Gijima

Technology People

Sampling Strategies (Current trends)

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Agenda

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- **Specification Based Strategy:**
  - Data collection, data analysis and data interpretation steps are specified in a regulation, standard or other guideline. Serves to "prove" compliance only.

- **Performance based Strategy:**
  - To detect unacceptable exposure profiles with a high degree of confidence and is goal (exposure control) orientated.

- **OHS Act; Regulations for Hazardous Chemical Substances**:
  - ○ prescribes NIOSH OESSM – highest exposed individual strategy;
  - ○ 12 monthly for CL substances and 24 monthly for RL substances.

No statistical analyses or interpretation of data – purely for the purpose of "proving" compliance; truly **Specification based Strategy**

- **MHS Act; SAMOHP Codebook and COP Guideline Documents, e.g.:**

CAT.	PERSONAL EXPOSURE LEVEL	MINIMUM FREQUENCY
A	Exposures ≥ the OEL or mixtures of exposures ≥1	Sample 5% of employees within a HEG on a **3 monthly basis** with a minimum of 5 samples per HEG, whichever is the greater.
B	Exposures ≥ 50% of the OEL and < OEL or mixtures of exposures ≥ 0,5 and <1	Sample 5 % of employees within a HEG on a **6 Monthly basis** with a minimum of 5 samples per HEG, whichever is the greater
C	Exposures ≥ 10% of the OEL and < 50% of the OEL or mixtures of exposures ≥ 0,1 and < 0,5	Sample 5 % of employees within a HEG on an **annual basis** with a minimum of 5 samples per HEG, whichever is the greater

- ○ 90th Percentile HEG Classification
- ○ Upper 95% Confidence Limit for comparison to the OEL (1)

- **MHS Act; Statistics.:**
  - Prescribes fixed minimum quantities and frequency of sampling – no certainty that it is sufficient (not tested, not considering data variability or statistical certainty)
  - Uses 95% UCL for compliance testing – not the best statistical parameter, as it looks at the mean exposure of the group; basically ignoring 50% of the exposures above the mean – what good is that?
  - Uses 90th percentile for "exposure profiling" – a poor statistical parameter, as it does not consider data variability/certainty (not very strict or robust)
  - Compliance orientated – not goal/control orientated

- **In both cases (OHS Act and MHS Act) we have Specification Based strategies:**

  - Entire Strategy Prescribed by legislation, as a "one size fits all approach"

  - Entirely intended for "testing" legal compliance

  - OESSM strategy will most certainly, regularly (almost 50% of the time) under-estimate true exposure levels

  - MHSA approach – cannot say with any certainty what it aims to achieve (other than collecting data)

- **The Purpose of OH is to Control – right?**

- **So why implement strategies that are purely intended for compliance testing?**

- **If the purpose of OH is to control, we should rather implement a Performance Based Strategy, with <u>control</u> as a goal**

- **AIHA – A Strategy for Assessing and Managing Occupational Exposure, 4th Ed.**

- **584 pages – published 2015; less than 2 months ago (2)**

- **Going beyond the traditional understanding of OH Practice - Confirm (3).**

- **In order for the Strategy "to work/to be effective", everything must be done correctly right from the start – else it will have to be re-worked and refined a lot (4).**

- **The Aim or Goal of the Strategy is to accurately and confidently place every employee, exposed to every hazard in a confidently and accurately defined Control Category (5)**

- **What is meant by Comprehensive (6).**

- **Basic steps of the Comprehensive Strategy (7).**

- **Benefits of a Comprehensive Strategy/Approach (11)**

- **The Starting point of the strategy (12).**

- **Understanding who is exposed where, when (duration and frequencies), to what, why and from which sources and activities, and potential health effects caused by the exposure/s.**

- **In our terms – gathering workplace and exposed worker information as for a detailed Risk Assessment (13)**

- **Part of the exposure assessment, is to define SEGs**

- **The principles of a SEG (8) – an extremely crucial step; if this is done incorrectly or too crudely, the rest of the strategy will not work, and trying to apply it will frustrate you immensely.**

- **Logic process:**
  - ○ **Divide workplace into Processes**
  - ○ **Sub-divide Processes into Jobs**
  - ○ **Sub-divide Jobs into Tasks**
  - ○ **Persons performing same/similar task, exposed to same hazard/same source, for similar frequency and duration = SEG**

- **Award an exposure band, relative to the OEL, for each hazard for each SEG (9)**

- **Lots of effort to ensure that "all" employees in a SEG, falls into only one Exposure Category/band , with very high statistical confidence (14)**

- **Done through observation and professional Judgment (historical/current approach) – found to generally underestimate exposure category by at least one level (same accuracy as random chance)**

- **Or done purely through analyses of historic data, or combination of data analysis and professional judgment.**

- **Profiling of SEG from historic data:**

  ○ **As a start, the 95th percentile must be less than an exposure category limit, and the GSD must be less than 3 – be wary of Critical SEGs (18)**

- **Profiling of SEG from new/baseline monitoring data, or surrogate data:**

  ○ **Collected over short period of time (6 to 10 samples) – does not include much day-to-day, inter- or intra- employee variation; likely to underestimate exposure**

- **Profiling of SEG from Qualitative Modeling:**

  ○ **Found to be even more accurate than sampling data, as it considers intra-SEG exposure variables.**

- **Profiling of SEG from Modeling:**
  - **Check-list based, well documented systematic approach (meaning anyone can re-trace the steps at any time in future) – based on mathematical algorithms**
  - **Excel spreadsheet based freeware models, e.g. IH Mod (15) , Monte Carlo Simulation and others (16)**
  - **As well as NIOSH Control Banding, Stoffenmanager, Industrial Hygiene Exposure Scenario Tool (IHEST) freeware, etc.**

- **Making sure that you have correctly (with sufficient certainty) placed your SEG in a particular exposure band (10)**

- **Uncertainty (17)**

- **This is where most time and effort will be spent – else your monitoring strategy will be meaningless; monitoring data will be interpreted incorrectly and provide you with false information.**

- **Improving professional judgment, in setting SEG Exposure profiles:**

  - ○ **Refining confidence with exposure data – use 95%UCL of 95th percentile, to focus on the upper tail of exposure profile (19).**

  - ○ **Introduce BDA (Bayesian Decision Analysis) – combining monitoring data and professional judgment, to improve certainty (20)**

  - ○ **Applying "Analysis of Variance" (ANOVA) statistical tool to refine Critical SEGs**

- **Continual refinement of Exposure Profiling:**
    - **Testing whether your data set conforms to a normal, or log-normal distribution to ensure that the correct type of statistics is applied – by means of W-Test**

    - **Identify outliers and other employees/exposures that should rather be assigned to another SEG, by conducting "probability plotting" statistical techniques**

- **At last, now you are confident that your SEGs are correctly identified and their exposures profiles correctly categorized (with Statistical confidence) – why?:**

  - **To reduce data variability (21) – ensure effective sampling**

  - **And highly variable data will result in SEGs having very high UCL95%,95%, meaning they will more likely (and unnecessarily) be classified in Control Category 4**

True Statistical, representative sampling

- **How many samples?:**
  - ○ **Calculated on the basis to ensure that you do not incur excessive false positive or false negative decisions (22)**
  - ○ **Very, very Randomly selected**

- **How Frequent should one Sample?:**
  - ○ **Dependent on SEG's Exposure Category (23)**
  - ○ **Higher frequency of sampling for Higher Risk SEGs (i.e. exposed to Carcinogens), Critical SEGs.**
  - ○ **Be logic**

- **Start moving away from compliance based strategies and start practicing what OH practice is meant to be – To Control.**

- **Working under the MHSA, you have a basic strategy framework and ample historic data, and can easily gradually convert what you have to a proper Performance Based Strategy.**

THANK YOU

Kind Regards

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