**Institution:** Queen's University Belfast

**Unit of Assessment:** 19

**Title of case study:** Safeguarding women from occupational exposure to breast cancer carcinogens

**1. Summary of the impact** (indicative maximum 100 words)

Research on the relationship between women's working lives, occupational exposures and breast cancer, which uses detailed work histories as a means of identifying toxic exposures, has found there to be an elevated risk for women working in agriculture, bars and gambling environments, as well as automotive plastics manufacturing, food canning, and metalworking workplaces. The influential study has led trade unions, politicians and charities in the United Kingdom and Canada to demand health and safety regulatory changes and further research.

A number of studies have been produced by the multidisciplinary, multinational team, in which Professor Matthias Beck plays a lead role. The main study was published and released to the media in 2012 (Brophy *et al.* 2012b); so far it has attracted more than 16,000 downloads and over 220 media references.

**2. Underpinning research** (indicative maximum 500 words)

Breast cancer is the most frequent cancer diagnosis among women worldwide[1] and North American and UK rates are among the highest in the world.[2] There is now evidence of associations with numerous lifestyle, genetic, physiological, and pharmaceutical risk factors, but these factors do not fully explain breast cancer etiology.

Professor Beck, who joined Queen's University Management School in June 2011, works with a multidisciplinary team including management researchers, public health experts, oncologists and statisticians in Canada and the UK. His specific contribution includes the review of the literature, data interpretation and the joint preparation of the team's manuscripts. The team's research utilises women's work histories of occupational exposures to identify the role of endocrine-disrupting chemicals and carcinogens on breast cancer incidence. Endocrine-disrupting chemicals and carcinogens, some of which may not yet have been classified as such, are present in many occupational environments. Their impact is poorly understood, however, largely because the type and duration of occupational exposures is often unclear. This situation is particularly challenging since endogenous estrogen (that originating from within) affects the risk of breast cancer and exogenous estrogenic compounds (external estrogen-producing factors) may also do so.

Endocrine disruptor theory not only implies that the timing of exposure is important due to varying susceptibility, particularly during critical periods of breast development when breast tissue is less differentiated, but also predicts that effects may occur at low doses. Earlier research by Rudel et al. (2007) identified 216 chemicals as mammary gland carcinogens in experimental animals, many of which have also been listed as potential endocrine-disrupting chemicals (EDCs)[3] This highlights the need to evaluate the breast cancer risk associated with these chemicals among women whose occupations expose them to these substances..

Research by the team demonstrates the central role of these exposures on the health outcomes of working women (Brophy *et al.* 2012a, Brophy *et al.* 2012b, De Matteo *et al.* 2012). Accordingly, the group's main study (Brophy *et al.* 2012b) found women in jobs with potentially high exposures to carcinogens and endocrine disruptors had elevated breast cancer risk. The study

1 http://www.wrcf.org/cancer_statistics/world_cancer_statistics.php

2 http://www.cancerresearchuk.org/cancer-info/cancerstats/types/breast/incidence/#world

3 http://onlinelibrary.wiley.com/doi/10.1002/cncr.22653/pdf

breast cancer cases referred by a regional cancer centre and 1,146 randomly-selected community controls; all of the women participating in the research provided detailed data on their occupational and reproductive histories. Specific sectors with elevated risk included agriculture, bars-gambling, automotive plastics manufacturing, food canning and metalworking. Moreover, pre-menopausal breast cancer risk was highest for those in the automotive plastics and food canning sectors.

These findings advance existing knowledge in the area, especially as the group's main study (Brophy *et al.* 2012b) can be considered the first scientifically rigorous treatment of this subject matter, identifying the significance of occupational exposure in relation to other factors (such as lifestyle). The identification of several important associations in the mixed industrial and agricultural population that were investigated highlights the importance of occupational studies in identifying and quantifying environmental risk factors and illustrates the value of taking detailed occupational histories of cancer patients. It also identifies areas of regulatory deficits and under-regulation especially in relation to the exposure risks of female workers – this has given a major impetus to campaigning organisations and charities working in this crucial area of health and well-being.

**3. References to the research** (indicative maximum of six references)

Brophy, James T, Margaret M Keith, Andrew Watterson, Michael Gilbertson, and Matthias Beck, "Farm work in Ontario and breast cancer risk", (2012a), *Rural Women's Health*. Edited by Leipert BD, Leach B, Thurston W. Toronto: University of Toronto Press, 101–121.

Brophy, James T, Margaret M. Keith, Andrew Watterson, Robert Park, Michael Gilbertson, Eleanor Maticka-Tyndale, Matthias Beck et al. (2012b), "Breast cancer risk in relation to occupations with exposure to carcinogens and endocrine disruptors: a Canadian case–control study", *Environmental Health 11, no. 87*: 1-17.

DeMatteo, Robert, Margaret M Keith, James T Brophy, Anne Wordsworth, Andrew E Watterson, Matthias Beck, Anne Rochon Ford. "Chemical exposures of women workers in the plastics industry with particular reference to breast cancer and reproductive hazards", (2012), *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy -1,* 427-448.

The research has been supported by cash and "in kind" donations from a number of organisations, including the Windsor Regional Cancer Center Foundation, the Canadian Breast Cancer Foundation – Ontario, the Green Shield Foundation, Breast Cancer Society of Canada, Government student summer employment support for research assistants and miscellaneous small donations.

**4. Details of the impact** (indicative maximum 750 words)

Both the methodology employed by the researchers and the identification of specific occupational breast cancer risks affecting working women has had an impact across a number of countries.

In relation to the team's focus on the role of occupation in breast cancer, the research (especially Brophy et al.2012) has triggered an important debate about the relative benefits of occupation-based studies in relation to gene–environment interactions[4]

With regard to the methodology employed by the group, both the secondary studies (Brophy et al, 2012a; DeMatteo et al, 2012) and the main study (Brophy et al, 2012b) have impacted beyond academia on how public health bodies, such as the surveillance body CAREX (CARcinogen EXposure) Canada approach issues of occupational cancer etiology and the etiology of occupational diseases more generally, with CAREX aiming to generate a widely disseminated data base of work related carcinogenic chemicals.[5]. Similarly the publicly funded Institute for Work and Health has noted the importance of the study's case control methodology in this specific work context.[6]

4 http://www.current-oncology.com/index.php/oncology/article/view/1326/1125

5 http://www.cbc.ca/news/health/story/2012/03/20/cancer-work-plastic.html

The research has also led trade union bodies, charitable organisations, environmental groups and, more recently, legislative bodies to demand regulatory change, improved inspection and further research.

In Canada, the Automobile Workers Unions (CAW) – one of the largest and highest profile social unions with over 225,000 members – has used the findings to demand changes to health and safety regulation to make the working lives of women safer. Specifically, CAW news releases (Nov 2012) note that "CAW is deeply troubled by the latest findings on the occupational causes of breast cancer among Canadian women and is calling for regulatory changes and increased attention by health officials to blue collar women's workplace exposures, in light of the new research."

In reviewing the group's main study, CAW's Health, Safety and Environment Director Sari Sairanen publicly has stated that "Important studies like this give credence to the glaring trends that we see in our workplaces – it is absolutely urgent that we do not continue to wait until overwhelming evidence piles up before we take action."

CAW called for a series of measures including (19 Nov 2012):
- increased attention by health officials to blue-collar women's workplace exposures and cancer research;
- research initiatives into preventable environmental causes of breast cancer;
- a public inquiry or commission to examine the risks to women posed by exposures in the plastics industry;
- regulatory changes; and
- action by the Federal Government to ensure that companies that use safer and healthier products do not face an unfair competitive disadvantage with overseas companies using harmful substances.

The Canadian Breast Cancer Foundation – one of the largest non-governmental funders of breast cancer research worldwide – noted in a press release (18 Nov 2012) that "[t]his landmark research provides new evidence to help inform discussions with governments, industry, health care providers and stakeholders about the serious effects occupational risk factors can have on the development of breast cancer."

The Director of the National Network on Environments and Women's Health, Dayna Nadine Scott (a CBCF official), has stated that the research will be used to "demand a precautionary approach to dealing with toxic substances" based on a "growing understanding that when it comes to endocrine disrupting chemicals, even low doses can be dangerous" (19 Nov 2012). Similar demands have been made by a number of charitable and civic organizations in North America, including the Canadian Breast Cancer Research Network, the National Association of Professional Women (USA), the Breast Cancer Fund (USA).

Also in the UK, the Alliance for Cancer Prevention – a multi-stakeholder group which includes representatives from NGOs, environmental and occupational health organisations, trade unions, (including UNITE, UNISON and USDAW), public health advocates and civil society groups – has stated that "a dramatic policy switch to eliminate exposure to Endocrine Disrupting Chemicals (EDCs) must be the main focus of the EU's EDC strategy." Specifically, the Alliance demands "an urgent refocus of the EDC strategy to eliminate exposure to EDCs" and calls "on the UK Government to support a hazards based approach to identification and assessment of EDCs including mixtures of EDCs across all exposures in the workplace and for the public in general" (7 Dec 2012).

[6] http://www.iwh.on.ca/wrmb/case-control-study

**5. Sources to corroborate the impact** (indicative maximum of 10 references)

1) Announcement by the Canadian Automobile Workers Union (19 Nov 2012) to demand regulatory changes based on this research ("New Canadian Research on Occupational Causes of Breast Cancer Point to Urgent Need for Increased Regulation and Action") http://www.caw.ca/en/11701.htm

2) News release by the Canadian Breast Cancer Foundation (18 Nov 2012) stating its intent to incorporate occupational breast cancer research in their campaigning and lobbying efforts based on this research ("Examining Workplace Risk for Breast Cancer") http://www.cbcf.org/bc/AboutUsMain/MediaCenter/NewsReleases/Pages/Workplace-Risk-for-Breast-Cancer.aspx

3) News release by the Canadian Breast Cancer Foundation, Ontario (19 Feb 2013) stating its intent to incorporate occupational breast cancer research in their campaigning and lobbying efforts based on this research ("Growing Evidence: Toxic Chemicals and Breast Cancer Risk") http://www.cbcf.org/central/AboutBreastHealth/PreventionRiskReduction/ReduceYourRisk/your-environment/Pages/EmergingEvidence.aspx

4) News release by the Canadian Breast Cancer Research Network (19 Nov 2012) stating a need to target cancer prevention effort toward occupations in line with this research ("Examining Workplace Risk for Breast Cancer") http://www.cbcn.ca/index.php?pageaction=content.page&id=7753&lang=en

5) News release by the National Association of Professional Women (US) (November 2012) highlighting implications of this research (Breast Cancer 'Linked' to Chemical Jobs") http://www.napw.com/press/napw-14669/breast-cancer-linked-to-chemical-jobs-stirling-study-suggests/

6) Blog entry by Breast Cancer Fund (US) (19 Nov 2012) highlighting the implications of this research ("Study spotlights high breast cancer risk for plastics workers") http://www.insideprevention.org/search.html?cx=007611168573976245246%3Apgsiq-5o8yw&cof=FORID%3A10&ie=UTF-8&q=brophy&siteurl=www.insideprevention.org%2F&ref=&ss=1012j228782j6

7) Extensive Coverage at the Center for Public Integrity Webpages (US) (19 Nov 2012) including an interview with Jeanne Rizzo, president of the Breast Cancer Fund pressing for more research and describing the study as "a very powerful piece of work. The piece that's really been missing for female breast cancer is occupation." (("Study spotlights high breast cancer risk for plastics workers") http://www.publicintegrity.org/2012/11/19/11806/study-spotlights-high-breast-cancer-risk-plastics-workers

8) UNISON press release discussing the group's work (UK) (7 Dec 2012) ("Occupational Breast Cancer, A Much Neglected Gender Issue") http://www.unison.org.uk/safety/pages_view.asp?did=15066

9) Alliance for Cancer Prevention Press release discussing the group's work (UK) (7 Dec 2012) ("Occupational Breast Cancer") http://allianceforcancerprevention.org.uk/occupational-breast-cancer-a-much-neglected-gender-issue/

10) News release by Hazards Magazine (UK) (December 2012) highlighting the dangers of occupational breast cancer in light with the group's findings ("Global: 'Toxic soup' of chemicals causes breast cancer) http://www.hazards.org/news/2012/