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**SAMPEL PENGUKURAN
PERTEMUAN KE 2
MIRTA DWI RAHMAH, S.KM., M.KKK.
PROGRAM STUDI KESEHATAN MASYARAKAT**

KEMAMPUAN AKHIR YANG DIHARAPKAN

- Mahasiswa mampu memahami dan menentukan sampel pengukuran

PENILAIAN PAJANAN DI TEMPAT KERJA

- Mengetahui secara kualitatif dan kuantitatif tingkat risiko yang muncul dari faktor-faktor yang ada di tempat kerja
- Mendapatkan gambaran kualitas lingkungan kerja dari aspek kesehatan kerja
- Untuk identifikasi dan karakterisasi sumber bahaya kesehatan aktual atau potensial di tempat kerja
- Pengembangan dan pemeliharaan basis data pemajanan di tempat kerja

MANFAAT SAMPEL

- Sebagai **perwakilan** pengukuran (hasil digeneralisasi untuk lingkungan dan populasi)
- Memastikan **pemenuhan** standar perundangan
- Melaksanakan **studi epidemiologis**
- Mengevaluasi keefektifan pengendalian secara teknik, sistem ventilasi, dan peralatan lainnya
- Memilih alat pelindung diri yang sesuai

DATA KESEHATAN KERJA

- **DATA FAKTOR RISIKO LINGKUNGAN KERJA**
 - DATA PEMANTAUAN HIGIENE INDUSTRI
 - DATA PEMANTAUAN ERGONOMI
 - DATA PEMANTAUAN PSIKOSOSIAL
 - DATA PEMERIKSAAN KESEHATAN SEBELUM BEKERJA, BERKALA, KHUSUS, *RETURN TO WORK*, PHK/ PENSUN
 - ANALISIS & KOMUNIKASI TREND FAKTOR RISIKO & STATUS KESEHATAN, HUBUNGAN ANTARA FAKTOR RISIKO & EFEK KESEHATAN

SUMBER DATA

- **Data Primer**
 - Pengukuran Personal
 - Pengukuran Lingkungan
- **Data Sekunder**
 - Data Hasil Pemeriksaan Kesehatan
 - Data Hasil Laboratorium
 - Data Hasil Pengukuran
 - Data Sumber Daya Manusia

DATA PRIMER

- **Pengukuran Personal**
 - Noise dosimeter
 - Personal dust sampler
 - Pengukuran dengan Spirometer
 - Pengukuran logam berat di urine dan darah
- **Pengukuran Lingkungan**
 - Kebisingan di lingkungan kerja
 - Debu di lingkungan kerja
 - Temperatur di lingkungan kerja
 - Logam berat di lingkungan kerja

DATA SEKUNDER

- Jenis data sama dengan seluruh data primer
- Bedanya tidak dilakukan pengambilan data secara langsung, data/ informasi didapatkan dari sumber-sumber seperti:
 - Medical department/ Clinic
 - SHE department
 - Human Resources department, dll

SUMBER DATA PAJANAN

- Data higiene industri
- Data ergonomi
- Data pengorganisasian pekerjaan & budaya kerja, dll

PENGUKURAN PAJANAN

- **Pajanan:** suatu agent/ kondisi yang dapat mempengaruhi kesehatan seseorang bila terjadi kontak dengannya (epidemiologi)
- **Pemajanan:** cenderung berkonotasi kuantitatif VS kualitatif, misalnya: batas pemajanan
- **Pengukuran:** klasifikasi dari suatu objek dan kejadian dengan simbol (angka, huruf, kata) – suatu simbolisasi angka terhadap objek dan kejadian berdasarkan aturan – ukuran tertentu

EXPOSURE ASSESSMENT

The most elegant design of study will not overcome the damage caused by unreliable or imprecise measurement (Fleiss, 1986)

EXPOSURE ASSESSMENT

- **Metode Kualitatif** – klasifikasi kasar yang mungkin mengaburkan kemampuan untuk mendeteksi hubungan pajanan dengan hasil
 - Pernah VS tidak pernah terpajan
 - Durasi atau frekuensi pajanan
 - Kedekatan dengan sumber
- **Metode Kuantitatif** – mengukur agen pajanan pada pintu masuk pajanan (*route of entry*) atau pada cairan biologis
 - Environmental monitoring (air, water, soil)
 - Personal monitoring (e.g. Noise dose meter, breathing zone of the individual)
 - Biological monitoring

DOSIS ESTIMASI

Asumsi

- Pekerja terpajan, rata-rata sebesar $30 \mu\text{g}/\text{m}^3$ of uap merkuri selama 8 jam
- Inhalasi udara sebesar 9.6 m^3 selama 8 jam
- Absorpsi di paru-paru 80%
- Paparan terjadi 5 dari 7 hari

Kalkulasi dosis estimasi per hari:

Konsentrasi*dosis inhalasi*faktor absorpsi*regimen paparan:

- $= 30 * 9.6 * 0.80 * 5/7 = 165 \mu\text{g}/\text{hari}$

TINGKAT PAJANAN PEKERJA

- **Pajanan rata-rata berdasarkan:**
 - Sampel area
 - Sampel individu (toksikan, *biological exposure index (BEI)* misalnya:
 - azide iodide pada urine karena karbondisulfida
 - fenol dalam urine karena benzene
- **Berdasarkan jenis pekerjaan**
pajanan x tahun = *person-years*
- **Pajanan sesaat VS pajanan kumulatif**

BIOLOGICAL EXPOSURE INDEX (BEI)

→ **Indeks Paparan Biologis**: Nilai yang digunakan untuk panduan menilai hasil pemantauan biologis.

Pemantauan biologis adalah pengukuran konsentrasi penanda kimiawi dalam media biologis manusia yang menunjukkan paparan, biasanya berhubungan dengan paparan bahan kimia

KLASIFIKASI PAJANAN

Pajanan dapat diklasifikasi ke dalam sejumlah karakteristik – yang menentukan pemilihan metode/alat ukur

1. Karakteristik individu / agen lingkungan?
2. Data objektif / subjektif?
3. Pajanan saat ini / yang lalu?

ALAT UKUR PAJANAN

- Angket
- Wawancara
- Analisis biokimia darah/spesimen biologi lainnya
- Analisis lingkungan fisik, kimia, ergonomi, psikososial

Surveillance No.:

Facility:

Date Completed:

Activity 1 - Review Health Hazard Assessments

Health hazard assessments are performed periodically to anticipate, recognize, evaluate, and control occupational health hazards.

Yes No N/A

___ ___ ___ 1. Has the hazard assessment been conducted within the following time frames?

a. Within one year for industrial areas, research and development facilities, craft shops, etc.?

b. Within three years for low-hazard areas such as offices and non-hazardous facilities?

c. Within the frequency specified by the senior industrial hygienist for changing work sites such as construction sites and hazardous waste sites?

___ ___ ___ 2. Does the hazard assessment include analyses of all new designs, operations, processes, materials, and equipment?

Activity 2 - Observe Work Practices

The Facility Representative selects work in progress such as routine operations, maintenance, decontamination or decommissioning, construction, or deconstruction for observation. The Facility Representative should select activities that entail occupational health risks such as exposure to hazardous, toxic, or carcinogenic materials or exposure to other physiological hazards such as extreme cold.

Before beginning this activity, the Facility Representative should obtain and review documents governing the work such as work packages, administrative procedures, and program documents.

Yes No N/A

___ ___ ___ 8. Do the governing documents identify the occupational health hazards that will be encountered by the workers while performing these tasks?

___ ___ ___ 9. Do the work documents specify appropriate hazard prevention and control measures to protect the health of workers?

___ ___ ___ 10. If personal protective equipment such as use of respirators has been mandated, are work conditions such that it is not feasible to limit worker exposure by some other means such as engineering controls or alternative work practices?

Activity 3 - Examine Records

The Facility Representative selects specific records regarding recent work projects for examination. As a minimum, the Facility Representative should select work activities that involve personnel monitoring for airborne contaminants, specific surveys to detect hazardous chemicals, and training records.

Yes No N/A

___ ___ ___ 17. Are records available documenting the results of exposure monitoring for employees including a description of sampling, analytical methods, and interpretation of results?

___ ___ ___ 18. Do records substantiate that employees were informed of the results of exposure monitoring within 10 working days of receipt of monitoring results?

___ ___ ___ 19. Do exposure monitoring results verify that total exposure to employees was below the applicable threshold limit value for hazardous substances?

___ ___ ___ 20. Do records document the basis for selecting specific employees for exposure monitoring?

___ ___ ___ 21. Do records of surveys for hazardous chemicals identify sampling techniques, areas sampled, and results?

SURVEILLANCE GUIDELINE for INDUSTRIAL HYGIENE

FINDINGS:

Finding No.:

Description:

OBSERVATIONS:

Observation No.:

Description:

FOLLOWUP ITEMS:

CONTRACTOR MANAGEMENT DEBRIEFED AND RESULTS:

Signature: _____

Facility Representative

Date: ____/____/____

METODE PENGUKURAN PAJANAN

Metode Pengukuran	Jenis Data		Waktu		Jenis Pajanan	
	Subj	Obj	Saat Ini	Masa Lalu	Karakt. Individ.	Agen Lingk
Interview	+	-	+	+	+	+
Angket	+	-	+	+	+	+
Observasi	-	+	+	-	+	+
Data Sekunder	-	+	+	+	+	+
Pengukuran Personal	-	+	+	-	+	+
Pengukuran Lingkungan	-	+	+	+	-	+

TUJUAN PENGUKURAN PAJANAN

- Hasil ukur dengan validitas tinggi
- Mendapatkan karakteristik pajanan
 - Sifat pajanan
 - Variabel yang diukur harus spesifik, sensitif
 - Rute pajanan oral, nasal, dermal dll.
 - Cara pengendalian pajanan
 - Dosis
 - Konsentrasi di lingkungan
 - Dosis pajanan kumulatif
 - Dosis *intake*
 - Waktu pajanan
 - Masa kerja
 - Masa pajanan
 - Estimasi pajanan puncak, pajanan rata-rata

POPULASI & SAMPEL

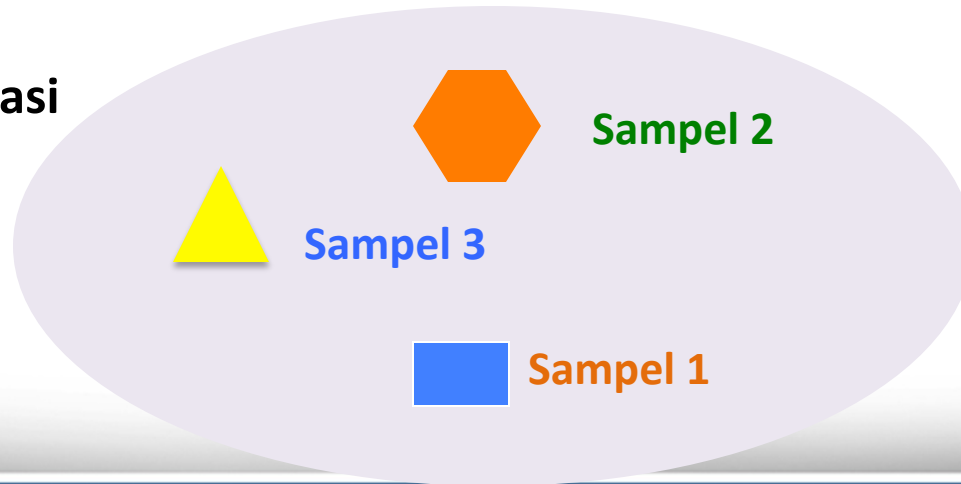
→ **Populasi:** Keseluruhan pengamatan yang menjadi perhatian kita

→ **Sampel:** Suatu himpunan bagian dari populasi

Contoh:

10 mahasiswa Kesmas atau 100 mahasiswa K3, atau
25 orang dosen EU

Populasi



PERSYARATAN STANDAR *SAMPLING* DAN ANALISIS BAHAN KIMIA DI UDARA

- Strategi pengambilan sampel
- Jumlah sampel yang akan diambil untuk sampel lingkungan dan sampe personal (*representative samples*)
- Metode pengambilan sampel
- Analisis sampel (pembacaan langsung; laboratorium)
- Perlengkapan dan alat
- *Field Surveyor/ Operator*
- Laboratorium, bahan kimia dan *Analyst*

(OSHA standards 29 CFR 1910.1200 ; CFR 1910.1450; CFR 1910.1450, etc.)

STRATEGI PENGAMBILAN SAMPEL

BAHAN KIMIA DI UDARA

- Apa dan bagaimana melakukan pengambilan sampel
- Dimana melakukan pengambilan sampel
- Siapa yang akan dijadikan sampel
- Kapan melakukan pengambilan sampel
- Berapa lama melakukan pengambilan sampel
- Apa yang harus dicatat saat pengambilan sampel
- Berapa banyak sampel yang harus diambil
- Kapan berhenti melakukan pemantauan
- Siapa yang seharusnya melakukan pengambilan sampel

WHAT TO SAMPLE

1. Chemicals contaminants in the air

- Gas and vapor
- Particulate

WHAT TO SAMPLE

2. Physical Hazards

- based on work environment

3. Pathological Hazards

- Irritants
- Asphyxiants (Anoxia-Producing Agents)

HOW TO SAMPLE

- *Active Sampling*: Pompa, Media , Kalibrator
is the collection of airborne hazards by means of a **forced movement of air** by an **air sampling pump** through the appropriate sampling **media**. The pump is used to collect and/or concentrate the chemical of interest onto the sampling media. The pump must also be *calibrated*.
- *Passive Sampling*
- *Dermal & Surface Sampling*
- *Metode:*
 - Grab
 - Komposit, dll.

WHERE TO SAMPLE

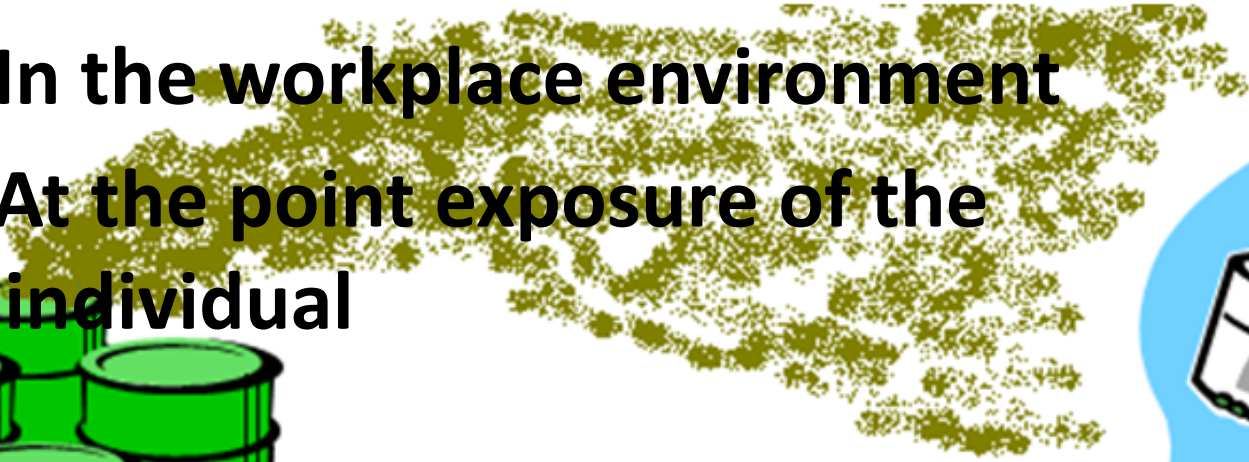
- *Sources*
 - Measure generation rate of hazards
- *Work Place and Environment*
 - Measure Levels or Concentration of Hazards in the work Area
- *Outlet and Stack*
 - Measure Concentration of Hazards at outlet and stack
- *Worker*
 - Measure individual exposure dose at the workers

LOKASI PENGUKURAN

1. At the source of the hazards
2. In the workplace environment
3. At the point exposure of the individual



Source



Path



Worker

WHOM TO SAMPLE

- Selecting employees who close to the source of hazards (most highly exposed)

WHEN TO SAMPLE

- Each Season
- Each Shift

HOW LONG TO SAMPLE

- Full Shift (8 hrs/shift) → TLV- TWA ; PEL
- 15 minutes samples during a worst-case → STEL

WHAT TO NOTE DURING SAMPLING

- *Accurate record keeping*
 - Total time sampled; pump flowrate, etc.
 - Location of the area and the person being monitored.
 - Climate (dry and wet season) and weather (wind, temperature, humidity, sunny, cloudy)

HOW MANY SAMPLE TO TAKE

- NIOSH recommends to include at least one high risk employee (exposure in highest 10%)
- For a CL 90% (Confidence Level) approximately 20(40%) employees from a group of 50 should be sampled
- For a “**Similar Exposure Group**” approximately **8** TWA samples should be taken to estimate the mean (average) exposure

WHEN TO STOP MONITORING

- OSHA requires that monitoring be based on a routine basis;
- Frequency depends on the substance and initial monitoring
- For example : Formaldehyde
Monitoring for it can be terminated if results from two consecutive sampling periods, taken at least 7 days apart, show that employee exposure is *below* both the TLV-TWA , and the STEL.

WHEN TO STOP MONITORING

- If initial sampling results are low, it is *not necessary to repeat* routine monitoring of employee exposure, as long as monitoring of other factors crucial to the overall health and safety program continues.
- Area of interest should include the *adequacy* of engineering controls, work practices; the use of personal protective equipment, and training in all of these aspects

WHO SHOULD CONDUCT SAMPLING

- *Field Surveyor/ Operator* must be *adequately trained* and *supervised* by a professional Industrial Hygienist.
- *Field Surveyor/ Operator* must be *familiar* with potential problem and *aware* of the limitation of sampling alone, know how to integrate observation and interviews with quantitative measurement and know when it is not necessary to sample.

Sampling Techniques

- **Active**
- **Passive**

Active Sampling

...is the collection of airborne hazards by means of a **forced movement of air** by an **air sampling pump** through the appropriate sampling **media**. The pump is used to collect and/ or concentrate the chemical of interest onto the sampling media.

The pump must also be *calibrated*.