



# Skin Exposure Assessment

**Ayman Al-Arfaj, PhD**  
**Saudi Aramco, Saudi Arabia**  
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# Introduction

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... is skin exposure really a problem?

The answer is **YES**, but it is difficult to determine the extent of the problem!

*In 2011, 1,556 cases of occupational skin disease were reported by dermatologists and occupational physicians in Great Britain.*

www.iosh.co.uk..

*Both the number of cases and the rate of skin disease in the US exceeds recordable respiratory illnesses. More than 13 million workers in the United States are potentially exposed to chemicals via the skin .*

Workplace Injuries and Illnesses - 2010, -OHSA

# Dermal Exposure Pathways

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- Immersion (Direct contact with substance)
- Surface contact and
- Deposition



# Factors Causing Dermal Exposure

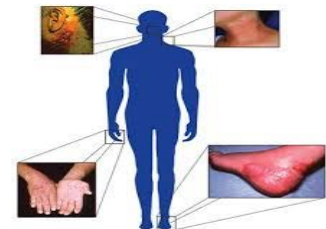
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- Using hands as working tools.
- Contamination of the surfaces such as tools, equipment
- Air contamination depositing on skin
- Splashes landing on the skin
- Using internally contaminated gloves.
- Incorrect wearing and taking-off of gloves.



# Effects of Dermal Exposure to Chemicals

- **Direct**
  - Chemicals can cause effects at the point of contact
- **Systemic**
  - Chemicals can enter the body through skin and cause toxic effects in various organ systems
- **Sensitization**
  - Chemicals may cause a sensitization effect for individual who is susceptible to a chemical or group of chemicals
- **Combined**
  - Chemical may cause multiple effects



# Health Hazards of Chemical

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- Risk phrases provides information on health hazards of chemicals.
- Risk phrases is a system of hazard phrases for labeling dangerous chemicals and compounds.
- The following list contains some example of risk phrases associated with dermal exposure to chemicals:

R34 – causes burns

R35 – causes severe burns

R36 – irritating to the eyes

R38 – irritating to the skin

R40 – Limited evidence of carcinogenic effects

R43 –may cause sensitization by skin contact

R66 – repeated exposure may cause skin dryness or cracking

# Health Hazard Groups (HHGs)\*

A IRRITANTS	B HARMFUL	C-10 mg TOXIC	D= 1 mg VERY TOXIC	E SPECIAL
R36	R20	R23	R26	R42
R38	R21	R24	R27	R45
R66	R22	R25	R28	R46
		R37	R40	R49
		R41	R48/21	R40
		R43	R60	R68
		R34*	R61	R39/24
		R35*	R62	R39/27
			R63	R48/24
				R48/25
				R68/21

## HEALTH HAZARD GROUPS (HHGs)

\*- Bob Rajan (2008) Controlling Skin Exposure to chemical and wet-work a practical book, HSE publication, UK

# Recommended Total Daily Dermal Contamination\*

Health Hazard Group (HHG)	Total daily dermal contamination giving cause for concern A,B, C	
	SOLIDS (mg)	LIQUIDS (mg)
A	5000	50
B	5000	50
C	500	10
D	50	1
E	Any amount	Any amount

## Health Hazard Groups and total daily dermal contamination giving cause for concern

Note:

\*This Table is based on Developing COSSH Essentials; Dermal Exposure, Personal Protective Equipment and First Aid. ANI Garrod and Rajan Sithamparahandarajah. Annals of Occupational Hygiene; 47(2003):577-588.



# Objectives of this Study

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- To establish a baseline database for the dermal exposure
- To determine if there is a potential risk of personal exposure to chemicals through skin
- To assess effectiveness of gloves being used at the labs
- To assess whether different work habits or practices impact dermal exposure levels.
- To take immediate intervention measures to reduce the incidence of occupational skin disease and to monitor changes
- To raise awareness on dermal exposure risk management among employees

# Dermal Exposure Assessment

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- Qualitative Assessment
  - Review literature and consult appropriate sources
  - Develop a standardized Questionnaires
  - Conduct initial walk through survey to identify process areas and jobs where hazardous chemicals are used
- Quantitative Assessment
  - Determine chemical substances to be tested
  - Use sampling media (PERMEA-TEC) to determine gloves breakthrough and mass of the contaminants
  - Select analytical method to be used for the analysis

# Qualitative Assessment

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- Data about the employee
- Job Tasks
- Workplace description
- List of chemicals used (hazardous ingredients)
- Engineering Controls:
  - Which parts of the body are exposed?
  - How frequent is the skin exposed (e.g. daily, weekly)
  - How long is the duration of dermal exposure
  - Frequency of hand washing (e.g. several during the task, after the task)
  - Which protective measures are applied (e.g. barrier cream, gloves)
  - What is used for cleaning the skin,
- Does employee have skin problems
- Primary type of glove used (e.g. nitrile, latex, PVC)
- Number of pairs of gloves used per day

# Quantitative Assessment

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**PERMEA-TEC** pads are break-through indicators worn underneath protective gloves.

- The Permea-Tec pads are useful for monitoring contamination on hands and surfaces.
- The Permea-Tec pads detect specific chemicals and provide rapid visual indication.



# Quantitative Assessment

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## Procedure for collection of samples

PERMEA-Tech were placed on the thumb, middle finger and palm as these represent the areas of most frequent contact and glove abrasion



# Quantitative Assessment

## Procedure for collection of samples



# Quantitative Assessment Sampling & Analysis

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## Three laboratories

- Lab 1: 12 samples
- Lab 2: 18 samples
- Lab 3: 30 samples

## Chemicals Analyzed

- Benzene
- Ethyl Benzene
- Hexane
- Toluene
- Xylene
- Chloroform
- Naphthalene
- Carbon disulfide
- Isopropanol

# Risk Phrases of the Studied Chemicals

## Risk Phrases for selected chemicals

CHEMICAL	R PHRASES
acetone	R11, R36, R66, R67
benzene	R11, R36/38, R45, R46, R48/24/25, R65
butanol	R10, R22, R37/38, R41, R67
ethylbenzene	R11, R20, R48/20, R65
heptane	R11, R38, R65, R67, R50/53
Hexane	R11, R38, R48/20, R51/53, R62, R65, R67
isopropanol	R11, R36, R67
MTBE	R11, R38
naphthalene	R22, R40, R50/53
pentane	R12, R65, R66, R67, R51/53
toluene	R11, R38, R48/20, R63, R65, R67
xylene	R10, R20/21, R36/37/38, R65
chloroform	R22, R40, R38
carbon disulfide	R43, R62,

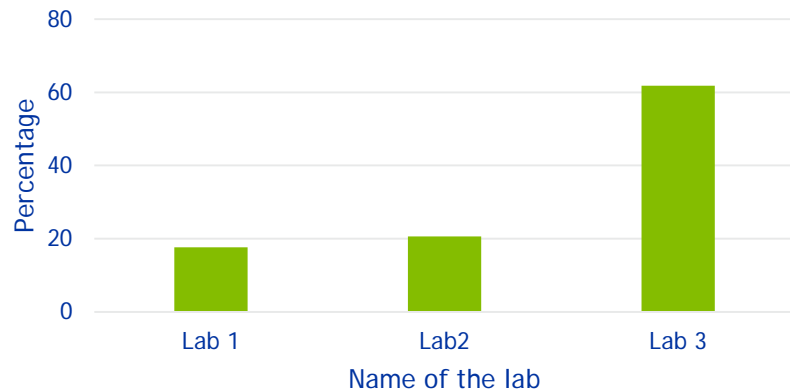
## Hazard Phrases

CHEMICAL	Hazard Phrases
acetone	irritant (A)
benzene	Toxic ( C ) , Special ( E ), Irritant ( A )
butanol	Irritant ( A )
carbon disulfide	Special ( E ) , Irritant ( A )
chloroform	irritant ( A ), Special ( E )
ethylbenzene	Harmful ( B )
heptane	Irritant ( A )
Hexane	Irritant ( A ), Harmful ( B )
isopropanol	Irritant ( A )
MTBE	Irritant ( A )
naphthalene	Special ( E )
pentane	Irritant ( A )
toluene	Irritant ( A )
xylene	Harmful ( B )

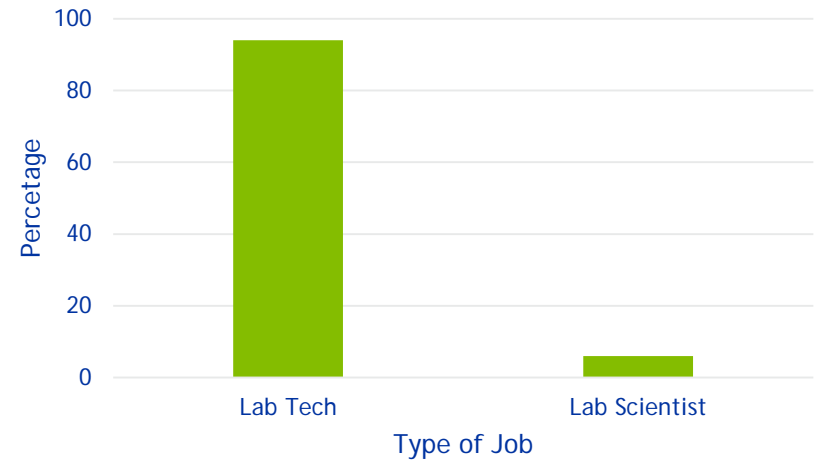


# Qualitative Assessment Results

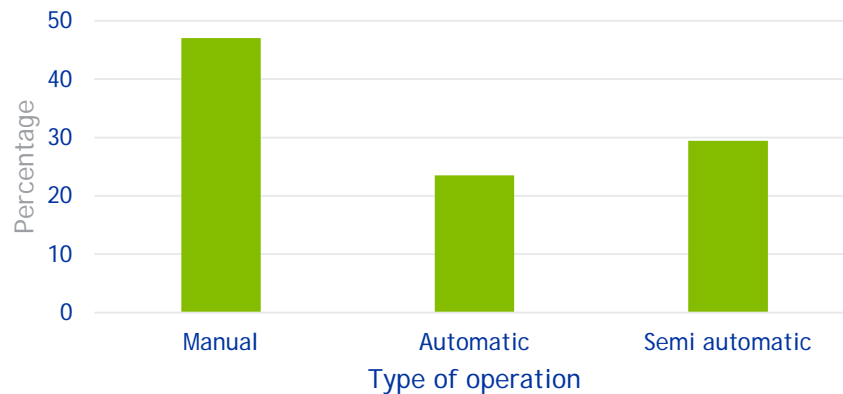
### Participants of each lab



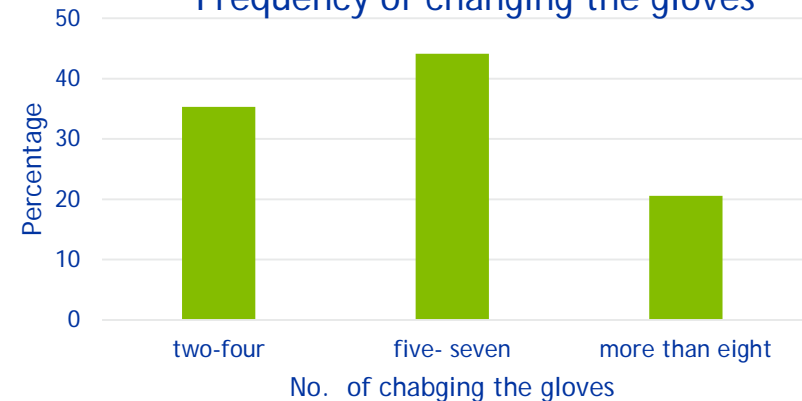
### Job description



### Job tasks

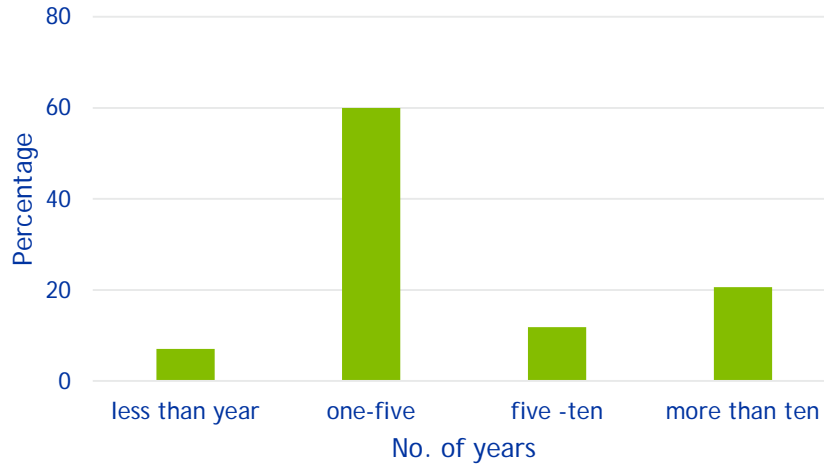


### Frequency of changing the gloves

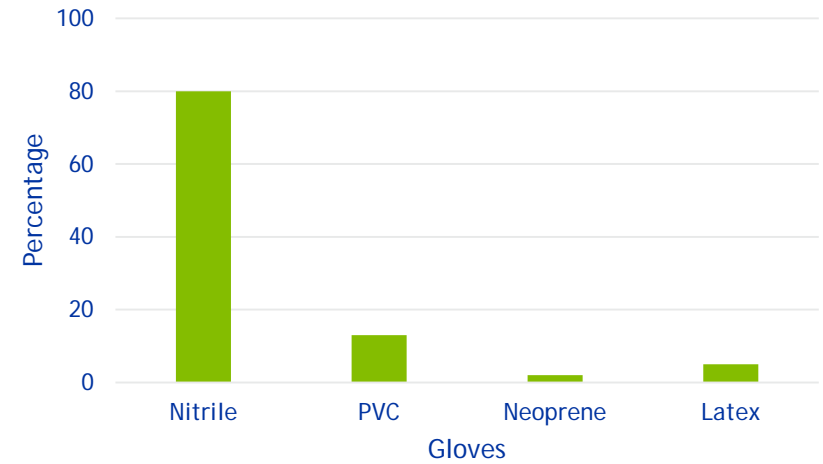


# Qualitative Assessment Results

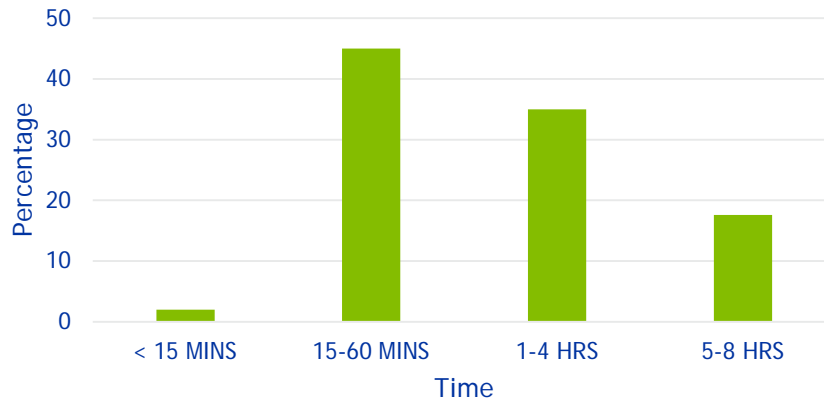
Work experience



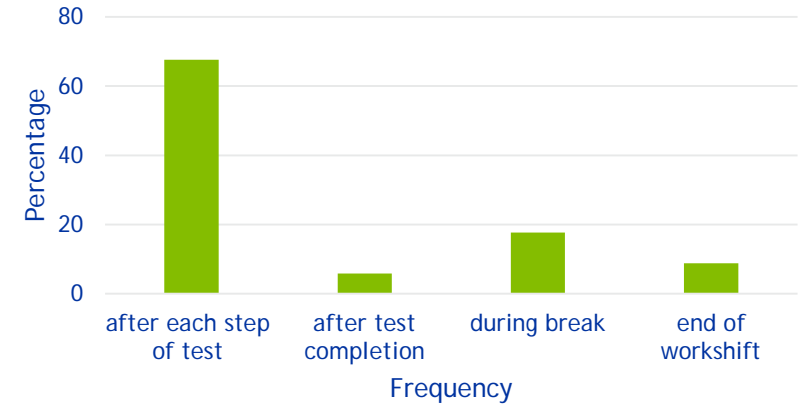
Type of gloves



Duration of dermal exposure

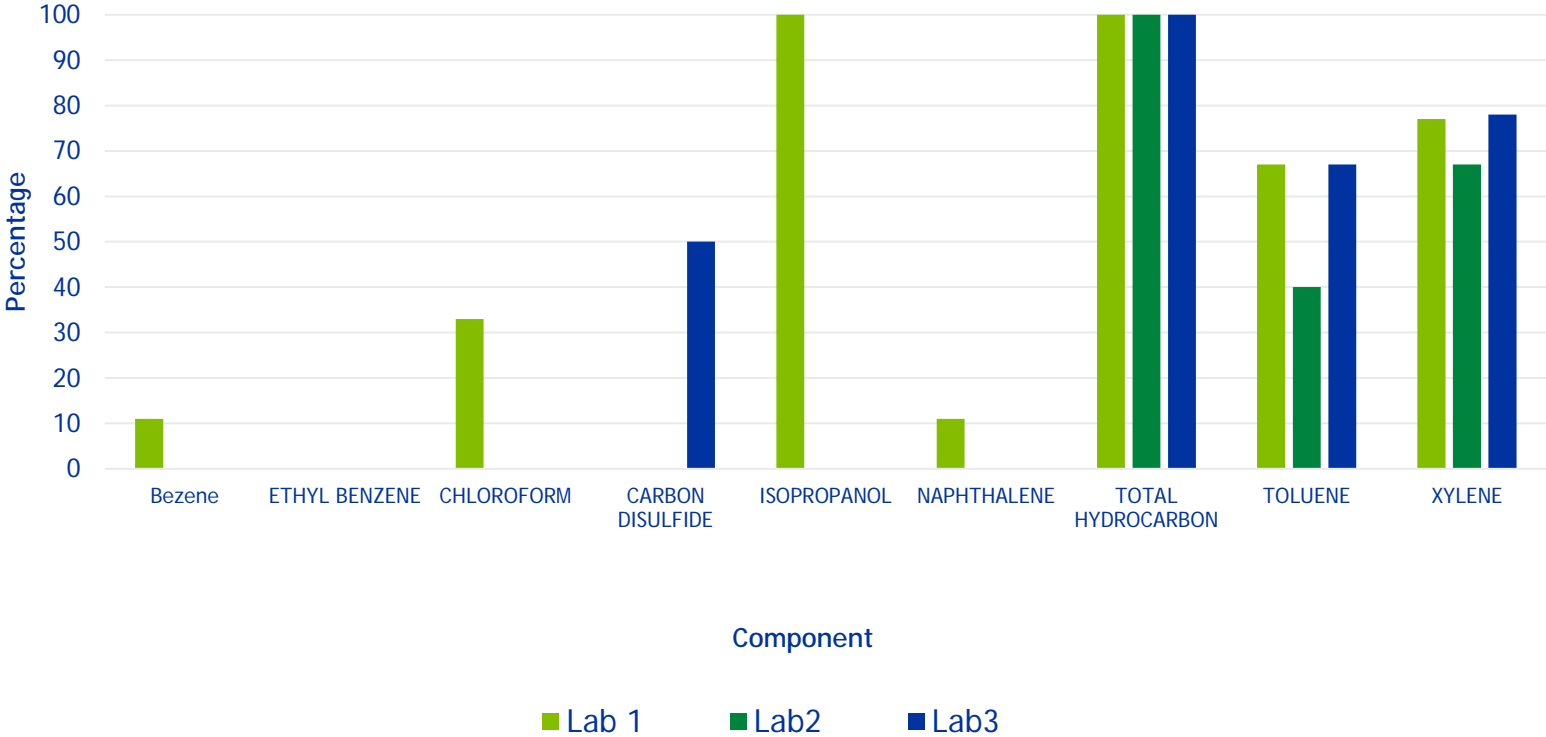


Washing hands

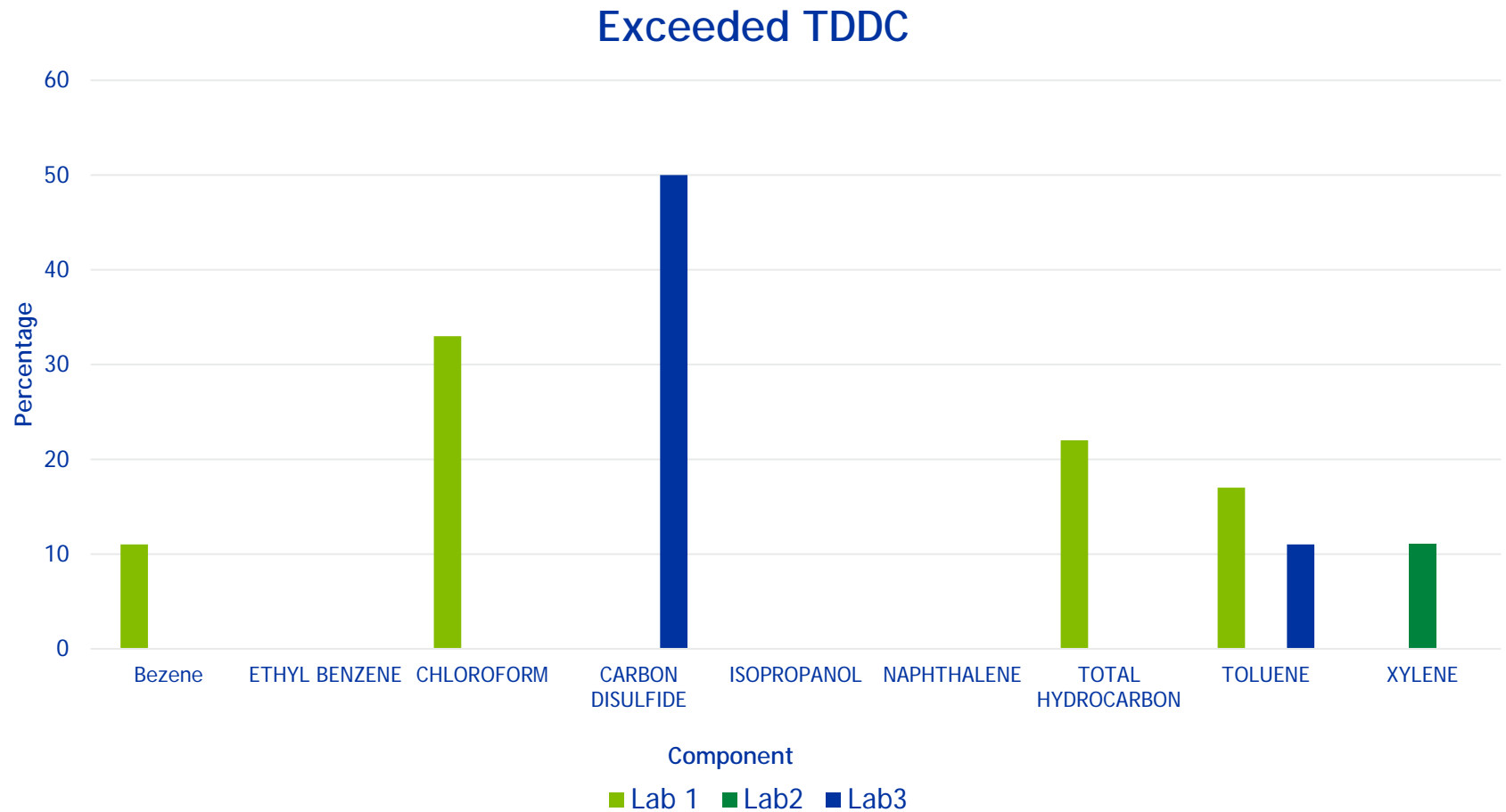


# Quantitative Assessment Results

## Gloves breakthrough



# Quantitative Assessment Results



# Limitations of this Study

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- **Qualitative Assessment**
  - The team presence during data gathering can affect the subjects' responses.
  - Accuracy is more difficult to maintain, assess, and demonstrate
  - Conclusion produced might not apply to other workers or other lab settings

# Limitations of this Study

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- **Quantitative Assessment**
  - There are no established occupational exposure limits for dermal exposure
  - The study was limited to the chemicals used in each lab and the available analytical method
  - The reliability of the patch sample measurements depended on the uniformity of skin deposition in the region of interest

# Conclusions

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- Work habits or practices had an impact on dermal exposure levels
- There was lack of awareness on the risk of dermal exposure
- Twenty percent of the respondents claimed that they have skin problems (skin dryness)
- Most of the chemical substances analyzed were identified in the Permea-Tec Pads. This was indicative of gloves breakthrough

# Conclusions (cont'd)

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- Benzene, Toluene, Chloroform and Total Hydrocarbon as Hexane exceeded the recommended TDDC values
- There was a potential risk of dermal exposure to chemical.
- Occupational skin disease is common but preventable
- Occupational skin disease is often not prevented, recognized, diagnosed, managed or reported.



Thank you