

Institution: Heriot-Watt University		
Unit of Assessment: UoA 08 Chemistry		
Title of case study: Preventing Occupational Cancer		
Period when the underpinning research was undertaken: 2015 – 2017		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
John Cherrie	Professor	Jan 2015 – Apr 2020
Period when the claimed impact occurred: 2015 – Dec 2020		
Is this case study continued from a case study submitted in 2014? No		
<p>1. Summary of the impact</p> <p>Research to help identify the environmental causes of cancer has important consequences in terms of public understanding of risks and for official government policy, particularly in workplaces where people often experience higher exposure to carcinogens than the general public. Pioneering research work undertaken at Heriot-Watt University (HWU) on preventing occupational cancers has led to policy changes by the British Health and Safety Executive who have developed priorities for future activity to prevent workplace cancer and also by the European Commission updating the Carcinogens and Mutagen Directive. This will lead to an estimated 100,000 fewer deaths over the next 60 years. The HWU research has also increased the public focus on carcinogens at work, and the Institution of Occupational Safety and Health (IOSH), the leading workplace safety and health organisation around the world (44,000 members in 120 countries) has used the results to develop a “No Time To Lose” campaign to reduce risk.</p>		
<p>2. Underpinning research</p> <p>HWU and the Institute of Occupational Medicine (IOM), a not-for-profit organisation based on the Heriot-Watt University Research Park, collaborate on research on workplace cancer. The initiative on preventing occupational cancer has grown from the close connections between the two organisations, particularly through Prof Cherrie who has appointments at both institutions.</p> <p>For carcinogenic agents the World Health Organisation’s International Agency for Research on Cancer (IARC) coordinates the evaluation of the scientific evidence. Actions to ensure safe use of chemicals in workplaces are dictated by government regulations. However, against the changing patterns of chemical use and scientific knowledge it is necessary to regularly update the legislation.</p> <p>Cherrie has been extensively involved in occupational cancer research, initially in collaboration with the IARC to understand whether synthetic mineral fibres could cause respiratory cancers studies of workers manufacturing titanium dioxide, and polytetrafluoroethylene, as well as exposed to emissions from coke ovens, the rubber industry and other agents. Cherrie has also</p>		

participated in a number of expert evaluations of hazardous agents and also in systematic reviews of evidence for carcinogenicity. A recent example was evaluating the evidence linking night work to increased risks of breast cancer in women in advance of an updated expert evaluation by IARC.

The results of the British cancer burden study added to the pressure on the European Commission to update the legislation on occupational cancer. At the request of the Commission, Cherrie led a team with ICL and others to carry out a Socioeconomic, Health and Environmental impact assessment to support proposed changes to the legislation - the *SHEcan* project, which concluded in 2017.

This work assessed the current and future cancer burden from 25 chemicals that were under consideration for inclusion within the scope of the legislation. Overall, more than 700,000 extra deaths were projected to occur in the coming 60 years if no intervention action was taken. The majority of these projected deaths come from a small number of substances, mainly crystalline silica and diesel engine exhaust particulates. There was a very high projected cost to industry and others of tightening the legislation, which is considered to be generally higher than the monetised benefits, although the cost-benefit analysis showed this was mainly found to be because costs were up-front, but benefits were in the future and were subject to a discounted rate. However, the most stringent changes proposed would result in over 100,000 fewer cancer cases over the next 60 years.

3. References to the research

- [3.1] Cherrie, JW, Hutchings, SJ, Gorman Ng, M, Mistry, R, Corden, C, Lamb, J, Sánchez Jiménez, A, Shafrir, A, Sobey, M, van Tongeren, M & Rushton, L 2017, 'Prioritising action on occupational carcinogens in Europe: a socioeconomic and health impact assessment', *British Journal of Cancer*, vol. 117, no. 2, pp. 274-281. <https://doi.org/10.1038/bjc.2017.161>
- [3.2] Cherrie, JW 2019, 'Binding occupational exposure limits for carcinogens in the EU - necessary but not sufficient to reduce risk', *Scandinavian Journal of Work, Environment and Health*, vol. 45, no. 4, pp. 423-424. <https://doi.org/10.5271/sjweh.3836>
- [3.3] Cherrie, JW & Levy, L 2019, 'Managing Occupational Exposure to Welding Fume: New Evidence Suggests a More Precautionary Approach is Needed', *Annals of Work Exposures and Health*. <https://doi.org/10.1093/annweh/wxz079>
- [3.4] Cherrie, JW 2017, 'Kaizen', *Annals of Work Exposures and Health*, vol. 61, no. 4, pp. 398-400. <https://doi.org/10.1093/annweh/wxx015>
- [3.5] McElvenny, DM, Crawford, JO & Cherrie, JW 2018, 'What should we tell shift workers to do to reduce their cancer risk?', *Occupational Medicine*, vol. 68, no. 1, pp. 5-7. <https://doi.org/10.1093/occmed/kqx187>
- [3.6] Hidajat, M, McElvenny, DM, Ritchie, P, Darnton, A, Mueller, W, van Tongeren, M, Agius, RM, Cherrie, JW & de Vocht, F 2019, 'Lifetime exposure to rubber dusts, fumes and N-nitrosamines and cancer mortality in a cohort of British rubber workers with 49 years follow-up', *Occupational and Environmental Medicine*, vol. 76, no. 4, pp. 250-258. <http://dx.doi.org/10.1136/oemed-2019-106269>

[3.7] IARC Monographs Vol 123 Group, 2018, 'Carcinogenicity of some nitrobenzenes and other industrial chemicals', *The Lancet Oncology*, vol. 19, no. 12, e681–e682.

[https://doi.org/10.1016/S1470-2045\(18\)30823-4](https://doi.org/10.1016/S1470-2045(18)30823-4)

4. Details of the impact

Research to help identify the environmental causes of cancer has important consequences in terms of public understanding of risks and in official government policy, particularly in workplaces where people often experience higher exposure to carcinogens than the general public.

Epidemiological evidence is most influential in the process of hazard identification, with the IARC only categorising agents as proven human carcinogens when there is convincing evidence of risk from a number of different populations. Research studies, such as the work on lead metal and compounds undertaken by Cherrie, has influenced the recommendation to a future evaluation of the carcinogenicity of this metal and its compounds. This metal was last classified as a probable carcinogen in 2006, but recommended by IARC for re-evaluation as a high priority (October 2019) [5.1].

In addition to hazardous chemicals, there are other workplace exposures that may cause cancer, including for women working on night shifts. A number of epidemiological studies have shown an increased risk of breast cancer associated with long-term night work, although in a recent systematic review, in which Cherrie participated, the evidence in the literature was found to be limited. However, when IARC recently reviewed this topic, it was concluded that night shift work should continue to be classified as probably carcinogenic.

Cherrie contributed from 2015 onwards to reviews of carcinogens as part of the Workplace Health Expert Committee (WHEC) of the British Health and Safety Executive (HSE) [5.2]. These WHEC reviews have influenced government policy in relation to respirable crystalline silica, diesel engine exhaust particulate and welding fumes. In the case of welding fumes, advice from the WHEC reviews has resulted in much tighter legal constraints on employers carrying out this type of work (HSE, 2019). Workplace carcinogens are now clearly recognised by the HSE as the main cause of death from work activities; workplace cancer deaths are more than fifty-times the number of deaths from accidents at work [5.3].

The British cancer burden study findings increased pressure on the European Commission to act to update European legislation on occupational carcinogens and mutagens, which resulted in the *SHEcan* research, led by Cherrie. Between 2017 and 2019 the Commission updated the Carcinogens and Mutagen Directive in Europe with the *SHEcan* research results used as part of the justification for change, particularly in the legislative impact statement prepared by the Commission [5.4, 5.5] and subsequent political discussions between governments, employers and trade unions about the legislation, e.g. by the European Parliament [5.6]. Three sets of amendments to the Carcinogens and Mutagen Directive have been published by the Commission and these were all approved by the appropriate European institutions. The final Directive 2019/983 entered into force on 10th July 2019 and has new binding occupational exposure limit values for twenty-five hazardous substances, including respirable crystalline silica, cadmium, beryllium, arsenic and formaldehyde, leading to an estimated 100,000 fewer deaths over the next 60 years.

The research has also increased the public attention on carcinogens at work, and the Institution of Occupational Safety and Health (IOSH), the leading workplace safety and health organisation around the world (44,000 members in 120 countries) has used the results to develop a campaign to reduce risk, leading to the “No Time To Lose” (NTTL). Cherrie advised on the key priorities for the campaign. Cherrie has also participated in specific initiatives in the NTTL campaign since its launch, e.g. a silica stakeholder summit to discuss action to reduce risks, and he has also spoken at specific campaign launch events and other events to provide information. By the end of 2019, the campaign had secured the formal support of over 360 employer organisations around the world. Campaign ambassadors and supporters have made presentations at over 250 events, reaching over 18,000 delegates. Almost 150,000 people have visited the project website and downloaded about 120,000 information resources [5.7].

The success of the grassroots IOSH campaign has encouraged further discussion, about the role of legislation in improving working conditions for carcinogen exposure. Cherrie has promoted the idea of continuous change (kaizen) though invited conference keynote presentations and networking as a more effective strategy than relying on just binding occupational exposure limits (OELS), the regulatory values which indicate levels of exposure that are considered to be safe (health based) for a chemical substance in the air of a workplace. This is particularly important for substances such as diesel engine exhaust particulate, where the *SHEcan* research showed a large number of cancers being caused.

5. Sources to corroborate the impact

[5.1] Group Head, Monographs Group, International Agency for Research on Cancer, can be contacted to corroborate the value Professor Cherrie’s research for cancer hazard and risk management.

[5.2] Letter from the Principal Scientist and Professional Lead for Health and Safety Executive.

[5.3] HSE (2019) Change in Enforcement Expectations for Mild Steel Welding Fume - this describes action by the HSE to tighten restrictions on welding activity.

[5.4] Protection of workers from exposure to carcinogens or mutagens: second proposal (CMD 2). A briefing for the European parliament (July 2017), which makes reference to the *SHEcan* research project outputs, see p1, 2, 6.

[5.5] Proposal for a Directive of the European Parliament and of the Council amending Directive 2004/37/EC on the {COM(2017) on the protection of workers from the risks related to exposure to carcinogens or mutagens at work.

[5.6] Carcinogens and Mutagens Directive Amended, article by BC Legal to update their clients and others about the upcoming changes to the law (2017), which mentions the *SHEcan* project results. www.bc-legal.co.uk/bcdn/232-198-carcinogens-and-mutagens-directive-amended.

[5.7] Head of Communications and Media, IOSH, can be contacted to corroborate impacts stated.