

Development of job-exposure-models for risk assessment of benzene exposure

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Background;

Kjersti Steinsvåg: Retrospective assessment of exposure to carcinogens in Norway's offshore petroleum industry. PhD dissertation (4 articles), 2007

- JEM for 29 agens, including benzene; - unlikely, possible and probable exposure

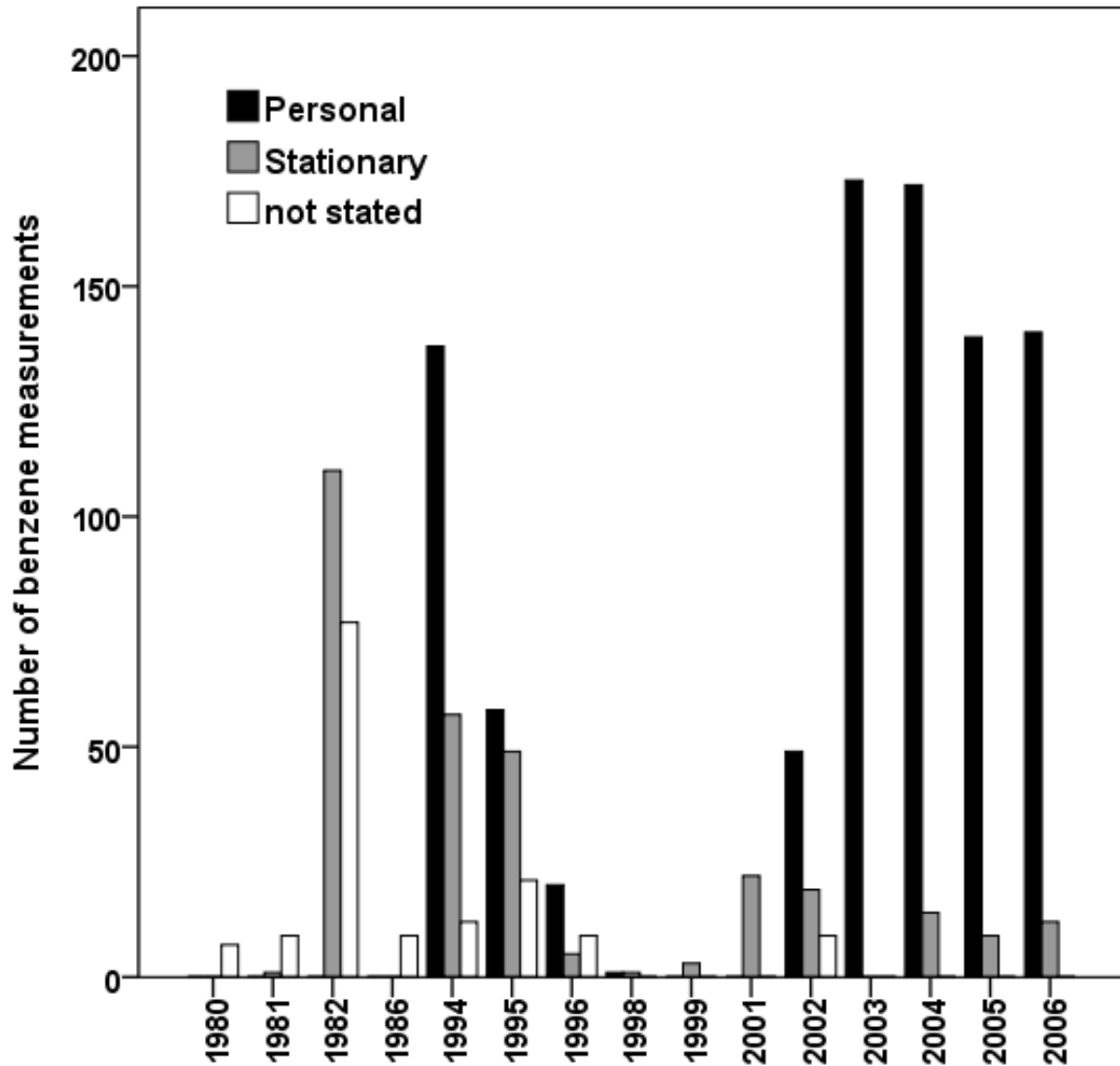
Jorunn Kirkeleit: Benzene exposure and hematological effects among offshore workers exposed to crude oil. PhD dissertation (5 articles), 2007

Bråtveit M, Hollund BE, Kirkeleit J, Abrahamsen EH. Refinement of the JEM for benzene. UiB/Uni health report, 2012



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Benzene measurements in the processing area



1387 measurements

38 installations





Semi-quantitative approach for benzene Hopf et al. 2010 :

- identification of relevant tasks
- rating of exposure intensity for each task based on 10 exposure determinants

- for each job category;
 - identification of tasks they usually perform
 - rating of tasks in terms of frequency and duration
 - exposure burden; sum of (intensity x frequency x duration) of the set of tasks usually performed

Tasks associated with benzene exposure



1	Cleaning and jetting of tanks and separators (crude oil, slop, etc.)
2	Pipeline cleaning operations
3	Sampling of crude oil, condensate and produced water
4	Maintenance of tanks and separators (e.g. crude oil, slop)
5	Opening, changing and closing blind flanges and valves
6	Testing, disassembly and cleaning of smaller devices
7	Inspection and maintenance of water treatment system
8	Cleaning, maintenance and changes of filters
9	Analysis of benzene-containing material



Rating of job categories – exposure burden



Table 3 Rating of the job categories relative to each other according to exposure burden (exposure intensity x duration x frequency) of performed tasks in four time periods.

Job category	Exposure burden (intensity x frequency x duration)			
	1970-79	1980-89	1990-99	2000 →
Process technicians ^a	2.4	2.4	2.1	1.8
Mechanics	1.9	1.9	1.6	1.4
Industrial cleaners	1.4	1.4	1.3	1.3
Process technicians ^b	1.4	1.4	1.1	0.9
Laboratory engineers	1.3	1.3	1.0	0.7
Deck crew	0.8	0.8	0.7	0.7
Plumbers and piping engineers	0.6	0.6	0.5	0.4
Non-destructive testing	0.5	0.5	0.4	0.4
Machinists	0.4	0.4	0.4	0.4
Electric instrument technicians	0.3	0.3	0.2	0.2
Scaffold crew	0.2	0.2	0.2	0.2
Sheet metal workers and welders	0.2	0.2	0.2	0.2
Insulators	0.2	0.2	0.1	0.1
Mud engineers and shale shaker operations*	*	*	-	-
Drill floor crew*	*	*	-	-
Surface treatment (painters)*	*	*	-	-

BJC

FULL PAPER

British Journal of Cancer (2015) 112, 1603–1612 | doi: 10.1038/bjc.2015.108

Keywords: benzene; case-cohort; cancer incidence; lymphohaematopoietic; offshore workers; petroleum industry

Benzene exposure and risk of lymphohaematopoietic cancers in 25 000 offshore oil industry workers

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Development of job-exposure-models for risk assessment of benzene exposure; Petromaks2-project; 2018-2021

Funding: Norwegian Research Council

- Competence building project in the Petromaks2 - program

Industrial partner;

- Equinor operates 40 offshore installations

Project group;

- UiB; Kirkeleit, Hollund, Bråtveit, Slettebø, PhD-candidate, Ousman
- equinor; Austgulen, Krüger, Ridderseth

External scientific partners

- Hans Kromhout, Utrecht University
- Tom K. Grimsrud & Jo Stenehjem, NCR



Objective

Develop task- and full-shift job-exposure models for five job categories assumed to have highest exposure.

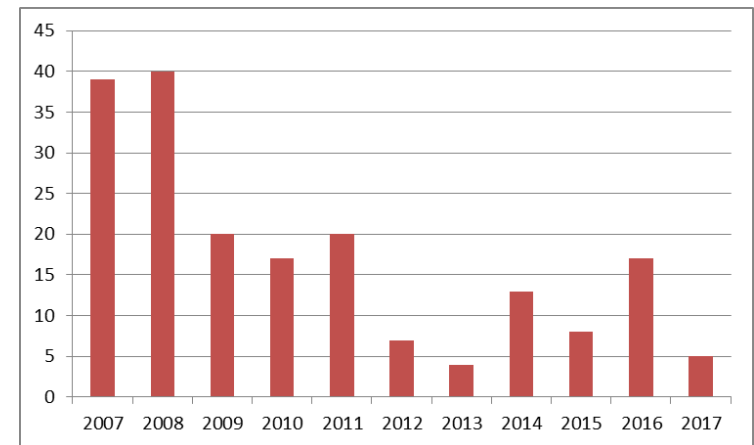
- Process technicians, mechanics, lab engineers, instrument technicians and industrial cleaners
 - For practical use in risk assessment
 - For use in epi-studies



Establishment of database on benzene exposure

Only personal measurements from Equinor – offshore & refineries

- From previous projects; 350 personal measurements from 2000-2007
- Measurement reports from 2007-2017 are under registration now
- Will end up with >2000 measurements



Variables;

- Sampling method, Lab, BTEX-results
- Installation, site/location
- Tasks (sampling, lab work, filter maintenance, etc)
- Equipment used
- Structural design of task sites (room size, ventilation, etc..)
- Benzene content of production stream
- Weather conditions
-



Activities

1	Cleaning and jetting of tanks and separators (crude oil, slop, etc.)
2	Pipeline cleaning operations
3	Sampling of crude oil, condensate and produced water
4	Maintenance of tanks and separators (e.g. crude oil, slop)
5	Opening, changing and closing blind flanges and valves
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9	Analysis of benzene-containing material

- Develop models to estimate benzene exposure for relevant work tasks
 - based on task-based measurement data and related contextual information
 - can be used to develop a tool/calculator for estimating exposure level for selected scenarios
- Develop models for full-shift benzene exposure for 5 job groups
 - based on task-based measurements and set of work tasks per job group
 - based on full-shift measurements
 - for use i epi-studies
- Validate the exposure models by new field measurements
- Test compliance between the full-shift exposure models and the present semi-quantitative job-exposure matrix used by CRN

Table 3 Rating of the job categories relative to each other according to exposure burden (exposure intensity x duration x frequency) of performed tasks in four time periods.

Job category	Exposure burden (intensity x frequency x duration)			
	1976-79	1980-89	1990-99	2000 -
Process technicians*	2.4	2.4	2.4	1.8
Mechanics	1.5	1.5	1.5	1.5
Industrial cleaners	1.4	1.4	1.4	1.5
Process technicians**	1.4	1.4	1.4	0.9
Laboratory engineers	1.3	1.3	1.0	0.7
Deck crew	0.8	0.8	0.7	0.3
Pumpers and piping engineers	0.6	0.6	0.6	0.4
Non-destructive testing	0.5	0.5	0.4	0.4
Machinists	0.4	0.4	0.4	0.4
Electric instrument technicians	0.3	0.3	0.2	0.2
Scaffold crew	0.2	0.2	0.2	0.2
Sheet metal workers and welders	0.2	0.2	0.2	0.2
Insulators	0.2	0.2	0.1	0.1
Mud engineers and shale shaker operators*	-	-	-	-
Drill floor crew**	-	-	-	-
Surface treatment (painters)**	-	-	-	-