

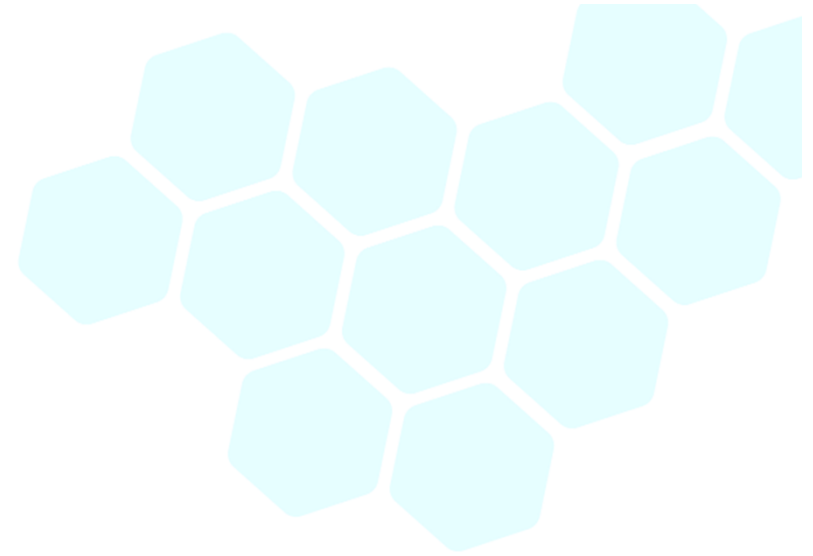


Finnish Institute of
Occupational Health

Well-being through work



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Firefighters' exposure based risk assessment in Finland

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Conference on occupational cancer in firefighters in the Nordic countries, Danish parliament, Christiansborg, landstingsalen. 1240 Copenhagen K

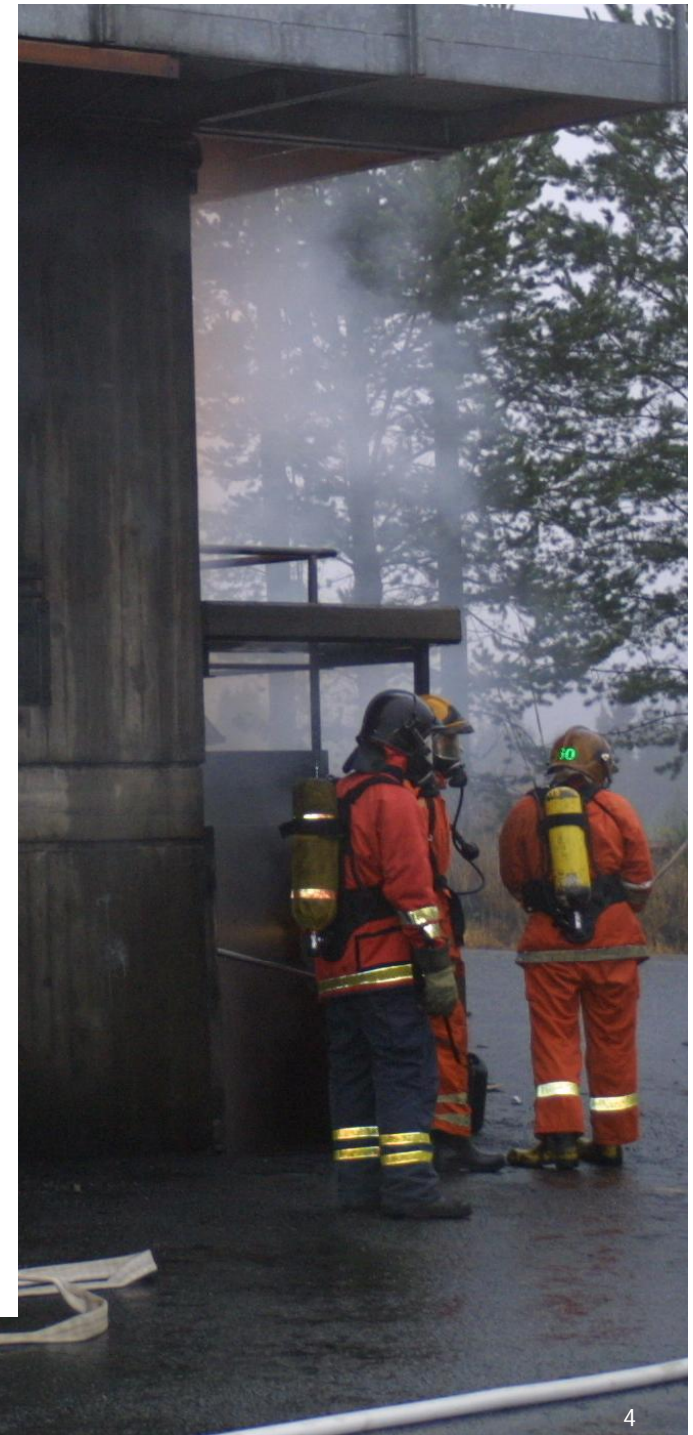
Outline of presentation

1. Exposure based risk assessment
2. Firefighters' chemical exposure
3. Exposure evaluation methods
4. Firefighters' exposure in training conditions and operative work
5. Tools to reduce exposure in future
6. Conclusion



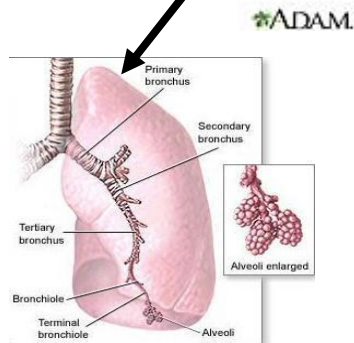
1. Exposure based risk assessment

- To characterize the most important exposure agents
- To measure exposure levels of found agents
- To find technical measures, safer working techniques or better personal protective equipment to be able to manage with found exposure agents
- To do risk communication about possible risks to workers' health due to the found exposure agents

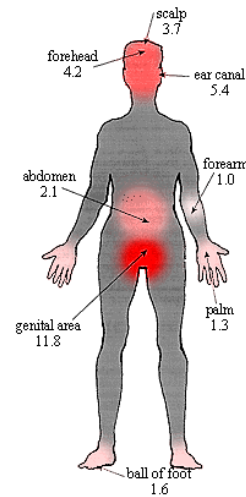
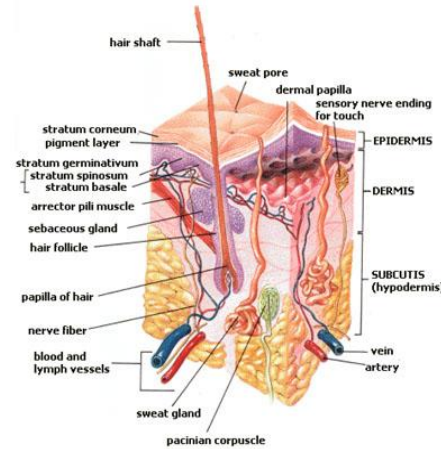


2. Firefighters' exposure routes

Inhalation exposure



Dermal exposure



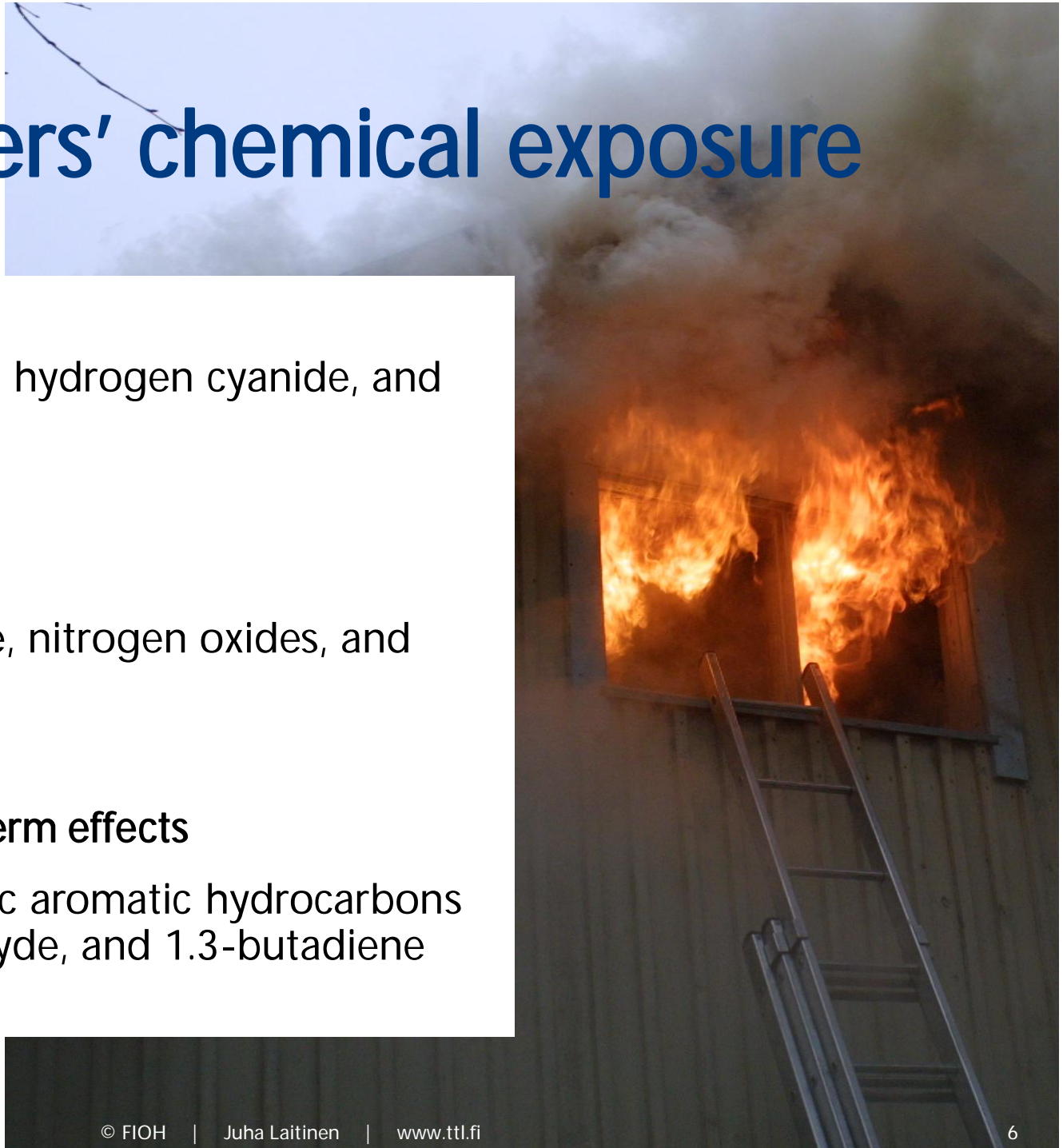
Relative absorption rates, as compared to the forearm (1.0)

Oral exposure

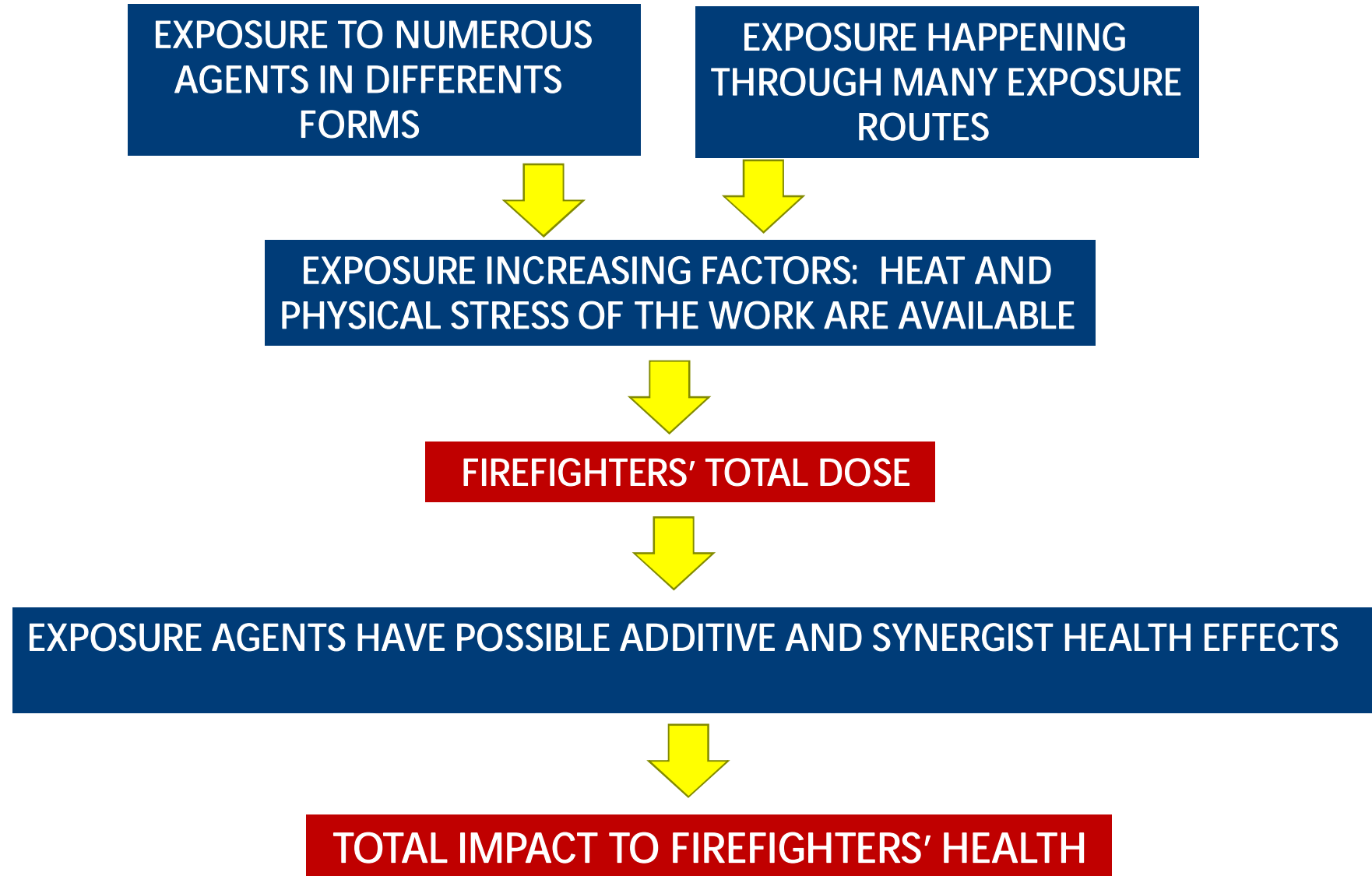


2. Firefighters' chemical exposure

- Chemical asphyxiants
 - Carbon monoxide, hydrogen cyanide, and hydrogen sulfide
- Irritative gases
 - Hydrogen chloride, nitrogen oxides, and sulfur dioxide
- Agents having long-term effects
 - benzene, polycyclic aromatic hydrocarbons (PAHs), formaldehyde, and 1.3-butadiene



2. Firefighters' chemical exposure



3. Exposure evaluation methods

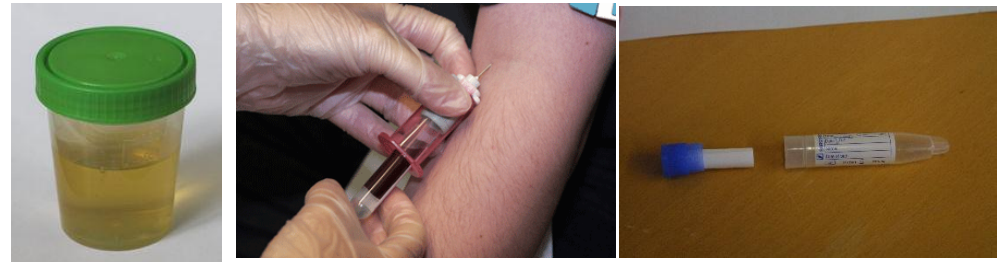
- Potential inhalation exposure
 - Air samples from firefighters' breathing zone outside respirator
 - Soot and ash samples from fire site
- Actual dermal exposure
 - Hand washing samples after exposure
 - Dermal exposure samples from the skin under fire suit



3. Exposure evaluation methods

- Total exposure

- Urine, blood and saliva samples



- Impact of exposure

- Pulmonary response; nitric oxide concentration in exhaled air reflects irritation of the lungs
- Vascular response; exposure to fine particles interferes wall flexibility of the blood vessels
- Inflammatory response; inhalation exposure to irritative gases cause liberation of inflammation markers

4. Firefighters' exposure in training conditions and operative work



In conventional (fire house) simulator in trainings



In conventional simulator (flashover simulator) in trainings



In modern simulator (gas simulator) in trainings



In residential fires in firefighters' operative work

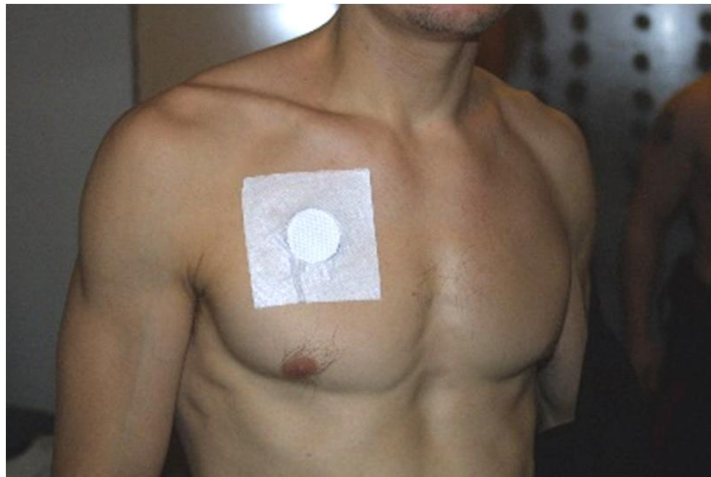
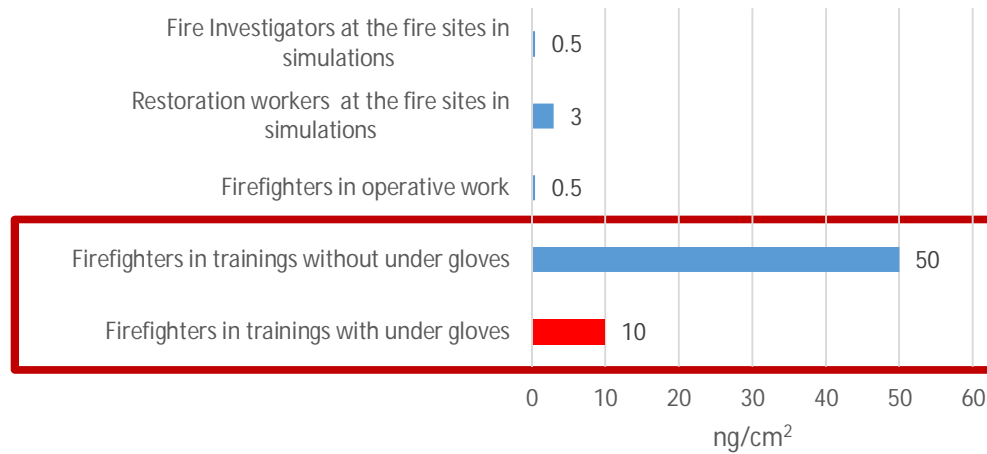
4. Firefighters' potential inhalation exposure

Firefighters' inhalation exposure to formaldehyde and benzene

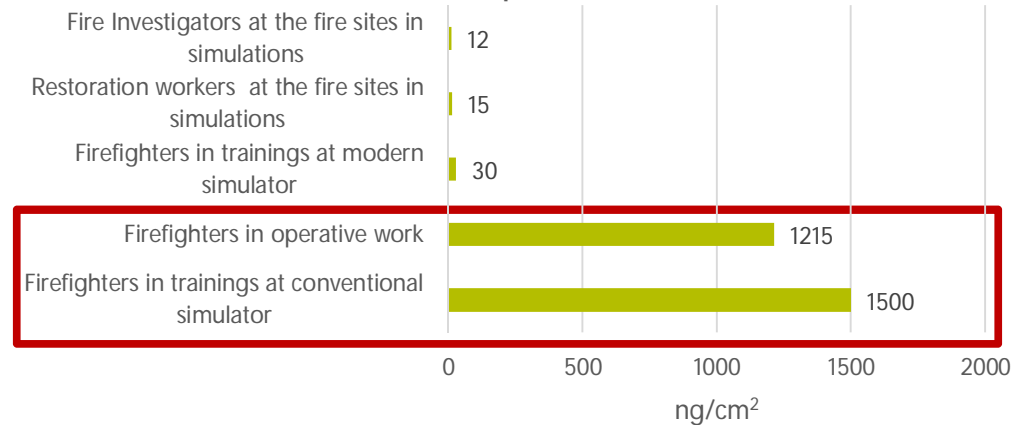


4. Firefighters' dermal exposure

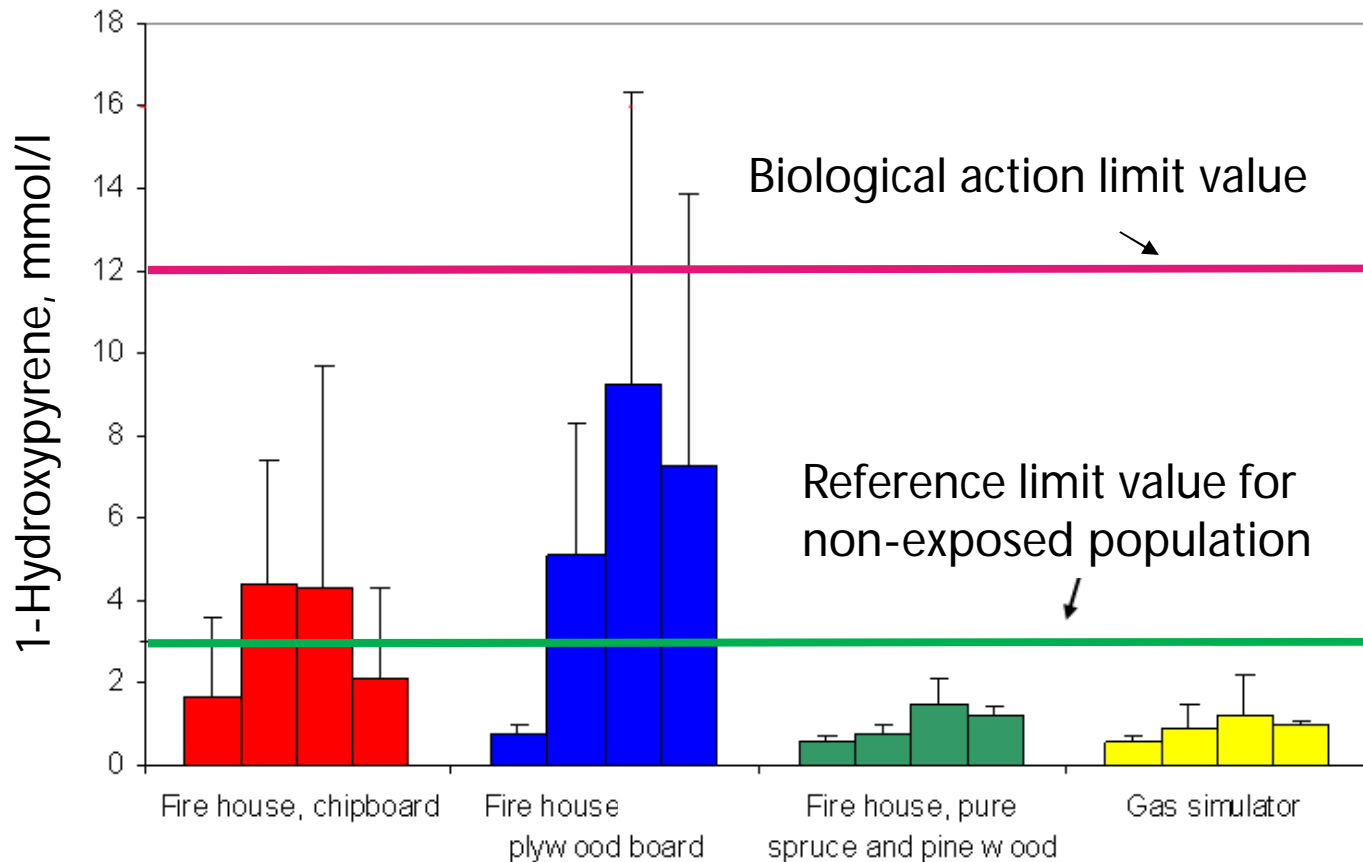
Dermal exposure to PAHs, hand exposure



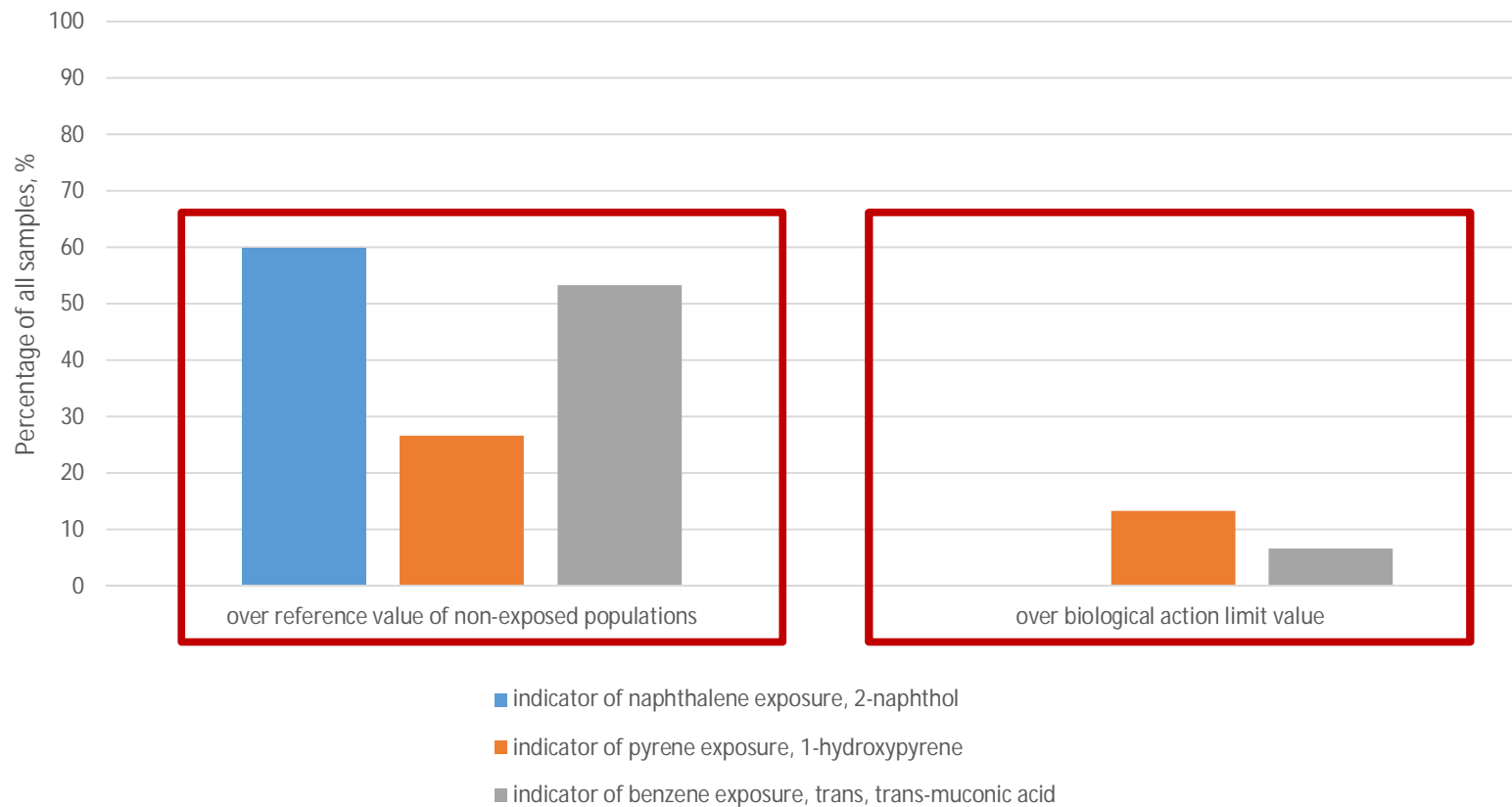
Dermal exposure to PAHs, surrogate of whole body exposure



4. Firefighters' total exposure to PAHs in trainings



4. Firefighters' total exposure to PAHs and benzene in operative work at residential fires



5. Tools to reduce exposure

- During the training...
 - Health Safety and Environment issues have to be an essential part of firefighters' training in Emergency Service College
 - The major issue during the training is to emphasize that risk taking "hero culture" is out and "safety thinking" is in
 - Emergency service colleges should also have the latest information about new working and firefighting techniques, which decreasing fire fighters' exposure in operative work



5. Tools to reduce exposure

- **At the operative work...**
 - Use for example Skellefteå-model to prevent contact with exposure agents and dangerous situations
 - To find the safest firefighting techniques
 - To pay attention to maintenance of personal protective equipment and vehicles and also cleanliness of fire stations
 - Use newer modern simulator in trainings every times when it is possible



5. Tools to reduce exposure

- What legislation demands in Finland...
 - Employers should know how much their workers' exposed during working day
 - Occupational nurses and doctors have to also give information to workers about possible cancer risk in their work
 - Workers' who are exposed to carcinogenic agents should be registered to the ASA-registry in Finland
 - If worker exposed to carcinogenic agents his health condition have to follow more precisely. If changes happening, probability to diagnose cancer at the very beginning stage is higher and the prognosis for workers' healing is much better

5. Tools to reduce exposure

- **New challenges in future...**
 - New firefighting techniques
 - Should we extinguish the fire from inside or from outside of the building?
 - What possibilities might new inventions in robotics deserve to the rescue tasks?
 - Personal protective equipment
 - Compatibility between different personal protective equipment
 - Performance of under wears and under gloves
 - Usefulness of same fire suits in different rescue tasks
 - Performance of protective equipment in extreme conditions
 - Intelligence fire suits and wireless technique (e.g. location and temperature)

6. Conclusion

- Fire fighters exposed in their duty to carcinogenic agents and due to that they have higher exposure associated risk to get cancer than unexposed population does
- Firefighters' health and exposure should be followed regularly
- Research about exposure decreasing fire fighting techniques and personal protective equipment are needed in future



More information...

Laitinen J, Mäkelä M, Mikkola J, Huttu I: Fire fighting trainers' exposure to carcinogenic agents in smoke diving simulators. *Toxicology Letter* 15;192(1):61-5, 2010

Hakkarainen T, Tillander K, Järnström H, Paloposki, T. Laitinen J, Mäkelä M, Oksa P: Chemical exposure and protection of fire site workers. *Interflam 2010. Proceedings of the twelfth international conference.* Interscience Communications Ltd. London, 937-948. 2010

Laitinen J, Mäkelä M, Mikkola J, Huttu I: Firefighters' multiple exposure assessments in practice. *Toxicol Lett* 2012;13;213(1):129-33.

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Thank you!



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