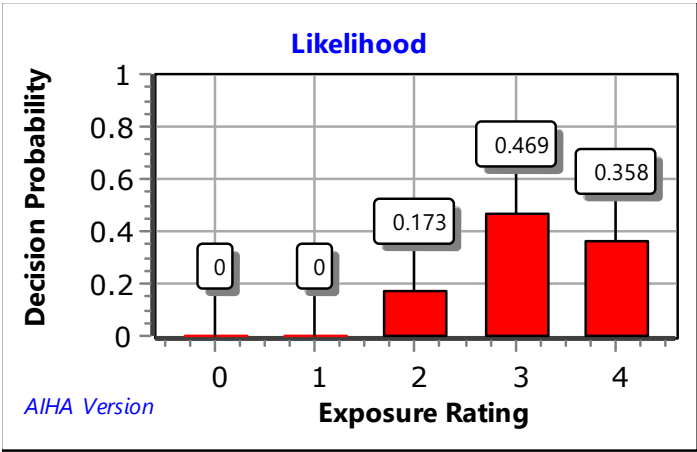
Expostats



IHDA

| Parameter Estimates* |         |                          |          |
|----------------------|---------|--------------------------|----------|
| GM:                  | 9.6 ppm | 95%ile:                  | 35.9 ppm |
| GSD:                 | 2.23    | UTL <sub>95%,95%</sub> : | 281 ppm  |

\*IHDA Uses Traditional / Frequentist Calculation Methods

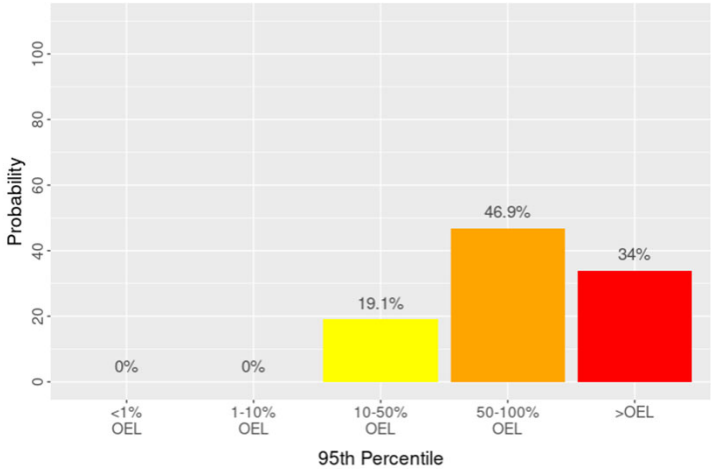


Category 3 (Low Certainty)  
Category 4 (>0.3): Problematic to Unacceptable

Expostats

| Parameter Estimates** |         |                          |          |
|-----------------------|---------|--------------------------|----------|
| GM:                   | 9.6 ppm | 95%ile:                  | 38.5 ppm |
| GSD:                  | 2.3     | UTL <sub>95%,95%</sub> : | 151 ppm  |

\*\*Expostats Uses Bayesian Analysis Calculation Methods



Category 3 (Low Certainty)  
Category 4 (>30%): Problematic to Unacceptable

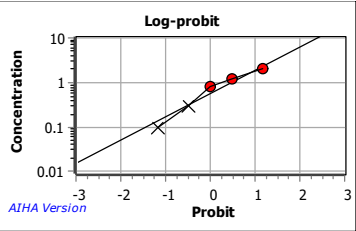
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example M

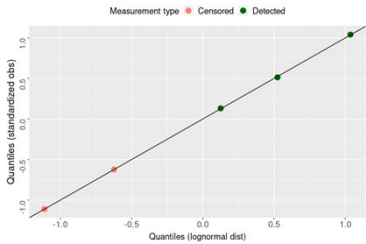
OEL = 5 ppm

| Sample Results (ppm) |
|----------------------|
| <0.1                 |
| 2.1                  |
| 1.2                  |
| 0.8                  |
| <0.3                 |

IHDA



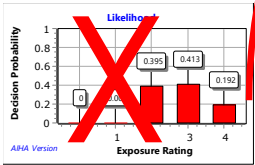
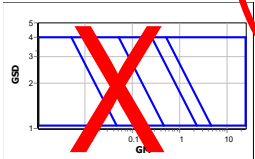
Expostats



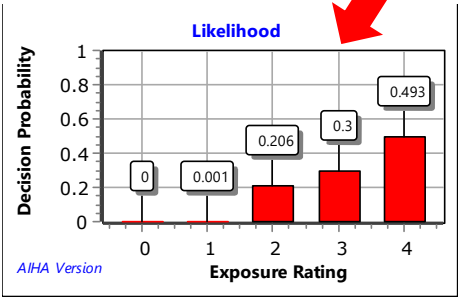
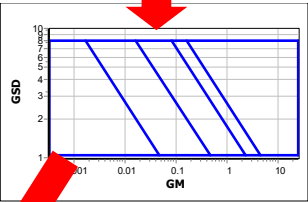
IHDA

| Parameter Estimates*†                                    |          |                          |         |
|----------------------------------------------------------|----------|--------------------------|---------|
| GM:                                                      | 0.50 ppm | 95%ile:                  | 4.8 ppm |
| GSD:                                                     | 3.97     | UTL <sub>95%,95%</sub> : | 163 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |          |                          |         |

†IHDA-AIHA CDA used substitution with DL/sqrt(2)



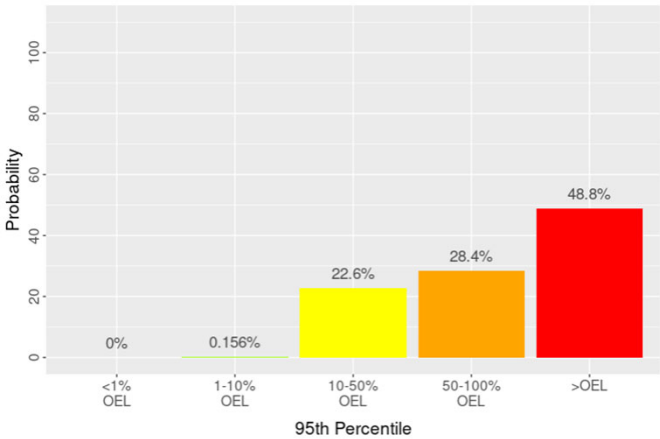
GSD too close to upper bound of Default Parameter Space. Increase to 8.0.



Category 4 (Low Certainty)  
Unacceptable

Expostats

| Parameter Estimates**                                  |          |                          |          |
|--------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                    | 0.38 ppm | 95%ile:                  | 4.86 ppm |
| GSD:                                                   | 4.9      | UTL <sub>95%,95%</sub> : | 63.1 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |          |                          |          |



Category 4 (Low Certainty)  
Unacceptable

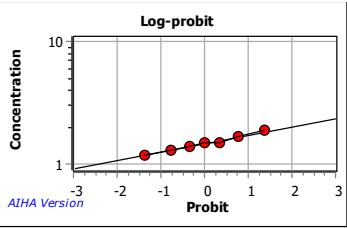
| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

Example N

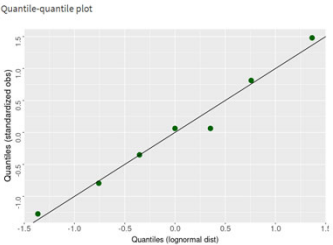
OEL = 10 ppm

| Sample Results (ppm) |
|----------------------|
| 1.7                  |
| 1.2                  |
| 1.5                  |
| 1.9                  |
| 1.3                  |
| 1.4                  |
| 1.5                  |

IHDA



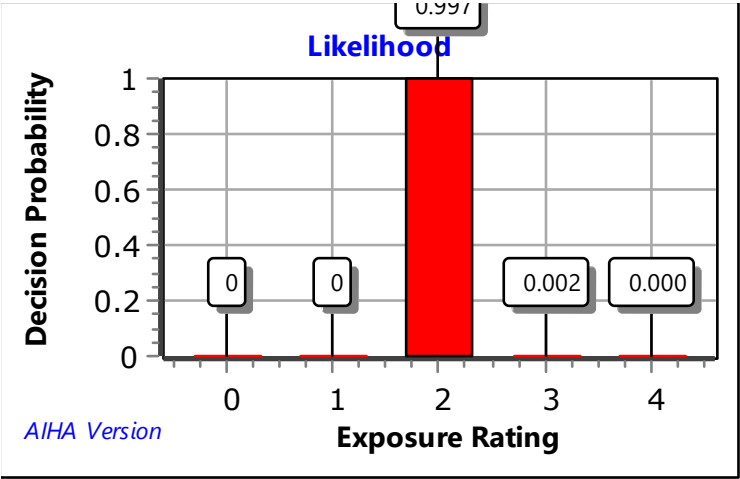
Expostats



IHDA

| Parameter Estimates* |          |                          |          |
|----------------------|----------|--------------------------|----------|
| GM:                  | 1.48 ppm | 95%ile:                  | 1.92 ppm |
| GSD:                 | 1.169    | UTL <sub>95%,95%</sub> : | 2.52 ppm |

\*IHDA Uses Traditional / Frequentist Calculation Methods

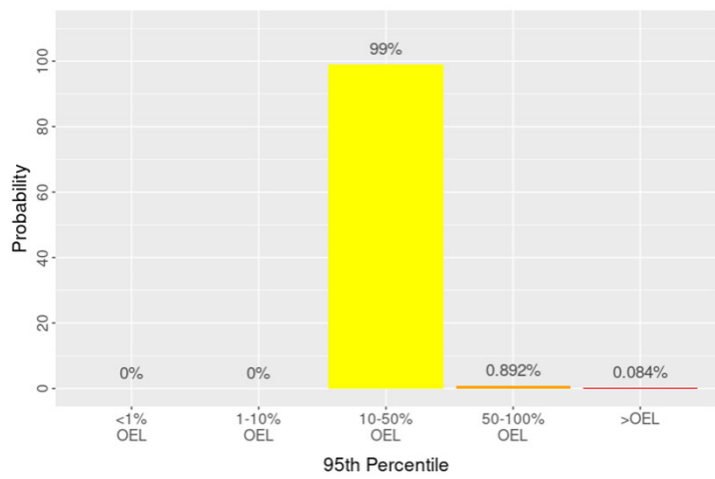


Category 2 (High Certainty)  
Category 4 (<0.05): **Acceptable**

Expostats

| Parameter Estimates** |         |                          |          |
|-----------------------|---------|--------------------------|----------|
| GM:                   | 1.5 ppm | 95%ile:                  | 2.21 ppm |
| GSD:                  | 1.3     | UTL <sub>95%,95%</sub> : | 3.45 ppm |

\*\*Expostats Uses Bayesian Analysis Calculation Methods



Category 2 (High Certainty)  
Category 4 (<5%): **Acceptable**

| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |

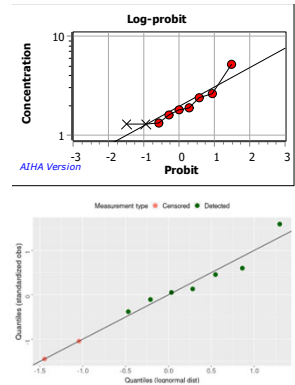
Example O

OEL = 5 ppm

| Sample Results (ppm) |
|----------------------|
| <1.3                 |
| 2.4                  |
| 1.63                 |
| 1.35                 |
| 1.92                 |
| <1.3                 |
| 5.25                 |
| 2.65                 |
| 1.82                 |

IHDA

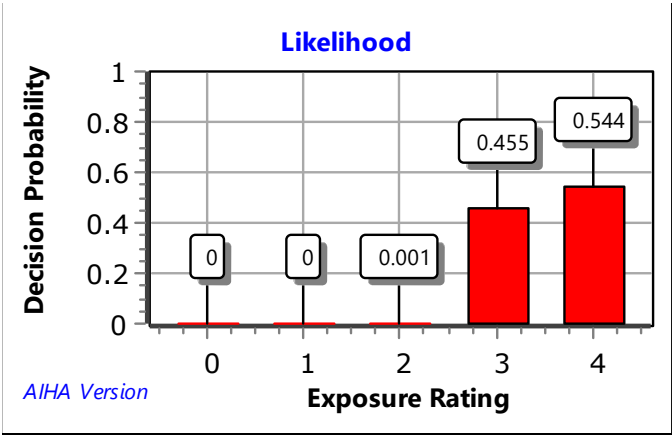
Expostats



IHDA

| Parameter Estimates*†                                    |          |                          |          |
|----------------------------------------------------------|----------|--------------------------|----------|
| GM:                                                      | 1.82 ppm | 95%ile:                  | 4.46 ppm |
| GSD:                                                     | 1.73     | UTL <sub>95%,95%</sub> : | 9.49 ppm |
| *IHDA Uses Traditional / Frequentist Calculation Methods |          |                          |          |

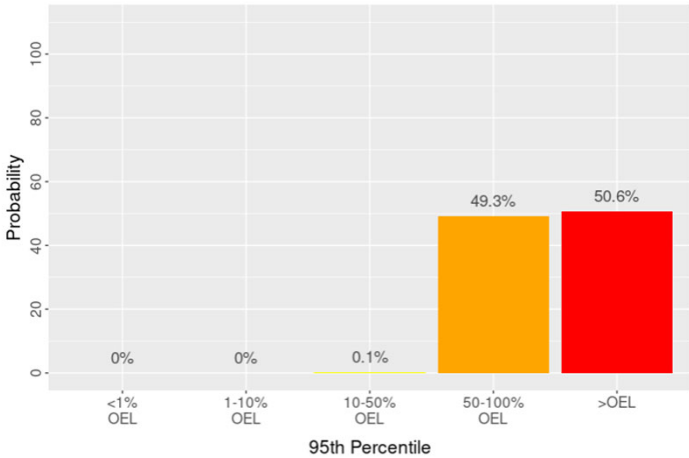
†IHDA-AIHA CDA used substitution with DL/sqrt(2)



Category 4 (Moderate Certainty)  
Unacceptable

Expostats

| Parameter Estimates**                                  |         |                          |          |
|--------------------------------------------------------|---------|--------------------------|----------|
| GM:                                                    | 1.8 ppm | 95%ile:                  | 5.03 ppm |
| GSD:                                                   | 1.9     | UTL <sub>95%,95%</sub> : | 11.4 ppm |
| **Expostats Uses Bayesian Analysis Calculation Methods |         |                          |          |



Category 4 (Moderate Certainty)  
Unacceptable

| ECC | Recommended Control                                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| 0   | No action                                                                                                                           |
| 1   | Procedures and Training; General Hazard Communication                                                                               |
| 2   | + Chemical Specific Hazard Communication; Periodic Exposure Monitoring,                                                             |
| 3   | + Required Exposure Monitoring, Workplace Inspections to Verify Work Practice Controls; Medical Surveillance, Biological Monitoring |
| 4   | + Implement Hierarchy of Controls; Monitoring to Validate Respirator Protection Factor Selection.                                   |