

DERMAL EXPOSURE TO NICKEL AT A SOUTH AFRICAN BASE METAL REFINERY

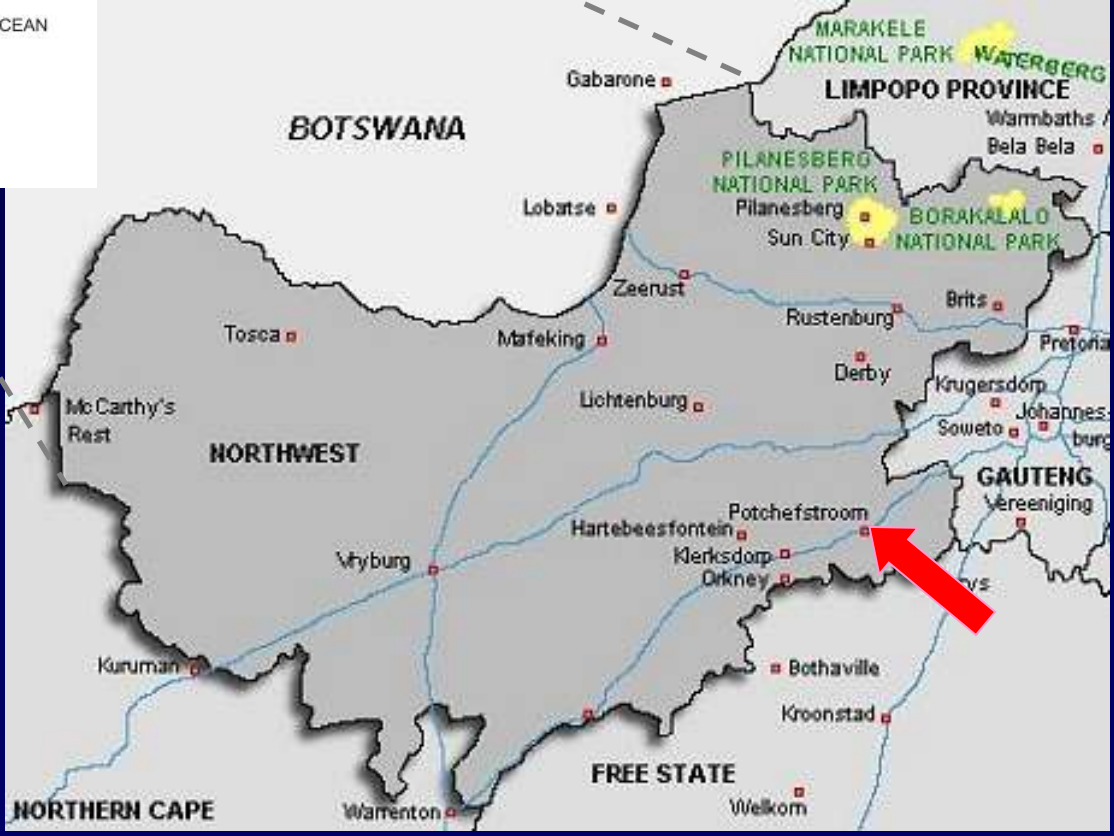
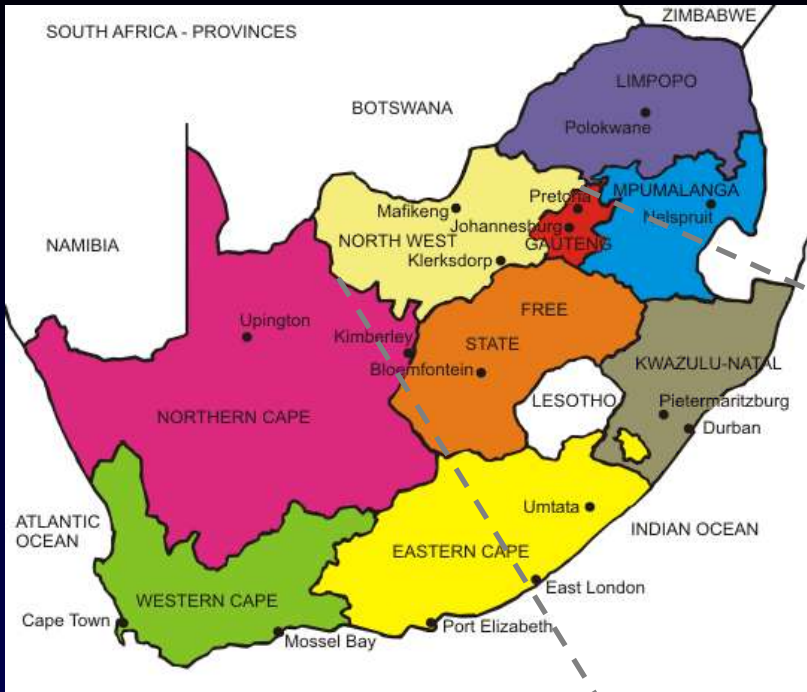
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Background

- Nickel is considered to be the most common contact allergen.
- Sensitization is through direct and prolonged skin contact.
- *In vitro* it has a very low skin permeation rate.
- *In vivo* it elicits allergic skin reactions on contact in sensitized individuals.
- Skin as a route of exposure in Occupational Hygiene is “neglected”, especially in South Africa.
- South African legislation – only skin (Sk) notations.

Background

- Numerous dermal measurement methods and strategies have been developed, i.e.:
 - Interception (surrogate skin)
 - Removal of contaminants
 - *In situ* detection methods
- Only two IOM reports (Hughson, 2004 & 2005) on dermal exposure to nickel in three European refineries.
- No published literature measuring skin condition upon occupational exposure in conjunction with dermal sampling.

Objectives

- To quantify dermal exposure of “cell workers” to nickel at a South African base metal refinery.
- To characterize skin condition by measuring skin hydration and Trans Epithelial Water Loss (TEWL).

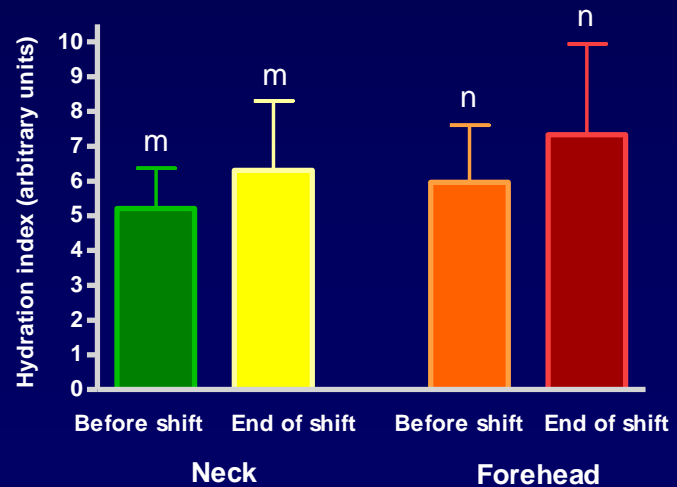
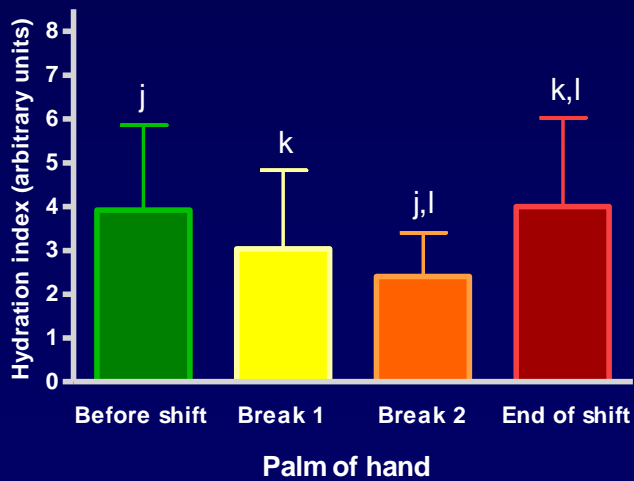
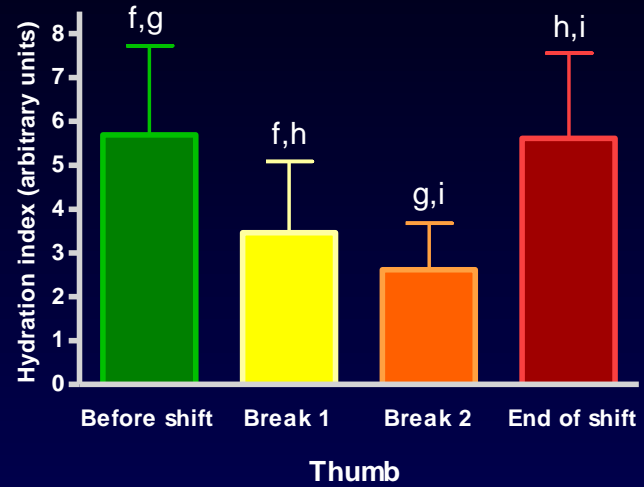
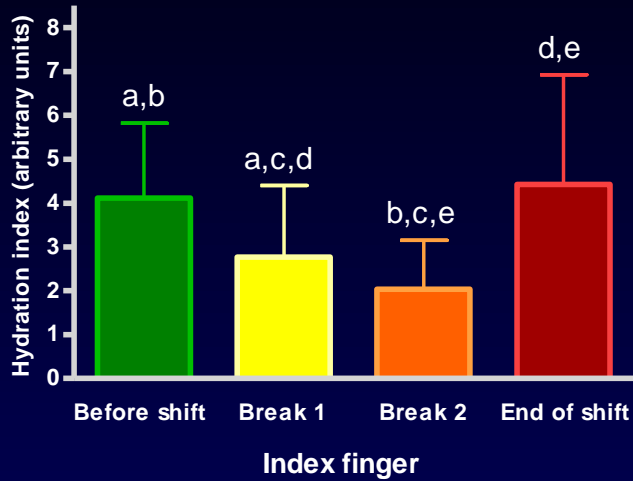
Project design

- Approved by the NWU Ethics Committee
- Electro-winning plant (tank house) of a base metal refinery
- 3 shifts per 24 hours
 - Morning shift – “highest risk”
- 26 African male “cell workers”
 - Average employment of 7.96 years (range: 1-24 years)
- Personal protective equipment
 - Two piece acid repellent overall
 - Disposable FFP2 respiratory protection
 - Protective gloves
 - Cotton liner (towelling) gloves
 - Silver talon whizard gloves
 - Flock lined latex gloves

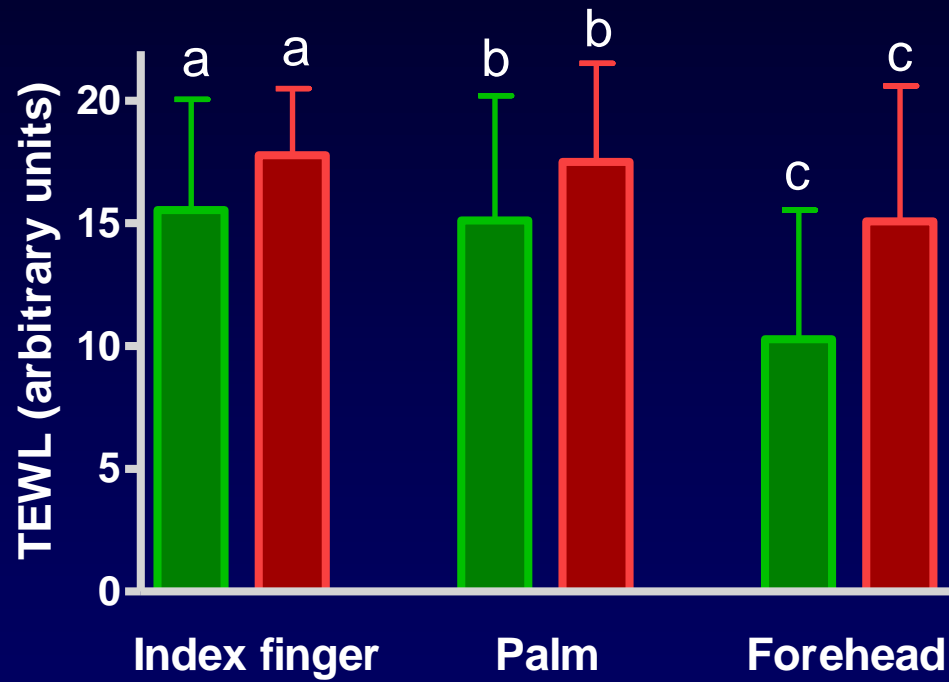
Skin condition

- EDS12 Dermal Measurement System (Enviroderm Services, UK)
 - Skin hydration – “...measurement of skin’s surface moisture levels.”
 - TEWL – “...reflects total amount of water vapor lost through skin under normal sweating conditions, and is accepted as a reliable indicator of skin barrier function.”
- Dalgard skin questionnaire
 - Self reported skin condition
 - Translated into Setswana

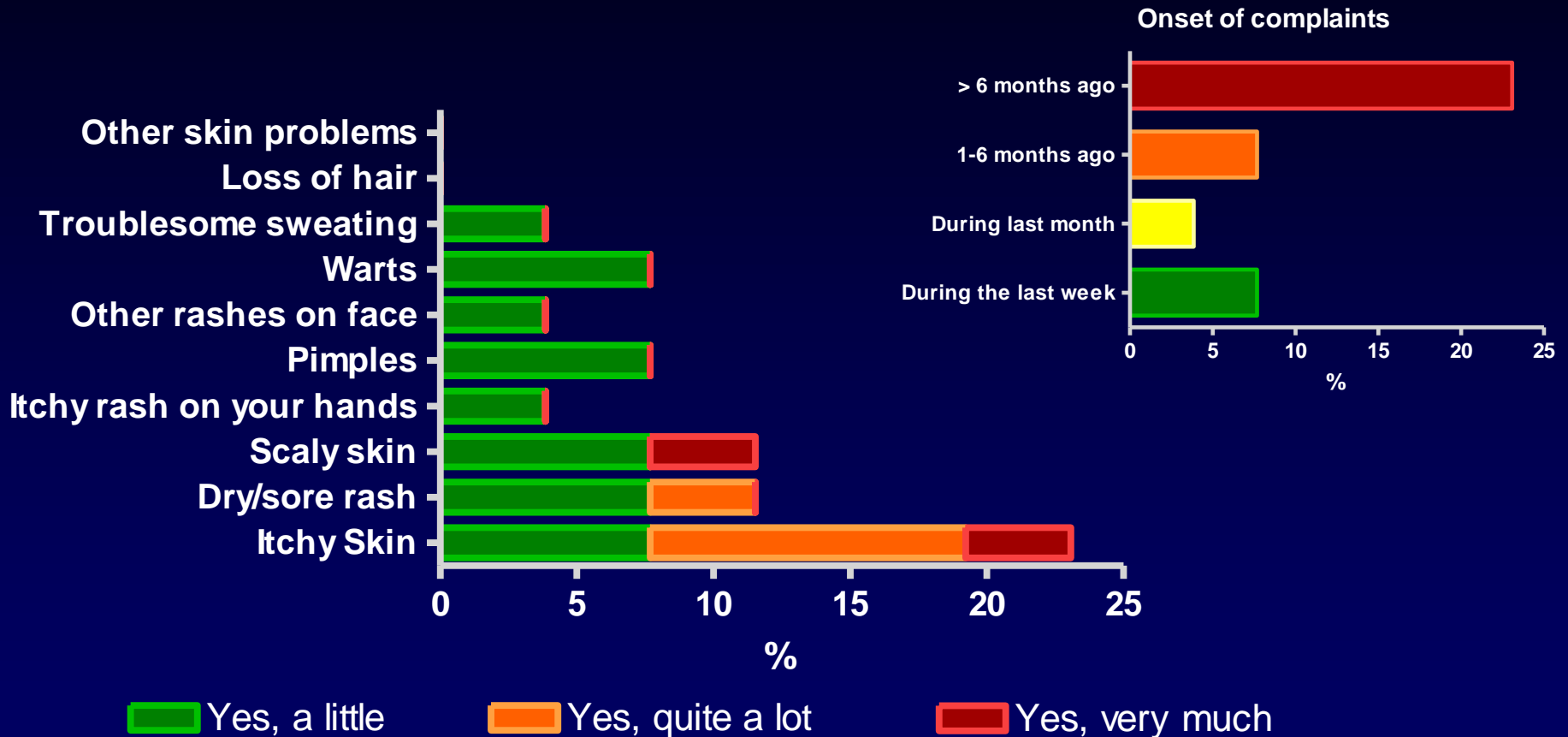
Hydration index



TEWL index

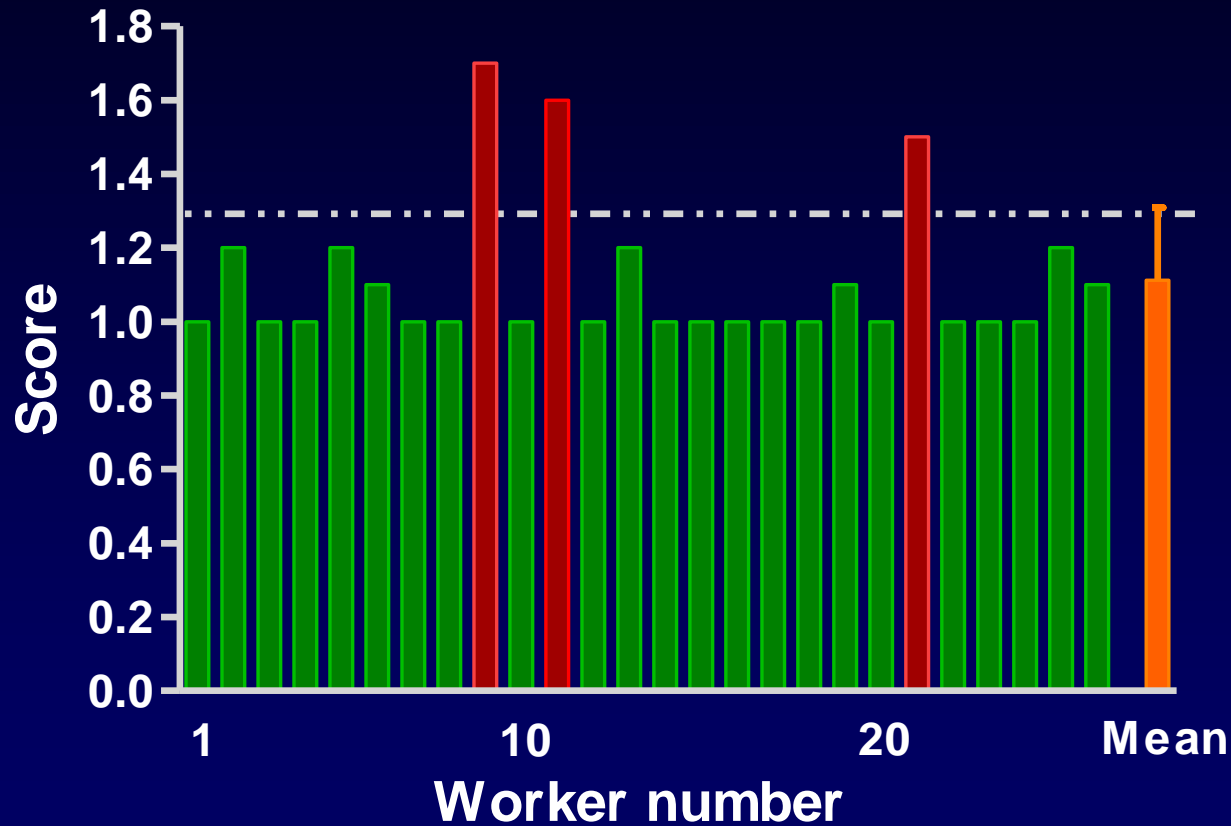


Dalgard skin questionnaire



Skin complaints during the last week

Dalgard skin questionnaire



Skin wipes

- Ghostwipes™
- Index finger (trace) – calculated surface area
- Palm of hand, neck and forehead – 10 cm² template
- Single wipe – wiped surface 3 times consecutively
- Single operator
- Clean pair of vinyl gloves
- Field blanks
- Analysis with ICP-AES by an accredited laboratory

Skin wipes

		$\mu\text{g Ni/cm}^2$			
		Mean	SD	Minimum	Maximum
Index finger	Before shift	0.974 ^{a,b,c}	0.703	0.239	2.612
	Break 1	17.466 ^a	46.221	0.236	177.772
	Break 2	7.717 ^b	9.749	0.301	42.339
	End of shift	3.763 ^c	2.720	0.813	11.3688
Palm of hand	Before shift	0.744 ^{d,e,f}	1.315	0.078	6.963
	Break 1	15.979 ^d	47.337	0.045	229.860
	Break 2	7.047 ^e	12.002	0.064	56.709
	End of shift	4.581 ^f	3.950	0.517	19.439
Neck	Before shift	0.310 ^g	0.341	0.034	1.169
	End of shift	1.869 ^g	3.212	0.174	16.969
Forehead	Before shift	0.792	1.639	0.087	8.599
	End of shift	1.259	0.872	0.056	3.151

Surface wipes

- Flat surfaces
 - Tables and benches – disposable 100 cm² template
- Uneven surfaces
 - Door handles and water taps

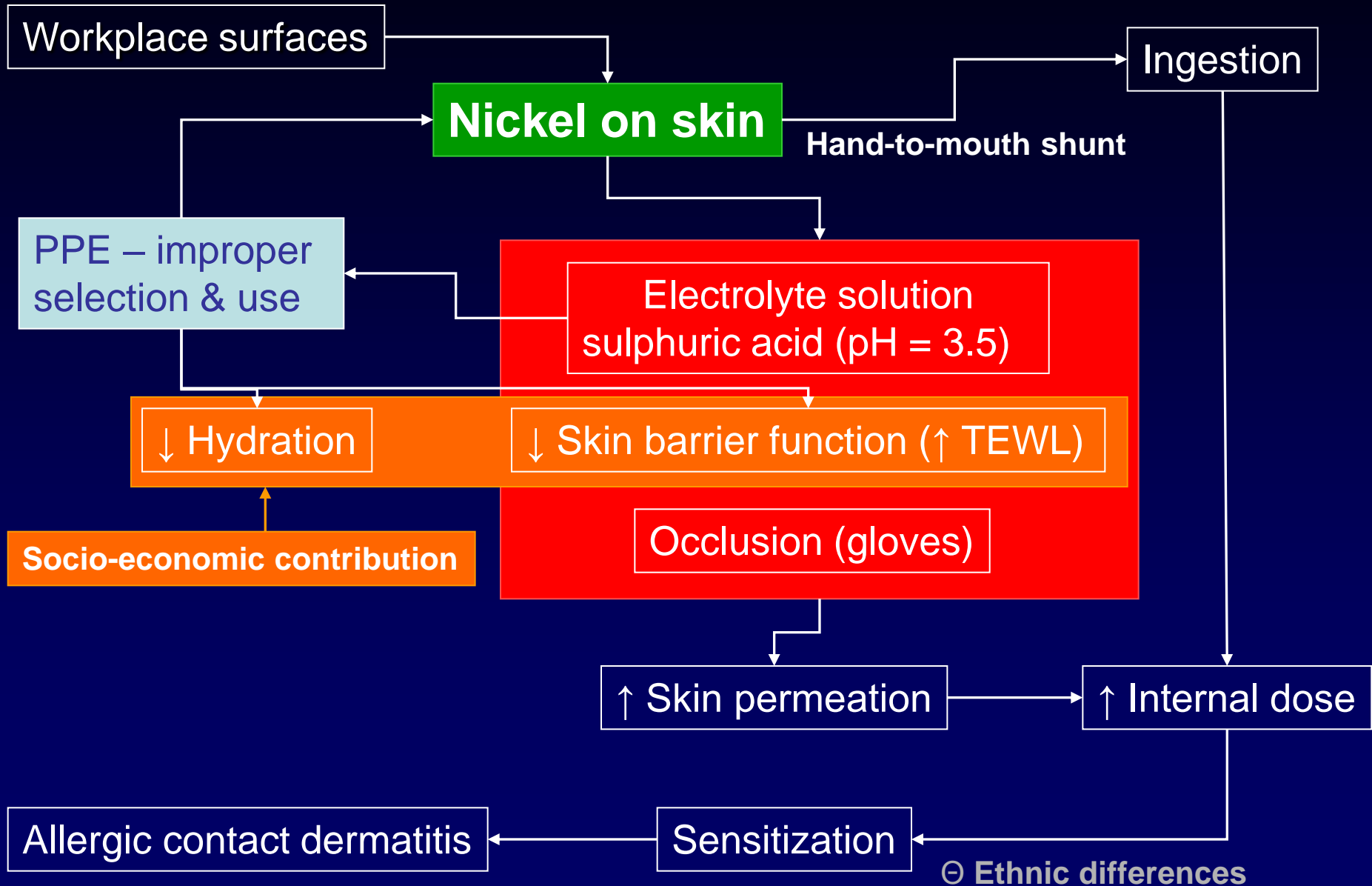
	n	Mean	µg Nickel/cm ²	
			Minimum	Maximum
Tea room tables	3	0.308	0.189	0.597
Change house collection counter	4	1.021	0.591	1.494
Change house benches	3	0.211	0.142	0.261

	n	Mean	µg Nickel/sample	
			Minimum	Maximum
Door handles	5	270.5	118.7	794.7
Water taps	7	25.7	3.9	64.2

Comparison with other studies

		Comment	n	Mean ($\mu\text{g Ni/cm}^2$)
Hands	Hughson (2004)	Ventral & dorsal side	9	1.212
	Hughson (2005)	(average of 3 measurements)	3	1.250
	Du Plessis et al.	Palm, ventral side only (break 1)	26	15.979
Neck	Hughson (2004)		9	0.697
	Hughson (2005)		3	0.127
	Du Plessis et al.		26	1.869
Head	Hughson (2004)	Peri-oral area	9	0.557
	Hughson (2005)		3	2.090
	Du Plessis et al.	Forehead	26	1.259

Conclusion



Recommendations

- Selection of protective gloves which provides mechanical and chemical protection
- Improvement of hand wash facilities
- Improvement in the cleaning schedule of facilities
- Doing spot-checks by using a colorometric wipe test
- Use of emolient skin moisturizer creams after completion of the shift to improve skin condition
- Frequent information and training sessions addressing personal hygiene and the correct use of PPE