Legal Issues in Radiography: Darkroom Disease

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Abstract

This article examines the legal issues that are relevant to the use of glutaraldehyde by radiographers and the prevention of Darkroom Disease, including the legislative framework. It also aims to investigate the role that the unions and government occupational health and safety bodies play in the management and protection of radiographers from Darkroom Disease. It examines the practical precautions that should be observed by the employer and the radiographer to protect the radiographer from developing the debilitating health problems associated with Darkroom Disease, in order to meet their legal obligations.

Introduction[1]

This paper aims to examine the Occupational Health and Safety laws that are relevant to the use of glutaraldehyde and the prevention of Darkroom Disease. Specifically, the Victorian legislative framework of the *Occupational Health and Safety Act 1985*, *Occupational Health and Safety (Hazardous Substances) Regulations 1999* and the *Code of Practice for Hazardous Substances 2000* will be analysed and the legal obligations of employers, employees and manufacturers to prevent Darkroom Disease discussed.

This article also aims to investigate the role that the unions and government occupational health and safety bodies play in the management and protection of radiographers from Darkroom Disease. Legal proceedings where adequate protection from this disease was disputed will also be analysed from both a national and international perspective, with the lessons learnt from these cases and avenues for compensation explored.

Most importantly, this paper aims to investigate the practical precautions that should be observed by the employer and the radiographer to protect the radiographer from developing the debilitating health problems associated with Darkroom Disease.

'Darkroom Disease' describes a collection of symptoms some healthcare workers experience when exposed to film-processing chemicals, and is often referred to as multiple-chemical sensitivity (MCS).[2] Processing chemicals enter the body via contact through the skin, inhalation into the lungs or ingestion. Radiographers can be exposed to these chemicals through manual film processing, cleaning of the internal components of the film processor or by fumes from the normal processing procedure.[3]

[1] James Batch and Patrick Nowlan are both final year students in Bachelor of Radiography and Medical Imaging, Monash University, Melbourne. This paper is a based on a research report in the subject RAD4030 Selective Studies in Medical Imaging supervised by Paul Latimer of the Department of Business Law and Taxation at Monash University

[2] T. Sanchez, 'When it hurts to breathe: Chemicals and R.T.s' (1999) 31 *ASRT Scanner* 11, 6-8.

[3] Occupational Health and Safety Service, *The Safe Occupational Use of Glutaraldehyde In the Health Industries* (1992) Department of Labour, Wellington, New Zealand.

Symptoms associated with Darkroom Disease are well-documented in the literature, as illustrated in Table 1.

Route of Exposure	*Symptoms*
Inhalation	Occupational/glutaraldehyde induced-asthma, chemical/metallic taste, sore throat, sinusitis, catarrh, nose bleeds, rhinitis.
Contact – direct	Dermatitis, skin rash.
Contact – indirect (vapour)	Eye irritation.
Ingestion	Sore throat, abdominal pain, cramps, vomiting, diarrhoea, coma, liver and kidney damage.
Unknown	Memory loss, difficulty in concentrating, fatigue, tiredness, headache, nausea.

Table 1. Routes of exposure and symptoms of Darkroom Disease.[4]

It is recognized that developer and fixer solutions used to produce radiographs contain substances known to cause or exacerbate asthma with glutaraldehyde, formaldehyde, sulphur dioxide and acetic acid specifically implicated as eye and upper-respiratory tract irritants.[5]

Relevant to the radiography profession is exposure to glutaraldehyde, identified as the principal cause of most symptoms. Sensitisation to glutaraldehyde can occur after any number of exposures, even below recognised occupational standard levels.[6] Glutaraldehyde is included in most processing chemicals to act as a film hardening agent, and its content has been increased since the mid-1980s with the advent of softened film emulsions due to the introduction of low-silver-content films.[7] This higher concentration has been implicated in the increased incidence of Darkroom Disease symptoms seen in radiographers.[8] Exposure to glutaraldehyde is not confined to radiography departments, and similar symptoms have occurred with endoscopy, dental and operating theatre staff where glutaraldehyde is utilised as a cold steriliser of medical equipment.[9]

This paper will examine the Victorian Occupational Health and Safety (OHS) legislative framework that is currently in place to protect Victorian employees from harmful exposure to glutaraldehyde. This encompasses the *Occupational Health and Safety Act 1985*,[10] the *Occupational Health and Safety (Hazardous*

[4] H. Dimich-Ward, M. Wymer, S. Kennedy, K. Teschke, R. Rousseau and M. Chan-Yeung, 'Excess of symptoms among radiographers' (2003) 43 *American Journal of Industrial Medicine* 2, 132-141; E. Leacy, and P.C. Brennan, 'The "Darkroom Disease": A randomized control trial' (2002) 8 *Radiography* 3, 127-132; M.P. Shaffer, and D.V. Belsito, 'Allergic contact dermatitis from glutaraldehyde in health-care workers' (2000) 43 *Contact Dermatitis* 3, 150-6; T. Sanchez, above n 1; Department of Human Services, *Guidelines for the Use of Glutaraldehyde in the Health Industry* (1996) Human Services Promotions Unit, Melbourne; J. Smedley, H. Inskip, G. Wield, and D. Coggon, 'Work related respiratory symptoms in radiographers' (1996) 53 *Occupational & Environmental Medicine* 7, 450-454; P.F.G. Gannon, P. Bright, M. Campbell, S.P. O'Hickey, and P. Sherwood Burge, 'Occupational asthma to glutaraldehyde and formaldehyde in endoscopy and x-ray departments' (1995) 50 *Thorax* 2, 156-9; P.J. Hewitt, 'Occupational health problems in processing of x-ray photographic films' (1993) 37 *The Annuals of Occupational Hygiene* 3, 287-295; J.A. Bernstein, 'Occupational asthma: "My job is making me sick!"' (1992) 92 *Postgraduate Medicine* 3, 109-118; F. Di Stefano, S. Siriruttanapruk, J. McCoach, and P. Sherwood Burge, 'Glutaraldehyde: an occupational hazard in the hospital setting' (1999) 54 *Allergy* 10, 1105-9; P. Wiggins, S. McCurdy, and W. Zeidenburg, 'Epistaxis due to glutaraldehyde exposure' (1989) 31 *Journal of Occupational Medicine* 10, 854-856; D. Norback, 'Skin and respiratory symptoms from exposure to alkaline glutaraldehyde in medical services' (1988) 14 *Scandinavian Journal of Work Environment Health* 6, 366-371.

[5] K. Teschke, above n 3; J. Smedley, above n 3; Miscellaneous Workers Union of Australia, *Handbook on Chemical Hazards in the Photographic Industry* (1987) The Federated Miscellaneous Workers Union, Australia.

[6] K. Teschke, above n 3; P.F.G Gannon, above n 3; Occupational Health and Safety Service, above n 2.

[7] P.F.G. Gannon, above n 3.

[8] M. Gordon, 'Danger – toxic fumes' (1985) April *Radiographers News*, 7-8.

[9] M.P. Shaffer & D.V. Belsito, above n 3; S. Di Stefano *et al.*, above n 3; P.F.G. Gannon *et al.*, above n 3.

[10] All States and Territories in Australia have similar laws dealing with occupational health and safety issues: *Occupational Health and Safety (Commonwealth Employees) Act 1991* (Cth)*; Occupational Health and Safety Act 2000* (NSW); *Workplace Health and Safety Act 1995* (Qld); *Occupational Safety and Health Act 1984* (WA); *Occupational Health, Safety and Welfare Act 1986* (SA); *Workplace Health and Safety Act 1995* (Tas); *Work Health Act 1986* (NT); *Occupational Health and Safety Act 1989* (ACT).

Substances) Regulations 1999[11] and the *Code of Practice for Hazardous Substances*.[12]

The Victorian *Occupational Health and Safety Act 1985* appoints the Victorian WorkCover Authority as the recognised enforcement body for all OHS laws. Additionally, unions play a vital role in the administration and standard of workplace OHS laws. Unions in Victoria with interests in protecting employees from glutaraldehyde exposure include the Australian Health Professionals Association (AHPA), Australian Council of Trade Unions (ACTU) and Australian Nursing Federation (ANF).

The *OHS (Hazardous Substances) Regulations 1999* in Victoria detail a hierarchy of control that must be observed when controlling risks associated with hazardous substances such as glutaraldehyde. Failure to implement these controls can result in litigation against the employer as evidenced by many courtroom battles, compensation payments and out of court settlements.

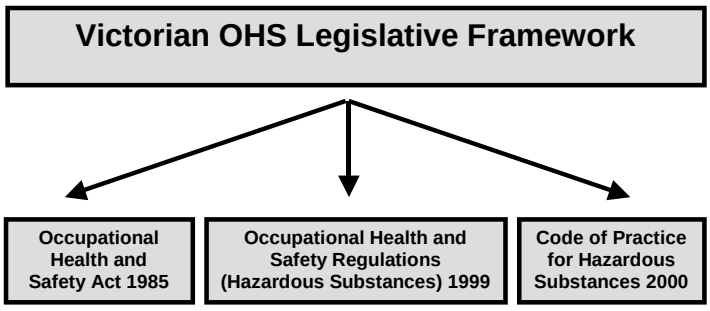

Figure 1. The Victorian Occupational Health and Safety legislative framework

Relevant occupational health and safety laws for employers

Several laws are in place to protect workers from exposure to hazardous substances such as glutaraldehyde. Figure 1 shows the Victorian OHS legislative framework.[13]

***Occupational Health and Safety Act 1985* (Vic)**

The *Occupational Health and Safety Act 1985* (Vic) *(OHS Act)* establishes general duties of care for employers, employees, manufacturers, importers and suppliers. Additionally, the Act allows regulations to be developed in relation to the safety, health and welfare of workers in specific areas. The effective implementation of the Act is vital for prevention of Darkroom Disease. The Act aims to:

- secure the health, safety and welfare of workers;
- protect workers against risks to health and safety;
  - assist in securing safe and healthy work environments;
  - eliminate, at the source, risks to the health, safety and welfare of workers; and
  - provide for the involvement of employees, employers and representative associations in the formulation and implementation of health and safety standards.

Section 21, termed 'Duties of employers', states that employers must provide a working environment that is safe and without risks to employee health. Additionally, the section provides that employers must make arrangements for ensuring the safety and absence of risks to health so far as practicable in connection with

[11] There are also Federal and State Codes of Practice dealing with hazardous substances: eg Code of Practice for the Management of Hazardous Substances (Qld); Code of Practice for the Control of Workplace Hazardous Substances (SA), with many other jurisdictions adopting the National Code of Practice for the Control of Workplace Hazardous Substances (Cth).

[12] *Occupational Health, Safety and Welfare Regulations 1995* (SA) Part 4; *Occupational Health and Safety (Commonwealth Employment) (National Standards) Regulations 1994* (Cth) Part 6; *Occupational Health and Safety Regulations 2001* (NSW) Chapter 6; *Occupational Safety and Health Regulations 1996* (WA) Part V; *Work Health (Occupational Health and Safety) Regulations* (NT) Part 7, Div 5; *Workplace Health and Safety Regulations 1997* (Qld) Part 13; *Workplace Health and Safety Regulations 1998* (Tas) Part 4, Div 2.

[13] WorkSafe, *Code of Practice for Hazardous Substances* (2000) Victorian WorkCover Authority, Melbourne.

the use, handling, storage and transport of plant and substances. This would indicate employers, in order to provide a safe workplace, are legally obliged to ensure the safety of radiographers exposed to glutaraldehyde and make certain that its use does not cause harm.

The Act also contains provisions relating to employee duties. Section 25 reads 'an employee must take reasonable care for their own safety and that of anyone else, who may be affected by their acts or omissions at the workplace'. The employee must also co-operate with their employer with respect to any action taken by the employer to comply with any requirements imposed by or under this Act. This reciprocates the duties of radiographers to their employers, ensuring they utilise any safety precautions that their employer provides, and do not wilfully or recklessly interfere with or misuse these precautions.

Section 28, titled 'Civil liability not affected by Part 3', provides that any common law actions for failure to comply with statutory duties are not possible simply because a statutory duty has been breached. Nevertheless, the Act does not affect the general common law rights of employees to sue for damages.

Section 54 provides that it is an offence for an employer to dismiss or damage employment prospects of an employee who has acted within their rights under the Act. Protection is specifically given to employees who:

- have performed any function or duty as a health and safety representative or as a member of a health and safety committee;
- have assisted or given any information to an inspector, health and safety representative or health and safety committee; or
- have made a complaint in relation to health and safety to an employer, fellow employee, inspector, or health and safety committee.

This protects the radiographer's right to notify appropriate authorities of any risk or unsafe work practice they are exposed to, including glutaraldehyde, without risking their employment.

***Occupational Health and Safety (Hazardous Substances) Regulations 1999* (Vic)**

The *OHS (Hazardous Substances) Regulations 1999* (Vic) specify duties of employers, manufacturers and suppliers to protect workers from potential health risks that may arise from exposure to hazardous substances. It is an offence to fail to comply with these Regulations.

Chemicals used or produced in radiographic film processing such as acetic acid, formaldehyde, glutaraldehyde, hydroquinone and sulphur dioxide are classified as hazardous substances under the '*Approved Criteria for Classifying Hazardous Substances*'[14] and are therefore classified as designated hazardous substances.[15] As the *OHS (Hazardous Substances) Regulations 1999* recognise the NOHSC as the principal body in this area, the use and exposure levels of these chemicals are subject to these Regulations.

Several duties exist for employers within Part 3 of the Regulations. Regulation 302 states it is the employer's responsibility to obtain a current Material Safety Data Sheet (MSDS), and to ensure its availability to employees. The MSDS should detail all hazards associated with the use of any chemical substance – this will be covered in further detail later. The MSDS for film-processing chemicals must be readily available to all radiographers in their workplaces.

[14] National Occupational Health and Safety Commission *Approved Criteria for Classifying Hazardous Substances* (1999, 2nd ed.). http://www.nohsc.gov.au/OHSInformation/NOHSCPublications/fulltext/standards/nohsc1008_toc.htm.

[15] National Occupational Health and Safety Commission (1999). *List of Designated Hazardous Substances* (1999, 2nd ed.). http://www.nohsc.gov.au/OHSInformation/NOHSCPublications/fulltext/techreports/nohsc10005_toc.htm

Regulation 308 stipulates an employer has a duty to perform risk assessments for all hazardous substances used in the workplace. These assessments must be completed before the introduction of a hazardous substance, or if the substance has been in use before 1 June 2000. The employer must retain a record of this assessment and review these at intervals not exceeding five years. Assessments must take into account:

- each hazardous substance used;
- MSDS information;
- information on the manufacturer's/importer's label;
- nature of work associated with each hazardous substance; and
- any information regarding incidents, illnesses or diseases associated with the use of these hazardous substances.

The final point is especially relevant for Darkroom Disease, as abundant information exists in the literature regarding ill-effects to employee health associated with glutaraldehyde use. Therefore, risk assessments regarding the use of film-processing chemicals must be performed by employers of radiographers at regular intervals.

The employer also has duties to control risks, as outlined by regs 312 and 313. In general terms, the employer must eliminate identifiable risks. If elimination proves impractical, risk must be reduced as far as possible. Specifically, the employer has a duty to substitute the offending substance with a less hazardous form or an equivalent, less hazardous substance.

The employer must isolate employees from the exposure source and employ engineering methods that minimise exposure. If these are adhered to and a perceivable risk remains, the employer must provide personal protective equipment (PPE) to their employees. Regulation 314 requires any measures to control risks associated with hazardous substances are both correctly used and maintained. Consequently, adequate protective precaution measures (such as sufficient ventilation and PPE) must be effective and supplied to protect the wellbeing of radiographers.

Regulations 315, 316 and 317 directly relate to atmospheric exposure levels. The employer must ensure that atmospheric concentrations of hazardous substances remain within recognised (NOHSC) exposure standards. The employer is legally obliged under the Regulations to undertake atmospheric monitoring if uncertainty about exposure levels exists, or to determine if a risk to health is present. The results of atmospheric monitoring must be released within the workplace immediately if risk to employee health is identified. A record of these results must be retained by the employer and be readily accessible to employees. According to the NOHSC, atmospheric exposure levels in excess of 0.1 parts per million (ppm) of glutaraldehyde are considered unsafe.[16]

Regulation 318 stipulates that employee health surveillance by accredited medical practitioners must be provided at the employer's expense if workplace exposure to hazardous substances is likely to promote adverse health effects. From the literature it can be argued that this would be useful for radiographers exposed to glutaraldehyde. The employer is required to retain copies of health surveillance reports for each employee. If adverse health effects are identified, the employer must ensure risk-control measures are reviewed.

Under reg 321, the employer has a duty to provide information, instruction and training to employees in regards to hazardous substances in the workplace. Specifically, the nature of hazards and risks associated

[16] National Occupational Health and Safety Commission, *Exposure Standards: Glutaraldehyde* (1995) AusInfo, Canberra. http://www.nohsc.gov.au/OHSInformation/Databases/ExposureStandards/az/Glutaraldehyde.htm

with these substances and the need for and proper use of measures to control risk should be clarified. This would indicate that employers should educate radiographers on the dangers and risks of working with hazardous substances such as glutaraldehyde and provide adequate training for the safe handling of film-processing chemicals.

Relevant occupational health and safety laws for manufacturers

***Occupational Health and Safety (Hazardous Substances) Regulations 1999* (Vic)**

The *OHS (Hazardous Substances) Regulations 1999* (Vic) contains a number of provisions that stipulate specific duties for manufacturers, importers and suppliers of glutaraldehyde.

Regulation 208 specifies that it is the manufacturer's and importer's duty to determine if a substance is hazardous before it is initially supplied or used. Glutaraldehyde has been classified as a hazardous substance according to the NOHSC.[17] Once a substance is determined to be hazardous, a Material Safety Data Sheet (MSDS) must be prepared according to the *NOHSC National Code of Practice for the Preparation of Material Safety Data Sheets*.[18]

Regulation 204 outlines the following requirements for inclusion on the MSDS:

- the identity and chemical/physical properties of actual components used in the product;
- any relevant health hazard information, including first aid information;
- the exposure standard relevant to the substance or any of its ingredients;
- information on precautions for safe use of the substance; and
- sources of further product information and contact persons.

Regulation 206 stipulates that it is the manufacturer's and importer's responsibility to review and revise the MSDS at least every five years to ensure it is accurate and current. Additionally, under reg 207 it is the manufacturer's, importer's and supplier's responsibility to ensure that a current MSDS is provided to any person to whom the substance is supplied.

The *OHS (Hazardous Substances) Regulations 1999* contain provisions concerning the manufacturer and importer's duty to label containers correctly. The preparation of labels must be achieved in accordance with the NOHSC *National Code of Practice for the Labelling of Workplace Substances*.[19] Regulation 208 stipulates the labelling must include:

- the product name of the hazardous substance;
- information relating to the contact details of the Australian manufacturer or importer;
- the chemical name for all Type I ingredients and chemical or generic name for all Type II ingredients;
- relevant health and safety information including 'risk' and 'safety' phrases, unless the container is so small this proves impractical; and
- the word 'HAZARDOUS', clearly and prominently displayed, unless signal words such as 'Poison', 'Dangerous Poison', 'Warning', or 'Caution' have been provided in

[17] National Occupational Health and Safety Commission (1999). *List of Designated Hazardous Substances* (1999, 2nd ed.) http://www.nohsc.gov.au/OHSInformation/NOHSCPublications/fulltext/techreports/nohsc10005_toc.htm

[18] National Occupational Health and Safety Commission, *National Code of Practice for the Preparation of Material Safety Data Sheets* (1994). http://www.nohsc.gov.au/OHSInformation/NOHSCPublications/fulltext/toc/H3-13.htm; WorkSafe, above n 12.

[19] National Occupational Health and Safety Commission, *National Code of Practice for the Labelling of Workplace Substances* (1994). http://www.nohsc.gov.au/OHSInformation/NOHSCPublications/fulltext/toc/H3-16.htm

accordance with other relevant Australian legislation.

***Trade Practices Act 1974* (Cth)**

In addition to the requirements of the OHS legislation, the *Trade Practices Act 1974* (Cth) (TPA) contains provisions governing correct labelling of storage containers of film-processing chemicals. Under the TPA, a good is deemed to be defective if its safety is not what a person is entitled to expect. Specifically, s 75AC(2) of the TPA covers correct packaging of goods and requires the inclusion of instructions and/or warnings 'where the goods … may, if not used in accordance with directions, give rise to injury or damage'. It is vital to have a comprehensive set of instructions and/or warnings in order to meet the requirements of the TPA for adequate labelling.

An example of a Federal Court case regarding s 75AC(2) is *Glendale Chemical Products Pty Ltd v Australian Competition and Consumer Commission*.[20] In this case the packer and distributor were found liable to pay damages to a person for injuries suffered whilst using caustic soda to clear a drain. The Court held that the instructions/warning of the product label were inadequate because they failed to indicate the dangers of using caustic soda with hot water which had caused the plaintiff's injuries.

Code of Practice for Hazardous Substances 2000 (Vic)

The *Code of Practice for Hazardous Substances 2000* (Vic) provides practical guidance on compliance for employers, manufacturers, importers and suppliers. The provisions of the Code are not mandatory, meaning that an employer can comply with the relevant provision of the regulations using another method. An employer or company cannot be prosecuted for failing to comply with an approved code of practice. However, failure to observe a relevant approved code of practice can be used as legal evidence that a person/company has contravened or failed to comply with the provisions of the relevant legislation.

WorkCover

The Commonwealth has produced model OHS Act and Regulations for the states to use in framing their own regulations. The Victorian *OHS Act 1985* designates the Victorian WorkCover Authority (WorkCover) as the recognised administration and enforcement body, encompassing management of all relevant OHS laws. It is the primary responsibility of WorkCover to ensure the principles underlying the Act are followed, such as protection of employees against risks to health and safety and elimination of substances at work that may pose a hazard to employee health.[21]

It is the responsibility of WorkCover to enforce the various regulations under this Act – specifically relevant to the incidence of Darkroom Disease is the *OHS Act (Hazardous Substances) Regulations 1999*. WorkCover employs a 'constructive compliance' prevention strategy, utilising positive motivators and strong deterrents to encourage compliance with the relevant legislation.[22] WorkSafe Victoria is the OHS arm of WorkCover.

Several powers are conferred on WorkCover by the *OHS Act 1985*. To ensure that the legal obligations of employers, employees and manufacturers are observed, s 38 of the *OHS Act 1985* provides that inspectors are appointed to enforce this Act and are employed by WorkCover as WorkSafe inspectors. These inspectors have the power to scrutinise workplaces for compliance with the Act and relevant regulations.

Section 39 gives powers to WorkSafe inspectors to detect contraventions of the Act or regulations thereunder during inspections. They can issue notices to

[20] (1998) 90 FCR 40.

[21] WorkCover, *A Guide to the Occupational Health and Safety Act 1985* (1996, 7th Ed.).

[22] WorkSafe, *WorkSafe Victoria inspectors: Enforcing Victoria's health and safety laws* (2002).

remedy contraventions (under ss 43 and 44), or commence proceedings to prosecute. A contravention of the Act warrants a maximum fine of $250,000 for corporations and $50,000 for individuals, while a contravention of corresponding regulations has maximum fines of $40,000 and $10,000 for corporations and individuals respectively. Contraventions of the Act are indictable offences and triable before judge and jury in the County or Supreme Court in Victoria, while violations of the regulations are summary offences dealt with in the Magistrates Court in Victoria.

In respect to radiography workplaces and Darkroom Disease, WorkCover's role should be identical to other workplaces. For example, WorkCover has devised guidance material specific to the printing industry to assist their compliance to their legal obligations as outlined by the *OHS (Hazardous Substances) Regulations 1999*.[23] Of particular interest is the risk assessment for photographic processing. Given that radiographic film is developed using similar chemicals and in comparable workplace environments, it would be reasonable to apply these principles to radiography departments. However, no specific WorkCover guidelines for radiographic film processing or the work environment exists.

While the capacity of WorkSafe inspectors is clearly outlined by the Act and Regulations, the priority in monitoring radiographers' health remains unclear. It is clear from WorkCover's guidance material for the printing industry that they take a proactive role in this area but no evidence exists of similar scrutiny of the radiography profession. Of particular interest would be WorkCover's level of involvement in the monitoring of airborne contaminants but no relevant information could be found. WorkCover recommends that hazardous substances be eliminated entirely at the source as per the *OHS Act 1985*.[24]

Unions

Unions play a pivotal role in the administration and standard of OHS laws in most industries. Essentially, unions act as a mediating body between the employee, employer and relevant legal bodies. The role that unions play largely revolves around representing the employee in legal or industrial matters, as well as providing support for workers in the form of recommendations (such as policies and statements). Their primary interest is to provide a safe working environment for their members, and to do this they should promote a tough stance on hazardous chemicals that harm employee health such as those associated with Darkroom Disease.

Australian Health Professionals Association

The Australian Health Professionals Association (AHPA) is the primary union concerned with radiographer interests. The AHPA is the principal trade union for allied health professionals and also represents the interests of twenty-seven other occupations. According to the AHPA, the worst offenders for poor working conditions that risk radiographer health are generally private practices and small rural departments, probably due to budget constraints.

The AHPA (Victorian Branch) has been involved with three specific cases concerning complaints pertaining to exposure to darkroom chemicals, none of which resulted in financial compensation. It is difficult to obtain compensation, as it is hard to show causation from exposure to film-processing chemicals as well as gain access to specialists knowledgeable about Darkroom Disease. The AHPA's strategy in these situations is to recommend the employee submit an incident report to their employer. The AHPA then

[23] WorkCover, *Management of Hazardous Substances in the Printing Industry* (2001).

[24] WorkCover, *Getting started with workplace health and safety: An introduction to hazard management, workplace inspections and selecting a health and safety consultant* (2001).

pressures the employer to rectify the situation by implementing improved exposure-minimisation strategies, and by recommending that independent environmental assessments and air testing be performed. They also highlight the MSDS to the employer, reiterating their obligation to control the conditions of use for hazardous substances.

Australian Council of Trade Unions

The Australian Council of Trade Unions (ACTU) is the peak council and national centre representing the interests of the national workforce. The ACTU consists of forty-six affiliated unions with a total membership of 1.8 million. In order to provide an optimal service the ACTU has a unit devoted solely to OHS. The ACTU itself has no established recommendations for glutaraldehyde specifically. However, the ACTU did recognise the capability of workplace chemicals to cause occupational injury or disease, nominating sensitisation and irritants among workplace hazards.[25] When contacted, the OHS arm of the ACTU supported the phasing out of glutaraldehyde in all industries.

Australian Nursing Federation

Another union with interest in the use of glutaraldehyde is the Australian Nursing Federation (ANF). The ANF develops a range of policies, guidelines and position statements that aim to improve working conditions for nurses. The ANF has lobbied health ministers for glutaraldehyde to be discontinued as a useful disinfectant but it remains recognised by the Commonwealth government as a disinfecting agent if safe systems are utilised.[26] The Victorian branch has advocated the complete elimination of glutaraldehyde use in the healthcare system by June 2003 via a position statement (ANF Victoria, 2001).[27]

[25] Australian Council of Trade Unions Executive, *1989 Decision ACTU Health and Safety Policy: Chemical Hazards* (1989).
[26] V. Gilmore, *A matter of occupational health and safety* (2003).
[27] Australian Nursing Federation Victoria, *Position statement: Elimination of glutaraldehyde from healthcare facilities throughout Victoria* (2001).

Practical precautions

The *OHS (Hazardous Substances) Regulations 1999* sets out a hierarchy of control that must be observed when minimising risks associated with the use of hazardous substances. An employer must consider the appropriate control measures to eliminate or reduce any associated risk, as shown in Table 2.

Method	Practical application
Substitution	Substitute hazardous substance with a less harmful substance. *(i.e., substitute a less hazardous substance to control vapour hazards).*
Isolation	Enclose or isolate hazards from employees to eliminate/reduce risk of injury/illness. *(i.e., use a fume cupboard).*
Engineering controls	Changing processes, equipment or tools. *(i.e., use ventilation to remove chemical fumes).*
Administrative controls	Change work procedures to reduce exposure to hazards *(i.e., reduce exposure through job rotation).*
Personal protective equipment (PPE)	Maintain appropriate devices and clothing that provide protection to employees from hazards. *(i.e., gloves, appropriate aprons/suits, etc.).*

Table 2: Methods to minimise risk when elimination is not possible, as recommended by WorkCover.[28]

Substitution

The Code of Practice for Hazardous Substances (2000) states that a less hazardous substance or a substance in a less hazardous form should be used where practicable. Photosol, a manufacturer of photographic processing chemicals, claims to produce the world's best range of glutaraldehyde-free developers. As well as containing no glutaraldehyde, their CD2020 developer contains no hydroquinone, which is highly undesirable as it is a known skin sensitiser and suspected carcinogen. Photosol CD2020 developer can be used to develop most radiographic films. The best fume-free environment can be attained by using a non-hardening

[28] WorkCover, above n 22.

fixer in conjunction with a glutaraldehyde-free developer. Photosol produces the CF42 non-hardening fixer but its use may leave surface marks on the film. However, these surface marks are only evident in reflected light, therefore not impairing diagnosis.[29]

Isolation

Isolation involves separating employees from the hazardous substance by distance or barriers to prevent or reduce exposure. Separating radiographers from fume-generating film processors is not practical, but it is strongly recommended that film processors and associated mixing systems are isolated from other work areas within the radiology department. Specifically, they should not be closely associated with the radiographic sorting or viewing areas. If the processor is installed for 'through the wall' film-feed, then the side used to feed the film (darkroom side) must be at a positive pressure with respect to the processor side (light side) to prevent fumes being drawn back through the film-feed slot.[30]

Engineering Controls

Engineering controls are the physical controls used to eliminate or reduce the generation of substances, suppress or contain substances, or limit contamination areas in the event of spills and leaks.[31] General room ventilation must work in synergy with local exhaust ventilation for successful removal of atmospheric contaminants. It is essential that all air conditioning and venting systems be designed and installed by air conditioning engineers to ensure that all specifications are met.

Most automatic x-ray processors provide an exhaust system that serves to remove chemical and moisture vapours via a safe external vent. The key necessities for successful installation are:

- the exhaust system must be vented to an external environment, independent of general building air-conditioning;
- it needs to provide fan extraction so that the processor manufacturer's specifications are met;
- the fan extraction must operate continuously when chemicals are present in the processor, irrespective of whether it is being used;
- for tabletop and non-vented processors, a fume hood/extraction system should be used and operated whenever the processor contains chemicals.

It is recommended that a fume hood or extraction system be provided above the processor for escaping fumes. The design of the system should ensure that the fumes are not drawn over the worker's breathing zone.

Exhaust ventilation for the entire room should also be used to minimise exposure to processing fumes. The total air movement in the room should be balanced to maintain the room at a slight negative pressure, which helps to keep any fume vapour contained within the room. The room inlet and outlet should be situated so that the air can circulate completely through the room before being drawn out again. It is suggested that a fresh airflow rate of at least 2.5 litres per second per metre of room size be used.

When mixing chemicals, it is recommended that an exhaust hood and extraction system, similar to that used for processors, be placed above each mixing device.[32]

[29] Photosol, *X-ray processing chemicals* (2003) State of Victoria <www.photosol.uk.com>; *Occupational Health and Safety (Hazardous Substances) Regulations 1999* (1999).
[30] Occupational Health and Safety Service, 1992, above n 2.
[31] Occupational Health and Safety Service, 1992, above n 2.
[32] Occupational Health and Safety Service, 1992, above n 2; University of Notre Dame, *Welcome to the University of Notre Dame's ICP-MS Analytical Research Facility* (2003) <www.nd.edu/~icpmslab/I6b.jpeg>

Administrative Controls

Administrative controls are safe work practice systems that reduce employee exposure to glutaraldehyde. Specific measures taken should include:[33]

- keeping containers of processing chemicals tightly lidded when not in use;
- cleaning up spills immediately;
- prompt cleaning of residues of processing chemicals from empty containers;
- prohibiting eating, drinking and smoking in potentially contaminated areas;
- providing suitable cleaning facilities;
- ensuring that processor and ventilation systems undergo periodic checks to ensure they are properly maintained;
- making first aid facilities readily available; and
- administering possible job rotation away from areas where processing fumes are being emitted.

An employer has a responsibility to ensure that control measures are properly used and maintained. The use of periodic atmospheric monitoring may be employed to ensure that employees are not exposed to an atmospheric glutaraldehyde concentration of more than the exposure standard (0.1 ppm).[34] However, this concentration level is irrelevant to those individuals who have become sensitized to glutaraldehyde, as risk of reaction is not proportional to the concentration and can occur with extremely small exposures.[35]

Personal protective equipment (PPE)

Adequate PPE must be worn when pouring or mixing processing chemicals. The *New Zealand Guidelines for the Safe Use of Glutaraldehyde in the Health Industries (1992)* recommends the use of a half-face respirator with appropriate organic vapour cartridges as the minimal degree of protection.[36] The use of a surgical mask or a charcoal impregnated disposable dust mask is totally inadequate protection.

When handling film-processing chemicals, gloves should be worn to prevent skin contact. Gloves made from nitrile, neoprene rubber or butyl rubber provide adequate protection. Glutaraldehyde can penetrate surgical latex gloves, and therefore these are inadequate.[37] Impervious aprons should be worn to protect against chemical splashes.[38] When pouring quantities of processing chemicals, eye protection should be worn to prevent eye irritation. Eye protection is especially important for staff with contact lenses as glutaraldehyde can become trapped between the eye and the lens, causing irritation

In addition to the hierarchy of control measures proposed by WorkCover, each employer should have a written policy available for staff education and training on the safe handling and use of glutaraldehyde. It should include emergency procedures for spills and accidental exposure. New staff should not be permitted to start work with processing chemicals until they are competent in using them safely.[39]

Relevant legal cases

Since the worldwide introduction of developer with higher glutaraldehyde content in the mid-1980s, considerable common law litigation has been brought against employers and manufacturers internationally. The aims of this litigation have been to financially penalise negligent employers and manufacturers,

[33] WorkSafe, 2000; Department of Human Services, 1996; Occupational Health and Safety Service, 1992.

[34] NOHSC, 1995, above n 17.

[35] Occupational Health and Safety Service, 1992, above n 2.

[36] Occupational Health and Safety Service, 1992, above n 2.

[37] M. Warneminde, 'Hazard in our hospitals' (1992) 4 August *The Bulletin*, 46-48.

[38] Department of Human Services, *Guidelines for the use of glutaraldehyde in the health industry* (1996).

[39] Department of Human Services, *Guidelines for the use of glutaraldehyde in the health industry* (1996).

improve employee working conditions and financially compensate injured employees. However, as with other litigation, the vast majority of Darkroom Disease disputes are resolved not by a court but rather as out of court settlements.

In Australia, several worker's compensation claims have been awarded to employees who were unable to continue work due to their sensitisation to glutaraldehyde. One such case involved a 37-year-old radiographer who while working in a number of hospitals over an 18-year period was exposed to glutaraldehyde. As a result she became sensitised and had to halt her career due to chronic fatigue, severe headaches, abdominal cramps, and muscle aches. The New South Wales Superannuation Board has classified her as a partial and permanent invalid and paid her a lump sum of more than $82,000. Additionally, she collects $311 a fortnight in social security payments. At the time of the source article, the radiographer was attempting to have herself reclassified as a total invalid, which would entitle her to an additional lump sum payment of $240,000.[40]

An example court case in England in *Ogden v Airedale Health Authority*[41] involved a radiographer, Mr Odgen, who worked at a hospital for 17 years. During his employment he suffered attacks of breathlessness severe enough for him to be admitted to hospital. In 1995, a Sheffield Court found the relevant Health Authority liable for negligence and awarded Mr Odgen £62,000. He has since had to retrain as an occupational therapist.

From the decision, it emerged that the hospital had:[42]

- ignored advice from their own consultants to install ventilation in one of the x-ray areas;
- not given staff PPE;
- had not monitored processing chemical fume levels; and
- had not warned workers about the hazards of the chemicals they used or implemented procedures for dealing with spills.

This case exposes the employer's obligations to radiographers. The judge held that the hospital:

> knew or ought to have known that some of the irritant chemicals were, or might well be, sensitisers … [and] by 1987 the symptoms of which the radiography staff were complaining made it as plain as pikestaff that chemical fumes were having an irritant effect on staff's eyes and respiratory tract.

The judge held that the radiographer was indeed suffering from occupational asthma as a result of being sensitised to film-processing chemicals at work. He went on to say that the hospital's failure to protect Mr Ogden 'against exposure by providing exhaust ventilation, warnings as to the dangers and/or protective equipment was in my judgement negligent'.

Litigation has not been limited to employee/employer cases. A United States court has allowed a radiographer to proceed with an action for lung damage as a result of exposure to film processing fumes against Eastman-Kodak Company and Picker International.[43] The court allowed the radiographer to argue the case on grounds that included 'Kodak breached an implied warranty that its x-ray processor was fit for its ordinary purpose and/or safe use in a normal manner' and 'negligence, alleging inadequate warning and improper design'.

The vast majority of employee legal actions brought against employers are resolved as out of court settlements in order to minimise legal costs and the risk to both parties of losing. One such case in Scotland

[40] M. Warneminde, above n 35.
[41] (1996) 7 Med 153 (QB).
[42] London Hazards Centre, *Chemical Hazards Handbook* (2003) <http://www.lhc.org.uk/members/pubs/books/chem/>

[43] *Greenwood v. Eastman-Kodak and Picker International Inc.*, CV-92 0452919S (1994), Superior Court of Connecticut, Judicial District of Hartford – New Britain.

involved two darkroom technicians to whom the Greater Glasgow Health Board agreed to pay £130,000 after admitting liability. The technicians were forced to stop work due to chemical exposure, with symptoms including headaches, chest infections, mouth ulcers and skin problems for more than a decade.[44] Other recent out of court settlements involving radiographers include the following:[45]

- In 1999, an English radiographer received £150,000 as a result of being forced to retire prematurely on medical grounds after exposure to film processing chemicals.
- In 1990, Bath Hospital agreed to pay compensation to radiographers who suffered ill effects after being exposed to processing chemicals. Payment was £62,500.

Conclusion and recommendations

When the presence of chemical-related risk to health is considered in an occupational health context, most people think of an industrial workplace. However, this paper has clearly outlined that risk to health exists in the healthcare environment with exposure to both radiographic film-processing chemicals and disinfectant agents containing glutaraldehyde causing deleterious short-term and long-term effects. The severity of these symptoms illustrates the need for legal compliance in order to minimise the occurrence of Darkroom Disease.

It is clearly evident that Darkroom Disease is a very real problem faced by the radiography profession. From the literature, it can be shown that exposure to the hazardous substances contained in film processing chemicals, such as glutaraldehyde, acetic acid and hydroquinone has caused many employees illness and injury that have decreased their effectiveness and ability to perform their job. It is imperative that employers, manufacturers and especially employees endeavour to minimise the occurrence of Darkroom Disease through safe work practices, awareness of the disease and adequate training when handling chemicals. It is clear that unions and government OHS authorities have important roles to play in regulating and enforcing this issue. However, the priorities of some governing OHS bodies when dealing with the specific issue of Darkroom Disease should be questioned.

The incidence of legal proceedings, both in Australia and internationally, emphasises the need for awareness of this issue by all parties involved. It also highlights legal avenues available to victims of Darkroom Disease when pushing for compensation. These cases have all arisen through inadequate precautions to protect the employee from risk to health. Additionally, the inadequacy of several current work practices has been noted and could certainly be improved. This paper makes the following recommendations towards minimising the occurrence and effect of Darkroom Disease:

(1) Development of diagnostic criteria for Darkroom Disease

From the literature, the hazardous nature of glutaraldehyde and other constituents of film-processing chemicals has been highlighted. However, specific symptoms synonymous with Darkroom Disease (or MCS) remain unclear and this may hide the true incidence of the disease within the radiographer population. Without clear diagnostic criteria for this disease, any legal proceedings to claim for compensation are hindered. Therefore, it is vital that diagnostic criteria be developed so that Darkroom Disease can be recognised by both the individual and the legal system.

[44] F. Miller, 'Darkroom pay-outs may open floodgates' *Daily Mail*, 24th October, 1998, 19.
[45] Waikato Head Injury Society, *Solvent Neurotoxicity: Some Recent Legal Settlements* (2003) <whis.nzl.org/snftaas/pt24.html>

(2) Further education and training

It is clear that awareness of this issue is minimal in the radiography profession, with most instances of Darkroom Disease arising through ignorance. Therefore, it is imperative that education with respect to film-processing chemicals be introduced in all undergraduate courses, detailing not only the health concerns, but also the legal issues associated with its use.

The law requires employers to provide further training in the workplace with respect to safe and correct handling of film-processing chemicals. This should include information on the health effects indicative of the disease in order to promote awareness in the workplace.

(3) Observation of practical precautions

The practical precautions outlined by this report need to be observed for the welfare of all radiographers when dealing with film-processing chemicals. This can be pursued via two options:

- ***Elimination:*** It is vital that, where possible, hazardous substances are eliminated from the workplace.[46] The best option is the implementation of digital radiography systems (Picture Archiving and Communication Systems [PACS]). However, this may not be a financially viable option for all departments.
- ***Minimisation:*** If a hazardous substance cannot be eliminated, practical measures must be implemented to minimise employee exposure. Radiography departments and their employees need to seriously review their use of such measures, and ensure they are effective (such as ventilation and PPE). Also, automated processors and silver recovery units help reduce levels of exposure.[47] Observational assessments must be performed within the department to ensure these measures are being followed.

(4) The manufacturer's obligations

The manufacturer should provide the MSDS in a physical form with each delivery of film-processing chemicals so that it is readily available to the radiographer. Development of plain-English versions of the MSDS or an information pamphlet could be options to increase the radiographer's understanding of hazards associated with these chemicals. Also, labelling on each bottle should be made clearer and larger, with the associated hazards and instructions for its use detailed explicitly.

[46] WorkCover, (1996), above n 19.
[47] K. Teschke *et al.*, above n 4.