Federal Institute for Occupational Safety and Health

BAuA research project

Systematic Analysis of Dermal Exposure to Hazardous Chemical Agents at the Workplace (SysDEA)

Experimental setup and first results

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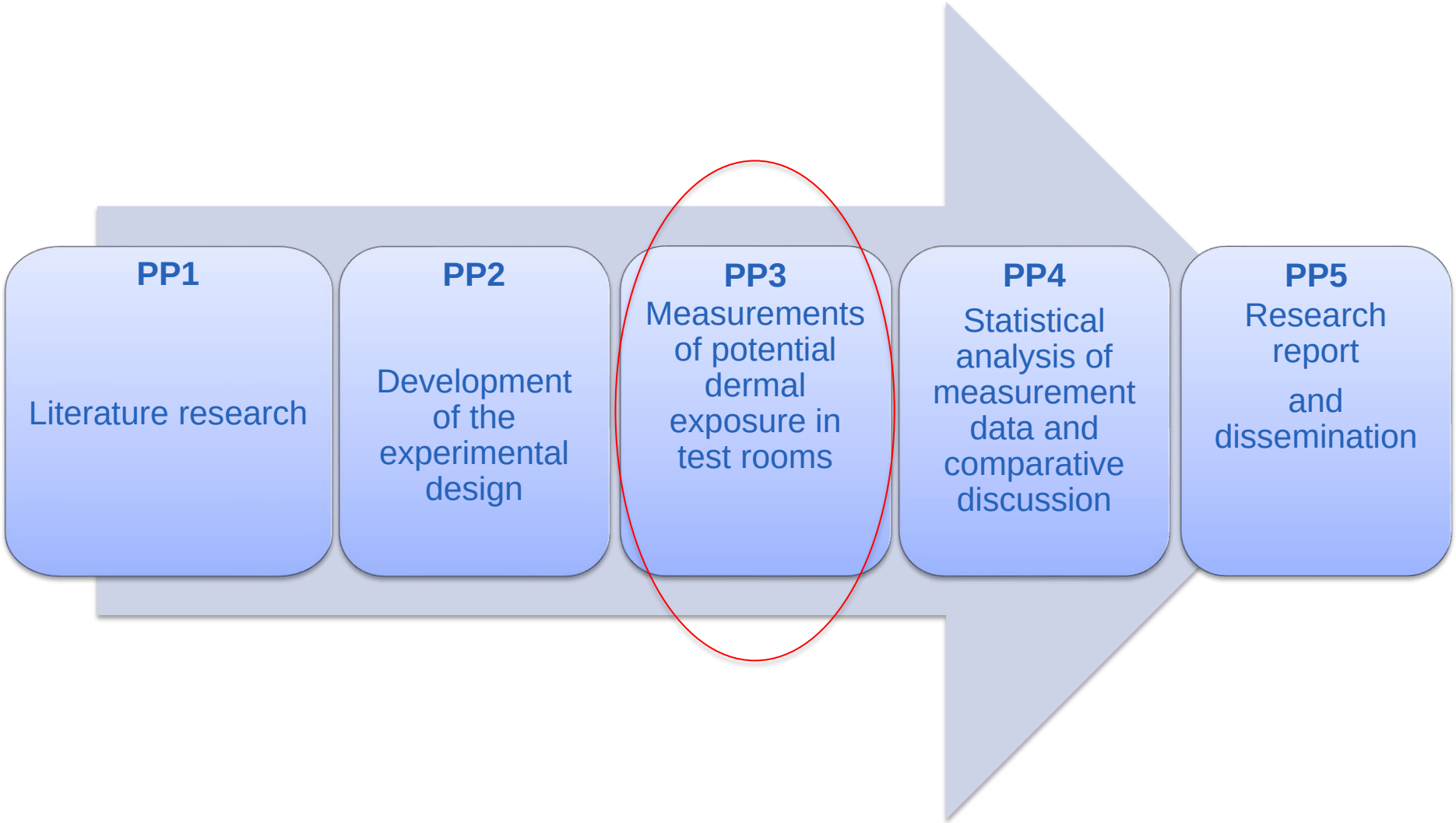
Outline

- **Motivation**
- **Project overview**
- **Methods and Execution**
- **First results**

Motivation

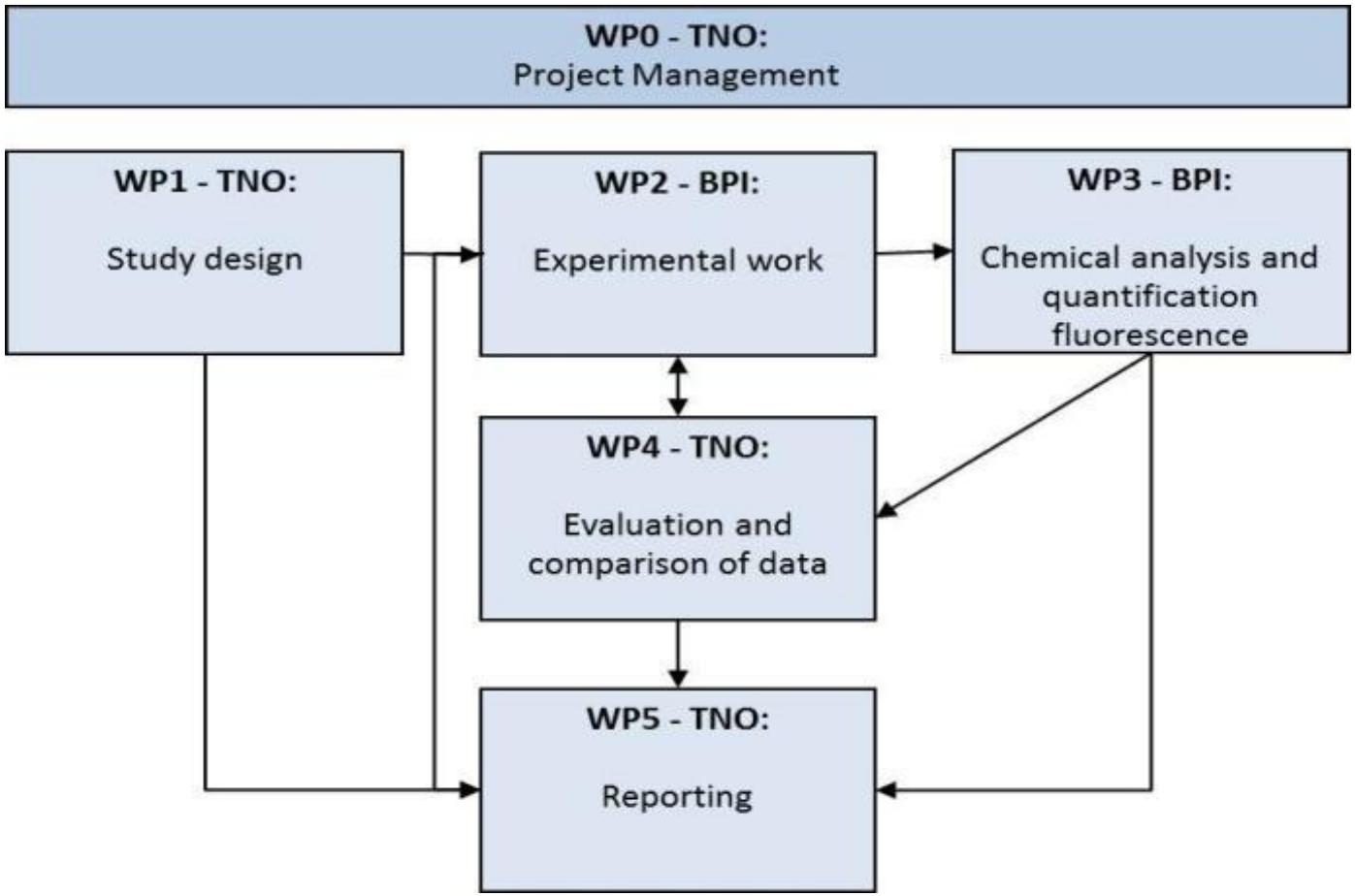
- Need for all stakeholders (Industry, NGOs, Authorities) to state occupational dermal exposure determination more precisely
- Need for method development
- Partly only qualitative dermal exposure assessment available
- Improved scientific justification by means of bigger collectives of dermal exposure data ➔ less conservative exposure assessment feasible
- Strengthened basis for dermal exposure assessment to reduce uncertainties

Project overview



Project organisation

Project Phase 3-5 are subdivided into 5 work packages



Measurement methods – details I

Interception - Whole body (body, hands, head)

For liquids:

Tyvek monitoring coverall (with hood)

- 10 body parts

For solids:

Cotton monitoring coverall (with hood)

- 10 body parts
- Cotton monitoring gloves
- Cotton monitoring headband

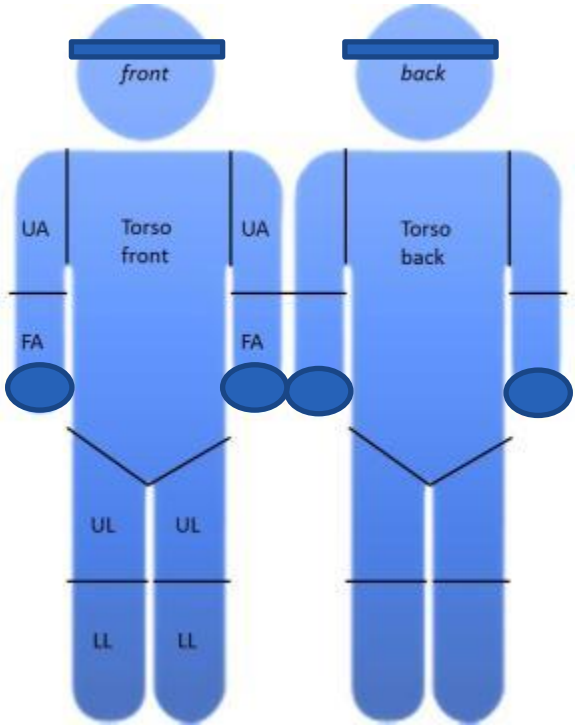
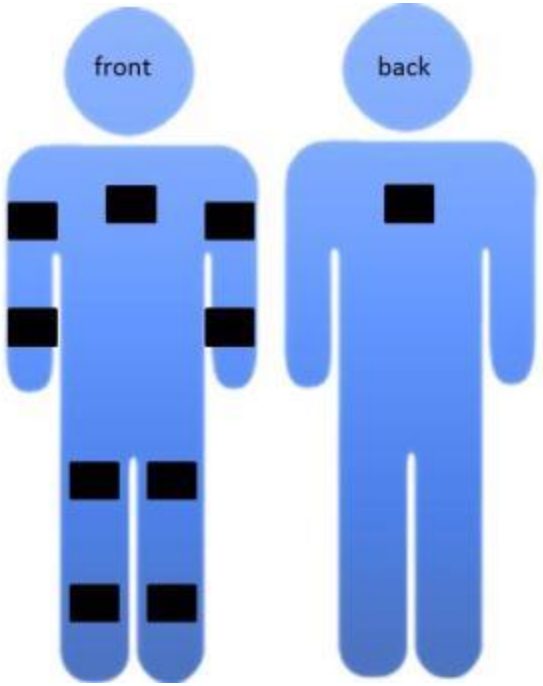


Photo: BPI

Measurement methods – details II

Interception – Patches (body)

- 10 patches (10x10 cm) on Tyvek coverall
- Extrapolation to whole body part
- Made from Tyvek **(liquid)** and cotton **(solids)** material, same as coveralls



Photos: BPI

Measurement methods – details III

Removal - Skin wash (hands):

- Washing procedure in plastic bags, 3 repeats with new wash solution → highest sampling efficiency
- Instruction for washing hands for volunteers
- EtOH: H2O (1:1), wash solution

Removal - Skin wipe (head):

- Fixed surface area of forehead
- Manual wiping by technical personnel
  → standardization procedure, incl. force
- Three “hanky’s” per time → highest sampling efficiency

Photo: BPI

Measurement methods – details IV

In situ – Fluorescence:

- Visualisation of dermal loading
- Illumination panel
- Photographs / videos

Quantification of fluorescent tracer:

- Photographs with UV light
- Skin or Tyvek coverall / cotton clothing
- Intensity of the re-emitted light
  → amount of fluorescent substance
- Sampling protocol and annotation tool have been developed
- Currently working on calibration and validation of quantification tool (software), for which also experimental data is collected

Photos: BPI

Procedure

Dermal exposure of volunteers performing selected tasks under defined and standardised conditions is to be measured in test rooms with liquid and solid test substances by different measurement methods.

<u>Determinants to be standardised :</u>

- Physical data
- Room size and room geometry
- Substance properties: viscosity, dustiness
- Execution of each individual tasks

Test chambers at BPI premises

Photo: BPI

Selected tasks

Main selection criteria for tasks to be investigated:

- Tasks shall cause a significant dermal exposure
- Tasks shall be relevant for exposure assessments in the context of chemical regulations (e.g. REACH and Biocides)

Task group	Activity	Solid Dusty	Liquid Low - viscosity	Liquid High - viscosity
A: Transfer	Dumping	x		
A:Transfer	Pouring		x	x
B: Spreading	Rolling		x	x
C: Spraying			x	x
D: Immersion / dipping			x	x
E: Handling of cont. objects		x		

Execution of experiments - data collection

Recording of main exposure determinants for each measurement:

- **details of the task execution**
  - working time, exposure time
  - specifics or anomaly during task
  - information about the emission source
  - distance between operator and emission source
  - number of emission sources
- **climatic conditions**
  - (room) temperature
  - humidity
  - atmospheric pressure
- **details about the technical risk management measures**
  - kind of ventilation
  - flow conditions

Training of volunteers

Precautions that all experiments are performed as reproducible as possible ➔ reach a high level of standardisation.

- Exposure situations designed relatively short (max. 30 min) and easy to conduct
- Volunteers will receive a proper instruction on exactly how to perform the activities
- Training concerning the dermal sampling methods explaining the role of the volunteers with regard to the dermal sampling methods
- Documentation of instructions

Exposure situations – spraying liquid

Photos: BPI

Exposure situations – spraying liquid – before

Photos: BPI

Exposure situations – spraying liquid – after

Photos: BPI

Exposure situations – spraying liquid – hands after

Photos: BPI

Exposure situations – spraying - results

Liquid – results chemical analysis (n=1)

Dosimeter	µg/dosimeter	% of total	ng/cm²
Headband	3.70	0.73%	9
Upper arms left	12.6	2.49%	6
Upper arms right	30.5	6.03%	15
Forearms left	21.4	4.23%	10
Forearms right	24.7	4.87%	11
Torso front	75.9	15,0%	8
Torso back	78.8	15.6%	10
Upper legs left	32.1	6.33%	8
Upper legs right	59.5	11.7%	15
Lower legs left	69.4	13.7%	14
Lower legs right	75.7	14.9%	15
Glove right	13.2	2.60%	19
Glove left	9.04	1.79%	13
Total	**507**		**153**

Exposure situations – Transfer of liquid (pouring), actual trial I

Photo: BPI

Exposure situations – Transfer of liquid (pouring), actual trial II

Photo: BPI

Exposure situations – Transfer of liquid (pouring) – coveral after

Photos: BPI

Exposure situations – Transfer of liquid (pouring) – patches after

Photos: BPI

Results
Exposure situation – Transfer of liquid (pouring)

First set of experiments have been performed –

Pouring LV liquid

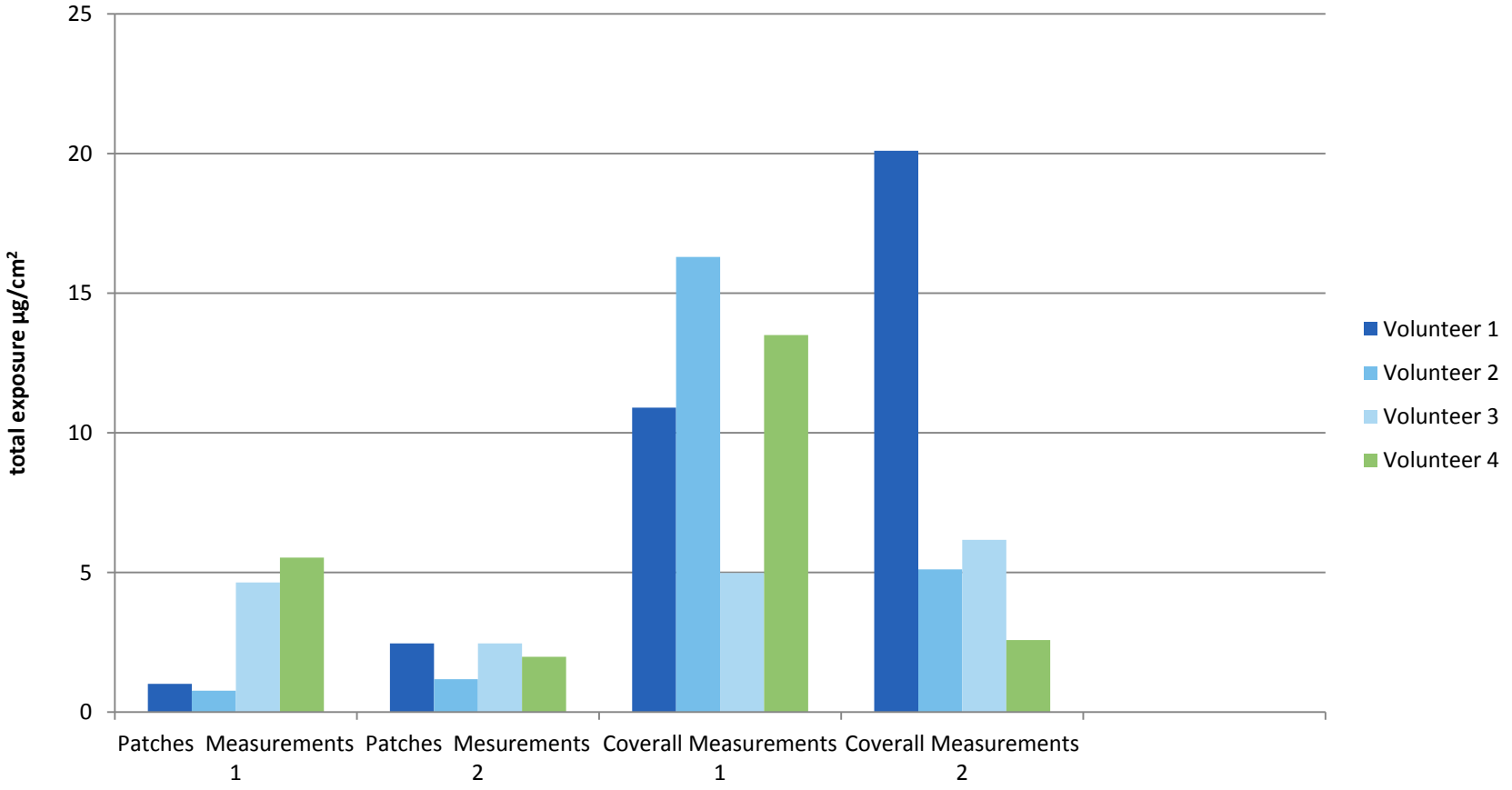
- 4 volunteers * 4 repeats = 16x coveralls / headband / gloves
- 4 volunteers * 4 repeats = 16x patches / head wipe / hand wash

Whole body experiments (coveralls / headband / gloves) (for the measurement-series 1 and 2):

- As expected, hands most contaminated
- Other parts with very low concentrations were: Torso (front), Forearms, Upper arms, Upper legs, Lower legs
- No trend observed with regard to total exposure or exposure of particular parts, except hands :
  V2 + V4 notable relative decrease in exposure, V3 relative slight increase, V1 relative increase

Results
Exposure situation – Transfer of liquid (pouring)

Comparison Patches - Coverall ➔ Liquid low viscosity



Project scientific committee

A continuous evaluation of the results takes place by consultation with scientists on dermal exposure:

- Dr. K. Galea, Head of exposure science section, Institute of Occupational Medicine (IOM)
- Prof. Dr.-Ing. Udo Eickmann, Institution for Statutory Accident Insurance and Prevention in Health and Welfare Services (BGW), Department Hazardous Substances / Toxicology
- Jan Urbanus, Team Lead Exposure Science, Risk Science Team, Shell Health
- Prof. Dr. rer. nat. Thomas Göen, IPASUM-Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine of the University of Erlangen-Nuremberg

Thank you for your attention

BAUA
Federal Institute for Occupational Safety and Health

Unit 4.1 "Exposure Scenarios“

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Photo: BAuA