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The Economics of Intervention: Protecting Workers Who Come in Contact with Wet Portland Cement

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The Economics of Intervention: Protecting Workers Who Come in Contact with Wet Portland Cement

Executive Summary

Updated 2014

Each year occupational contact dermatitis, from exposure to wet portland cement, costs affected workers up to \$1.8 billion, and governments, workers compensation, and other reimbursement programs another \$1.6 billion.* Total costs could be as high as \$2.9 billion.† By contrast, prevention of this disease through the use of gloves and simple hand-washing protocols, is already mandated under existing Occupational Safety and Health Administration (OSHA) regulations. Besides saving billions of dollars to protect workers who come in contact with wet portland cement, compliance with existing regulations would prevent the disease, avoid significant human suffering, and save workers and taxpayers billions of dollars.

Appropriate selection and use of gloves is essential to prevent contact dermatitis for construction workers exposed to wet portland cement. Clean water for washing hands and tools, as well as pH neutralizing products are also key.

Of 4.4 million construction workers‡ in the United States, in May 2013, over three million are likely to come into frequent, even daily, contact with wet portland cement. Over one million workers have jobs defined by cement work, and there are more than 1.9 million construction workers who, while not specializing in cement work, use it during their work and are exposed as they build highways, commercial and residential buildings, or work on tunnel projects. Without intervention and prevention activities, these workers are at a high risk of developing irritant and allergic contact dermatitis as well as acute chemical burns. According to some experts, 5 to 15 percent of construction workers -- most of them brick masons, cement masons and construction laborers -- develop dermatitis during their work lives. This would suggest that 220,000 to 660,000 current construction trades workers will, at some point in their careers, develop some type of occupational dermatitis, many of them from exposure to wet portland cement.

Occupational skin diseases and cement burns, while often difficult to treat and cure, are preventable. One way to prevent such diseases is to identify the sensitizing or irritating agent so that successful interventions can be designed and implemented. The National Institute for Occupational Safety and Health (NIOSH), approximately a decade ago, funded its National

* Does not include Social Security Disability.

† Total cost of worker illness, in any single scenario, is the summation of total cost to affected workers plus cost to government, Workers' Compensation, and other reimbursements. But, because the proportion of these costs varies from scenario to scenario, the summative total cost of worker illnesses (\$2.9 billion) is not the sum of these parts (\$1.8 billion and \$1.6 billion). It is calculated by the highest cost of services in a scenario.

‡ Construction Trades Workers, Helpers, and Other Construction-Related Workers (47-2000 to 47-4799).

Construction Center at CPWR – The Center for Construction Research and Training, to assess the effectiveness of interventions to protect workers from contact dermatitis. One portion of the original study focused on both the economic benefits that would result from prevention and healthier workers.

This paper is an update of the original study. Not only is preventing disease the right thing to do, the data show that it is also, by far, the cost-effective choice. For a person with irritant dermatitis, continued exposure to wet portland cement increases the chances that the individual will become sensitized and face a life-long allergic reaction. Many workers stay on the job while suffering from skin diseases, but when the disease becomes severe and they do lose work time, the time lost is likely to be longer than the typical lost time episode for a construction worker. Based on published data, this report estimates that lost work days associated with an incident of occupational dermatitis typically range from 4 days to 32 days. Based on the studies summarized in this paper, an estimated 5,960 to 29,840 cases of cement-related dermatitis occur each year.

Evidence from Europe shows that adding ferrous sulfate to wet portland cement significantly lowers the risk of dermatitis from exposure to hexavalent chromium. Although required within the European Union, it is rarely used in the United States despite its proven efficacy in reducing occupational dermatitis among those who work with wet cement.

Until, and unless engineering controls can reduce the hazard, such as adding ferrous sulfate as they do in Europe, proper use of appropriate gloves is the most important job-site prevention against cement-induced dermatitis. In 2007, following the issuance of its Chromium (VI) Standard, OSHA issued inspection procedures for construction sites using portland cement. Then, in 2010 OSHA released a letter of interpretation on the use of gloves by masonry workers, which reinforced the requirement under 29 CFR 1926.95(a) for employers to provide gloves to protect against a skin hazard.

One case of irritant or allergic dermatitis can devastate the life of a worker. It may even threaten one's means to earn a living and support a family. The net financial loss to a worker can be significant. A variety of possible illness scenarios, developed for this paper (see Section VI B), show individual costs, once a dermatitis illness requires medical attention, range anywhere from \$1,196 to \$95,568 a year – in a combination of medical costs, other out-of-pocket expenses, and foregone wages. In these scenarios, the cost to government and Workers' Compensation systems can reach more than \$52,000 per case per year. In addition to the cost of Workers' Compensation medical coverage, other costs include, where applicable, Workers' Compensation cash payments, Unemployment Insurance, food stamps, Temporary Assistance to Needy Families (TANF) payments, and job retraining. It is very easy for the non-medical costs to dwarf the cost of medical care.

For a year, if the number of cement-related dermatitis cases is 5,960 to 29,840 (as estimated in the report that follows), then the total burden, as noted earlier, to affected workers could be as high as \$1.8 billion, with a cost to government, Workers' Compensation systems, and other reimbursement programs (not including Social Security Disability) of as much as \$1.6 billion. And this assumes that no one becomes permanently disabled and dependent on Social Security's Supplemental Security Income program, which could cost the government \$1 million or more

over the remaining working life of one individual. Also not included in the cost estimates are those costs associated with severe cement burns, which, as described in law suits, can cost tens of thousands of dollars, even more if an average of 21 days in the hospital once admitted and four months to return to work are taken into consideration. It does not include lost work time to caregivers or losses from restricted activity days. Nor does this paper put a monetary value on the sometimes significant deterioration in the quality of life of a dermatitis victim.

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Over one million workers have jobs with frequent exposure to wet portland cement, and there are many more construction workers who, while not specializing in cement work, use it during their work and are exposed as they build highways, commercial and residential buildings, or tunnel projects. (See Table 1.) In fact, in 2013, of the 4.4 million construction workers in the United States,¹ over three million of them are likely to have regular exposure to wet cement. (See Tables 1 and 2.) These numbers may be extremely conservative: A 2011 study in Australia found that 93 percent of construction workers were exposed to concrete.²

Without intervention and prevention activities, workers exposed to wet portland cement are at a high risk of developing irritant and allergic contact dermatitis and acute chemical burns. According to some estimates, 5 to 15 percent of construction workers -- most of them masons and laborers -- develop dermatitis during their work lives.³ This would suggest that 220,000 to 660,000 current construction workers will, at some point in their careers, develop some type of occupational dermatitis, many of them from exposure to wet portland cement.

Occupational skin diseases, while often difficult to treat and cure, are preventable.⁴ One way to prevent such diseases is to identify the sensitizing or irritating agent so that successful interventions can be designed and implemented. The National Institute for Occupational Safety and Health (NIOSH) funded its National Construction Center at CPWR - The Center for Construction Research and Training to assess the effectiveness of interventions to protect workers from contact dermatitis from wet portland cement exposure. A portion of the CPWR study focused on the economic costs of these interventions and the economic benefits that would result from prevention and healthier workers.

This paper, after a brief discussion of the health risks from wet cement, estimates the number of workers exposed and the likelihood that they might become ill. After a discussion of how the

¹ U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, May 2013 State Occupational Employment and Wage Estimates, <http://www.bls.gov/oes/current/oesrcst.htm>, retrieved September 2014. Construction Trades Workers, Helpers, and Other Construction-Related Workers (47-2000 to 47-4099).

² Safe Work Australia, "National Hazard Exposure Worker Surveillance: Wet Work Exposure and the Provision of Wet Work Control Measures in Australian Workplaces," March 2011, http://www.safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications/Documents/572/NHEWS_WetWork.pdf, retrieved May 2012.

³ Roto, Pekka, "Case Studies: Prevention of Occupational Dermatoses Among Workers Exposed to Cement Dust," *Encyclopedia of Occupational Safety and Health*: Chapter 93 - Construction, <http://www.ilo.org/safework>, retrieved June 2012.

⁴ National Eczema Society, "Contact Dermatitis," <http://www.eczema.org/contact-dermatitis>, retrieved June 2014.

disease is treated, the costs of treatment and other economic burdens are estimated and compared to the already existing OSHA requirements for gloves and clean water for hand washing.

I. Health Risks From Wet Cement

Cement is the leading cause of skin disease for construction workers.⁵ The risks of hexavalent chromium to skin have been known since at least 1827⁶ – close to 200 years. Wet cement causes irritant and allergic contact dermatitis. Allergic contact dermatitis, and sensitivity to hexavalent chromium, can exacerbate the severity of chemical burns from cement.⁷ Hexavalent chromium, a strong sensitizing agent, is largely responsible for dermatitis in cement workers.

A. Cement-Induced Skin Conditions

As a consequence of exposure to cement, workers may develop any or all of the following skin conditions:

1. Dry Skin and Irritation may result from exposure to cement. This condition includes scaling, itchiness, burning, and redness of the skin.
2. Cement Burns can appear within a short period of time after exposure to such products as fresh mortar, concrete, and grout that contain portland cement. Wet portland cement can cause acute chemical burns because of its alkaline nature. These can be prevented with adequate skin protection.⁸ Without prevention, burns can lead to an average of 21 days in the hospital and four months before return to work.⁹ There is little information about the prevalence of cement burns; a review of two large burn units and a national repository of burn cases found that cement burns comprised 0.08 to 0.8% of admissions to burn units.¹⁰ These burns can be severe, and the affected worker may require skin grafts and have a residual disability.
3. Contact Dermatitis can be acute or chronic. Over time workers suffering from irritant dermatitis may become increasingly sensitized and develop an allergic form of the disease -- a condition harder to treat than irritant contact dermatitis. Approximately 25 percent of

⁵ Spoo, J., and Elsner, P., “Cement burns: a review 1960-2000,” Contact Dermatitis, 2001.

⁶ *Federal Register*, Preamble to the Hexavalent Chromium Standard at OSHA, February 28, 2006 (Volume 71, Number 9)] at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=18599, retrieved June 2014.

⁷ Hills, Linda and Johansen, Vagn, “Hexavalent Chromium in Cement Manufacturing: Literature Review,” Portland Cement Association, PCA R&D Serial No. 2983, 2007.

⁸ Spoo and Elsner.

⁹ Alam, M, Moynagh, M, et al., “Cement Burns: The Dublin National Burns Unit Experience,” *Journal of Burns and Wounds*, October 5, 2007.

¹⁰ Chung JY, Kowal-Vern A, Latenser BA, Lewis RW 2nd, “Cement-related injuries: review of a series, the National Burn Repository, and the prevailing literature,” J Burn Care Res. 2007 Nov-Dec; 28(6):827-34.

occupational dermatitis is allergic.¹¹ In cement work, as much as 62 percent of cement-related dermatitis becomes allergic contact dermatitis.¹²

a. Irritant Contact Dermatitis affects only the skin area in direct contact with an irritant. Cement causes irritant contact dermatitis because it is alkaline, hygroscopic,¹³ and abrasive. With a pH of 12.5, it can change the *stratum corneum* of the skin, allowing for the penetration of water-soluble substances.¹⁴ Irritant dermatitis results from direct damage to the skin caused by the combination of wetness, chemical corrosiveness, and abrasiveness of cement in concrete and mortar, and accounts for or contributes to approximately 80 percent of all occupational contact dermatitis cases.¹⁵ Irritant dermatitis can be severe enough to require hospitalization.

b. Allergic Contact Dermatitis (ACD) is an acquired sensitivity developed when an individual is exposed to a causative agent; in this case, wet portland cement. ACD is a generalized allergic skin reaction to exposure to the water-soluble chromium compound found in most cement.¹⁶ Hexavalent chromium, a strong sensitizing agent, is largely responsible for dermatitis in cement workers.¹⁷ Other sensitizing agents for cement workers include epoxy adhesives, sealants, and other admixture¹⁸ chemicals used with cement and plaster.¹⁹ Potassium dichromate in cement causes about half of all occupational cases of allergic contact dermatitis

¹¹ National Institute for Occupational Safety and Health, National Occupational Research Agenda (NORA), "NORA Topic Areas," p. 2, 2012.

¹² Bock, M., Schmidt, A., Bruckner, T., Diepgen, T. L., "Occupational skin disease in the construction industry," *Br J Dermatol*. 2003 Dec; 149(6):1165-71, http://www.wbcasd.org/web/projects/cement/tf3/Bock-et-al_Article-Contact-dermatitis.pdf, retrieved June 2012.

¹³ A hygroscopic material is one that attracts moisture from its surroundings. In this case, cement absorbs moisture from exposed skin.

¹⁴ Scientific Committee on Toxicity, Exotoxicity and the Environment (CSTEE), "Opinion on Risks to Health from Chromium VI in Cement," European Commission, Brussels, C2/AST/csteeop/Chromium VI 27062992/D(02), June 27, 2002.

¹⁵ Poppe H, Poppe LM, Bröcker EB, Trautmann A., "Do-it-yourself cement work: the main cause of severe irritant contact dermatitis requiring hospitalization," Contact Dermatitis, 2013 Feb; 68(2):111-5. doi: 10.1111/j.1600-0536.2012.02156.x. Epub 2012 Aug 20.

¹⁶ Spoo and Elsner.

¹⁷ Other sensitizing agents include various epoxy adhesives and sealants in addition to various chemicals present in the admixtures used with cement and plaster. (http://www.choosehandsafety.org/sites/default/files/docs/physicians_alert_pamphlet_final_2014.pdf).

¹⁸ Admixtures are concrete additives used to produce specialized properties that enhance the durability of concrete. The additives, for instance, can reduce concrete shrinkage by 50-80%, strengthen durability by 30%, and prevent erosion or washout when concrete is being used for foundations in water. (Eng-Tips Forums, <http://www.eng-tips.com/gviewthread.cfm/lev2/26/lev3/72/pid/591/qid/700>, retrieved May 24, 2001.)

¹⁹ The Center to Protect Workers' Rights, "Physician's Alert," http://choosehandsafety.org/sites/default/files/docs/sh_glove3.pdf, retrieved July 2014.

among construction workers (other agents include epoxy resins and cobalt).²⁰ The development of occupational hand eczema is affected by many factors, such as the concentration of the allergen, duration of exposure, work processes, and the need for improved hand washing.²¹ A range of studies showed fairly strong associations between the Cr(VI) content in cement and allergic dermatitis.²² According to the British Health and Safety Executive:²³

“...the way this works is quite distinct from that of irritancy. Sensitisers penetrate the barrier layer of the skin and cause an allergic reaction. Hexavalent chromium is known to be the most common cause of allergic dermatitis in men.... Once someone has become sensitised to hexavalent chromium, any future exposure may trigger dermatitis. Some skilled tradesmen have been forced to change their trade because of this. The longer the duration of skin contact with a sensitizer, the more it will penetrate the skin, and the greater the risk of sensitisation will become. Therefore, if cement is left on the skin throughout the working day, rather than being washed off at intervals, the risk of contact sensitisation to hexavalent chromium will be increased.”

Allergies to hexavalent chromium cannot be cured. Once they occur, the only way to prevent reactions is to avoid contact with the allergen.²⁴ The risk of relapse to allergic dermatitis persists throughout life. Once a person is sensitized to hexavalent chromium, any new exposure can trigger dermatitis.²⁵ If an allergy to chromium develops, very low future exposure can cause itching and a skin rash.²⁶ Because cement dermatitis is in large part caused by chromate sensitivity, the avoidance of exposure or the “elimination” of chromate in cement would decrease the number of cases of cement dermatitis.

²⁰ Bock, et al., “Occupational skin disease ...”

²¹ Ibid.

²² Kjuus, Helge; Lenvik, Kare; Kjaerheim, Kristina; Austad, Joar, “Epidemiological assessment of the occurrence of allergic dermatitis in workers in the construction industry related to the content of Cr(VI) in cement,” National Institute of Occupational Health, Oslo, Norway, May 2003, http://www.wbcscd.ch/web/projects/cement/tf3/NIOH-study_chromium_allergic_dermatitis.pdf, retrieved June 2012.

²³ Government of the United Kingdom, Health and Safety Executive, “Cement - Construction Information Sheet No 26 (revision 2)” First published 12/02, <http://www.hse.gov.uk/pubns/cis26.pdf>, retrieved June 16, 2014.

²⁴ Jacob, Sharon E. and Steele, Tace, “Allergic Contact Dermatitis: Early Recognition and Diagnosis of Important Allergens,” *Dermatology Nursing*, 2006;18(5):443-439, http://www.medscape.com/viewarticle/548007_2, retrieved May 2012.

²⁵ Government of the United Kingdom, Health and Safety Executive, “Cement – Construction...”

²⁶ New Jersey Department of Health and Senior Services, “Hazardous Substance Fact Sheet: Chromium,” January 2000, Revision March 2009, <http://nj.gov/health/eoh/rtkweb/documents/fs/0432.pdf>, retrieved June 2014.

B. Incidence and Prevalence of the Disease

Skin diseases are the leading non trauma-related occupational illness in the United States, as reported by the Bureau of Labor Statistics. Occupational contact dermatitis is the most common occupational skin disease in most countries.²⁷ “The rate of skin disease in the U.S. exceeds recordable respiratory illnesses. In 2010, 34,400 recordable skin diseases were reported by the Bureau of Labor Statistics (BLS) at a rate of 3.4 injuries per 10,000 employees, compared to 19,300 respiratory illnesses with a rate of 1.9 illnesses per 10,000 employees.”²⁸ The prevalence of cement dermatitis in groups of workers with regular contact with wet cement has been reported to be from 8 to 45 percent depending on the countries of origin, type of construction industry, and criteria used to diagnose dermatitis.²⁹ Of all occupational skin diseases, irritant and allergic contact dermatitis are the most common, and totally preventable.³⁰

Estimates of the prevalence of chromium sensitivity in construction workers overall, or in cement workers specifically, varies from 4% to 23%,³¹ estimates likely differ because they are derived using different study methods, different definitions of disease, and different exposed populations. The British Health and Safety Executive cites research findings that between 5 percent and 10 percent of construction workers may be sensitized to cement and that plasterers,

²⁷ Lau, M.Y.Z, Burgess J.A., et al., “A Review of the Impact of Occupational Contact Dermatitis on Quality of Life,” Journal of Allergy, Vol. 2011 Article ID 964509, 2011.

²⁸ U.S. Department of Labor, Occupational Safety and Health Administration, “Health Topics: Dermal Exposure,” <https://www.osha.gov/SLTC/dermalexposure/index.html>, 2010, retrieved September 2014.

²⁹ Federal Register, Hexavalent Chromium Preamble, 2006, (Exs. 46-74, 9-131; 35-317, 9-57, 40-10-10).

³⁰ Toholka, J., Cahill, J., et al., “Factors contributing to the development of occupational contact dermatitis and occupational contact urticaria,” May 2014, <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/851/Factors-contributing-contact-dermatitis.docx>, retrieved June 2014.

³¹ Wang , B.J., Wu, J.D., Sheu, S.C., Shih, T.S., Chang, H.Y., Guo, Y.L., Wang, Y.J., Chou, T.C., “Occupational hand dermatitis among cement workers in Taiwan,” J Formos Med Assoc. 2011 Dec;110(12):775-9, <http://www.ncbi.nlm.nih.gov/pubmed/22248832>, retrieved June 2012; Shelnutt, S.R., Goad, P., Belsito, D.V., “Dermatological toxicity of hexavalent chromium,” Crit Rev Toxicol. 2007 Jun; 37(5):375-87, <http://www.ncbi.nlm.nih.gov/pubmed/17612952>, retrieved May 2012; Liden, Bruze, Menne (2006) in Sarma, Nilendu, “Occupational Allergic Contact Dermatitis among Construction Workers in India,” Indian Journal of Dermatology, 54(2), April-June 2009; Wong, S. S., Chan, M. T., Gan, S. L., Ng, S. K., and Goh, C. L., “Occupational Chromate Allergy in Singapore: a study of 87 patients and a review from 1983 to 1995,” American Journal of Contact Dermatitis, 1998, Vol. 9, No. 1, Abstract, <http://www.ncbi.nlm.nih.gov/pubmed/9471980>; U. S. Department of Health and Human Services, NIOSH, A NIOSH Look at Data From the Bureau of Labor Statistics: Worker Health by Industry and Occupation, DHHS (NIOSH) Publication No. 2001-120, p. 86, available at <http://www.cdc.gov/niosh/pdfs/2001-120.pdf>; Varigos, G. A. and Dunt, D. R., “Occupational dermatitis: An epidemiological study in the rubber and cement industries,” Contact Dermatitis, 1981, 7:105-110, as reported in Boris Lushniak, “The Public Health Impact of Irritant Contact Dermatitis,” Contact Dermatitis, Volume 17, Number 3, August 1997, p. 351; Government of the United Kingdom, Health and Safety Executive, “Cement – Construction...”

concreters (cement masons) and bricklayers are particularly at risk.³² In the United States, this would suggest 220,000 to 440,000 sensitized construction workers.

OSHA used available data to estimate the number of workers who are exposed and those who develop contact from exposure to wet portland cement in the U.S., and concluded the incidence (i.e., new cases annually) was 2,980 to 14,900 cases of cement related dermatitis per year. If 62 percent of those with contact dermatitis develop allergic dermatitis,³³ then 1,848 to 9,240 of all workers with cement irritant contact dermatitis, each year, are expected to develop allergic dermatitis as well.

If, as NIOSH concludes, there are 1.98 cases per 10,000 concrete workers³⁴ and 3,008,060 construction workers did cement and concrete work in 2013 (See Tables 1 and 2), this would suggest 596 cases reported by employers each year. If, due to underreporting, there are really 10 to 50 times as many cases, then in actuality there are 5,960 to 29,840 cases a year.

1. Lost Work Days Associated With Occupational Dermatitis

According to the National Precast Concrete Association:³⁵

“Lost workdays due to skin problems caused by direct contact with wet concrete are significant. The BLS reports that lost workdays in the masonry fields are 2.5 times greater and in the concrete fields are seven times greater than the U.S. national average. In addition, concrete workers report four times more lost workdays for skin problems than other construction workers. Consequently, workers suffer reduced earnings, medical bills and, in cases where an allergy is diagnosed, loss of trade while employers must deal with workers’ compensation disability claims and lower productivity.”

A number of studies, both national and international, estimate lost work days associated with dermatitis:

- Analyzing ten years of workers’ compensation claims, a 2005 study³⁶ found that a

³² Government of the United Kingdom, Health and Safety Executive, “Cement - Construction Information Sheet No 26 (revision 2)”, first published 12/02, <http://www.hse.gov.uk/pubns/cis26.pdf>, retrieved June 16, 2014.

³³ Varigos, G. A. and Dunt, D. R., “Occupational dermatitis: An epidemiological study in the rubber and cement industries,” Contact Dermatitis, 1981, 7:105-110, as reported in Boris Lushniak, “The Public Health Impact of Irritant Contact Dermatitis,” Contact Dermatitis, Volume 17, Number 3, August 1997, p. 351.

³⁴ U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, “Occupational Dermatoses – A Program for Physicians,” <http://www.cdc.gov/niosh/topics/skin/occderm-slides/occderm.html>, retrieved July 2014. And because there is documentation that the incidence of occupational dermatitis is increasing, the 1.98 number is likely low.

³⁵ National Precast Concrete Association, “Cement Burns: Contact with wet concrete can do serious damage to skin,” May 29, 2010, <http://precast.org/2010/05/cement-burns/>, retrieved June 2014.

construction worker with a workers' compensation claim, had an average of 32.1 days off work per claim.

- A 2001 NIOSH report found that median days away from work was 33 percent higher for concrete work (4 days) than for all private industry (3 days).³⁷
- According to The Center to Protect Workers' Rights, in the 1990s, when concrete workers were away from work because of skin disorders, they were away longer than for construction workers generally -- a median of 13 days, rather than the median three days for construction workers generally -- more than four times the median. Masonry workers, when away from work for skin disorders, were away a median of 5 days,³⁸ still significantly longer than the median for construction workers.

Irritant contact dermatitis without further exposure, usually resolves in four to six weeks. One study from the National Institutes of Health found "that full restoration of the barrier requires another 4 to 5 weeks after visible healing."³⁹ Allergic contact dermatitis may take years to resolve and in some cases never resolves. A worker sensitized and allergic in his/her twenties has forty working years negatively affected, due to a preventable skin disease.

Studies have shown that cement induced allergic eczema is chronic even in the absence of further cement contact.⁴⁰ Once sensitized, an individual usually carries the allergic potential for years, sometimes for life. The condition is usually, though not invariably, lifelong.⁴¹ In an Australian study,⁴² more than half the patients who changed their occupation and rigorously attempted to avoid chromate, still continued to have symptoms. This is called persistent post-occupational dermatitis.⁴³

³⁶ McCall, B. P., Horwitz, I. B., Feldman, S. R., Balkrishan, R., "Incidence rates, costs, severity, and work-related factors of occupational dermatitis: a workers' compensation analysis of Oregon, 1990-1997," Archives of Dermatology, 141(6), 2005.

³⁷ NIOSH, "Occupational Dermatoses ..."

³⁸ The Center to Protect Workers' Rights, The Construction Chart Book, CPWR, Washington, DC, 1998, p. 41.

³⁹ Sasserville, Denis, "Occupational Contact Dermatitis," Allergy, Asthma, and Clinical Immunology, Vol. 4, No. 2, Summer 2008, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2868883/>, retrieved June 2012.

⁴⁰ Fousseureau, J., Benezra, C., Maibach, H. I., and Hjorth, N., "Bricklayers," Occupational Contact Dermatitis: Clinical and Chemical Aspects, Philadelphia, Pennsylvania, W. B. Saunders Company, 1982, pp. 142-149, (abstract) and CPWR - The Center for Construction Research and Training, The Construction Chart Book, December 2007.

⁴¹ Electronic Textbook of Dermatology, "Contact Dermatitis - Sensitizer Type," <http://www.telemedicine.org/stamford.htm>, February 15, 2001.

⁴² Halbert, A. R., Gebauey, K. A., and Wall, L. M., "Prognosis of occupational chromate dermatitis," Contact Dermatitis, 27, 1992, p. 219.

⁴³ Ibid.

Based on the studies reported below, this report estimates that lost work days associated with an incident of occupational dermatitis range from 4 days to 32 days. Workers continue to work with many skin diseases, but when the disease becomes severe and they do lose work time, the time lost is likely to be much longer than the typical lost time episode for a construction worker.

2. Underreporting of Dermatitis Cases

Contact dermatitis cases are underreported to agencies that collect data and are responsible for insurance or medical benefits. Underreporting is documented for the National Health Interview Survey and Workers' Compensation, and corroborated by NIOSH research. In addition, many work while sick, even though contraindicated by medical advice.

Reports reviewed below estimate that the actual number of cases is ten to one hundred times as many as those reported, but to be more conservative, this report considers actual cases to be ten to 50 times the number reported.

- A German professor at the Center for Occupational and Environmental Dermatology at the University of Heidelberg estimates the number of actual cases of work-related dermatitis to be 50 to 100 times the number of reported cases.⁴⁴
- A 2008 European study found the incidence of occupational skin diseases in the U.S. and Germany undercounted by up to 50 times and with milder cases not registered at all.⁴⁵
- A 2006 study in Europe discussed the under diagnosis and underreporting of occupational skin diseases in Europe, leading to incomplete national registries. The incidence in Europe, the authors found, could be understated by 10 to 50 times.⁴⁶
- According to the National Health Interview Survey of 1988, based on telephone interviews and self-reports of dermatitis, about 1.87 million workers reported rash due to occupational exposures. This indicates that the prevalence of occupational dermatitis is about 17-fold more than the incidence reported to Workers' Compensation.⁴⁷

⁴⁴ Diepgen, T.L., "Occupational skin diseases," J Dtsch Dermatol Ges., May 2012.

⁴⁵ Diepgen, T.L. and Kanerva, L., "Occupational skin diseases," European Journal of Dermatology. Volume 16, Number 3, 324-30, May-June 2006.

⁴⁶ Fritsch, et al., "Skin Diseases..."

⁴⁷ As reported in Kaufman, Joel; Cohen, Martin; Sama, Susan; Shields, Joanne; and Kalat, John; "Occupational Skin Diseases in Washington State, 1989 through 1993: Using Workers' Compensation Data to Identify Cutaneous Hazards," American Journal of Public Health, July 1998, Vol. 88, No. 7.

- Another study,⁴⁸ reviewing 76 cases of occupational skin conditions, could find only 14.5 percent of them (11 cases) in Workers' Compensation records, suggesting that Workers' Compensation data may underestimate the magnitude of the problem by sevenfold.
- The number of workers with severe dermatitis is larger than what is reflected in lost work time. A Norwegian study⁴⁹ in 1970 found that of 37 workers studied, many had severe dermatitis, which, in the opinion of the dermatologist, should have kept them away from work for some weeks, but they were still working – thus posing lifelong health risks.
- The most widely used estimates for occupational injuries and illnesses come from the Bureau of Labor Statistics. According to the Assistant Commissioner for Safety, Health, and Working Conditions of the Bureau of Labor Statistics, in 2008, “Estimates of the undercount range widely from 20 percent to 70 percent.”⁵⁰

II. The Number at Risk: Number of Workers in the Construction Industry Exposed to Wet Portland Cement

Those at risk of dermatitis from exposure to wet portland cement are mostly construction workers, the sole focus of this study.⁵¹ Portland cement is found in many common building products: concrete, mortar, plaster, grout, stucco, and terrazzo.⁵²

There are seven groups of workers that are 100 percent involved in concrete work and are exposed to wet portland cement frequently. These are brickmasons and blockmasons; stonemasons; cement masons and concrete finishers; terrazzo workers and finishers; construction laborers; helpers of brick, block, stone masons; and tile and marble setters. (See Table 1.) For the purposes of this paper, 17 of the remaining occupational codes within the construction industry are considered to have roughly 50 percent of its employees spending no more than half of their work-time performing some concrete work or being exposed to wet portland cement. (See Table 2.) The remaining categories of construction workers are assumed not to be involved in concrete work. (See Table 3.)

Based on the cited tables, there were over one million workers in 2013 who regularly worked with wet portland cement and more than 1.9 million other construction workers who are also likely to be exposed to wet portland cement.

⁴⁸ Discher, D. P., Kleinman, G. D., and Foster, F. J., “Pilot Study for Development of an Occupational Disease Surveillance Method,” DHEW publication NIOSH 75-162, 1975 as reported in Kaufman et al, p. 1050.

⁴⁹ Hovding, “Cement eczema and chromium allergy, an epidemiological investigation,” Thesis, University of Bergen, Norway, 1970, as cited in C. L. Goh, “Sickness absence ...”

⁵⁰ Ruser, John, W., “Examining evidence on whether BLS undercounts workplace injuries and illnesses,” Monthly Labor Review, August 2008.

⁵¹ Some workers engaged in the manufacturing sector are also exposed.

⁵² OSHA “Preventing Skin Problems from Working with Portland Cement,” 2008; <https://www.osha.gov/dsg/guidance/cement-guidance.html>; retrieved August 2014.

Thus in 2013, just over three million construction workers were at danger of cement burns, irritant dermatitis, and allergic dermatitis.

Given the prevalence of portland cement in building materials and use on a broad variety of construction projects, many other construction workers may be exposed to wet portland cement at some time. While these workers may not be exposed as often, they may face increased risk because of lower awareness of risks associated with exposure to wet portland cement.

III. The Industry

Cement is the main ingredient in concrete and concrete is the most consumed substance on earth, with the exception of water.⁵³ Cement is the essential binding ingredient found in virtually all forms of construction. Processed cement was discovered by Joseph Aspdin in 1824 and was called portland cement because it resembled a gray stone mined from the island of Portland off the coast of England.⁵⁴

Cement Work

The cement industry has two major types of establishments: those that manufacture cement and those that use cement or materials that contain portland cement to carry out their work. As noted earlier, the focus of this study is on construction workers.

Use of cement and related building products closely parallels the trend in construction activity; however, cement is somewhat protected from extreme cycles because it is used in nearly every type of construction. Individual sector growth, such as highway construction, affects cement consumption more heavily, while trends in building construction involving brick affects masonry cement consumption more heavily.

Employment levels for major cement-related occupational categories (see Table 4) are, in most cases, projected to grow at a faster rate, 2012-2022, 29 percent to 43 percent, than the average for all construction occupations according to the U.S. Department of Labor. This is a significantly greater increase, nearly double, than the average for all occupations of 10.8 percent and for all construction occupations of 21.4 percent.⁵⁵ Only terrazzo workers and tile setters have a lower growth rate than construction as a whole, but it is still higher than the projected growth rate for all occupations.

⁵³ Lafarge North America, "About Cement," http://www.lafarge-na.com/wps/portal/na/en/2_2-About_Cement, retrieved March 4, 2012.

⁵⁴ Kjuus, et al. "Epidemiological assessment of the occurrence of allergic dermatitis..." p. 6; Lafarge North America, "About Cement."

⁵⁵ U.S. Department of Labor, Monthly Labor Review, "Occupational Employment Projections to 2022," December 2013; <http://www.bls.gov/opub/mlr/2013/article/occupational-employment-projections-to-2022.htm>; U.S. Department of Labor, Bureau of Labor Statistics, "BLS Employment Projections Home Page," <http://data.bls.gov/projections/occupationProj>, retrieved August 2014.

Apart from being used in the occupational setting, do-it-yourself homeowners or very small contractors (self-employed) also work with portland cement or materials containing portland cement. These individuals may be at increased risk of developing dermatitis because of lack of information on how to protect themselves from the hazards posed. All exposures to wet portland cement – on the job or for at-home projects – increase the risk of irritant dermatitis becoming a lifelong allergy.

Earnings

According to the Bureau of Labor Statistics, the average hourly wage rates for workers in these primary occupations ranged from \$14.83 for “helpers” to \$24.37 for “brickmasons and blockmasons.” Average annual wages, based on 2080 hours per year ranged from \$30,860 to \$50,700. Average annual earnings range from \$34,841 to \$57,240. (See Table 1.)

IV. Treatment of Dermatitis

In general, the treatment for irritant dermatitis or chemical burns would involve protecting the skin from further exposure to the product that caused the dermatitis or burn. Under ideal circumstances anyone with allergic dermatitis would avoid contact with the product causing the reaction. But, those compounds may be integral to the work, and avoiding the substance that causes an allergic dermatitis can be difficult. For that reason, it is critical to take preventive measures to eliminate the risk of skin contact with products that could cause a burn or dermatitis and, when a worker is exposed, identify and treat early signs.

A visit to a dermatologist will help ensure proper diagnosis and treatment. At that visit, it is important to make the doctor aware of occupational exposures (the products worked with and tasks performed) that could be contributing to or causing the skin problem.

Topical corticosteroids are widely used in the treatment of established contact dermatitis, but steroids may work best in combination with after-work creams and the preventive measures described below to reduce exposure to irritants and allergens. Anyone using topical steroids on their hands should follow their dermatologist's instructions to be sure they are using the correct medication and using it properly. Steroids should not be used for long periods of time. A dermatologist can prescribe additional treatments if steroids are not effective, such as psoralen plus UVA, azathioprine, or cyclosporine.

Barrier creams by themselves are of questionable value in protecting against contact with irritants. Using barrier creams may give a false sense of security and in that way discourage use of gloves. Moisturizing creams give some degree of protection against developing irritant contact dermatitis, and play an important role in healing the skin when dermatitis is present. They should be applied after hand washing, after work, and before sleep. A good cream is one that is lipid rich and free from fragrance and preservatives. For more information visit www.choosehandsafety.org.

Change in Jobs to Treat Dermatitis

When an individual develops allergic contact dermatitis from wet portland cement, the prognosis is often bad.⁵⁶ In fact, nearly half of occupational contact dermatitis (OCD) patients who are not able to fully resolve their condition report a negative long-term impact on their quality of life.⁵⁷ Key to recovery is early diagnosis, often with a change of job and avoidance of further exposure. After years of apprenticeship and job experience, a victim of allergic dermatitis may be forced to make career changes. One study found that of those with OCD, between 23 percent and 82 percent of individuals either had to change jobs or make job modifications.⁵⁸

The benefits of job change are evident in Switzerland where, in severe cases, the Swiss Law on Accidents Insurance issues a declaration of medical inability, allowing workers to receive retraining. Construction workers with contact dermatitis, if they change their work completely and early enough, have a better prognosis. Seventy-six percent of Swiss construction workers with occupational dermatitis who changed jobs healed or improved, versus 16 percent among those who did not leave their job. This led Swiss researchers to conclude that strict allergen avoidance enforced by authorities, and financial support in the case of job change, are important factors in improving the prognosis in occupational dichromate dermatitis.⁵⁹ Nonetheless, chronic cement dermatitis can continue even with change in work, requiring disability payments.⁶⁰ A Danish study found occupational skin diseases “to be an important predictor for long term unemployment” -- yet another compelling reason for prevention.⁶¹

V. Health and Safety Activities to Reduce Exposure to Wet Portland Cement

According to NIOSH, “[b]ecause the prognosis of occupational irritant and allergic dermatitis is poor, prevention is imperative.”⁶² Prevention activities, classically, in health and safety follow a hierarchy of controls. Engineering controls and innovations could, ideally, prevent worker

⁵⁶ Diepgen, T.L., “Occupational skin diseases,” *J Dtsch Dermatol Ges.*, May 2012 and Lips, R., Rast, H., and Elsner, P., “Outcome of job change in patients with occupational chromate dermatitis,” *Contact Dermatitis*, 1996, 34, pp. 268-271.

⁵⁷ Lau, M.Y.Z, Burgess J.A., et al., “A Review of the Impact of Occupational Contact Dermatitis on Quality of Life,” *Journal of Allergy*, Vol. 2011 Article ID 964509, 2011.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Hjorth, Lars, “The occurrence and prevention of cement eczema,” *World Cement*, September 1995. In 1999, the National Research Council-Occupational Exposure Survey discerned that the cost to society of professionally treated ACD including lost work days was \$1 billion annually, and this number did not include over-the-counter medications (National Occupation Research Agenda, 1999).

⁶¹ Held, E., Mygind, K., Wolff, C., Gyntelberg, F., Agner, T., “Prevention of work related skin problems: an intervention study in wet work employees,” *Occup Env Med*, 2002.

⁶² National Institute for Occupational Safety and Health (NIOSH), “*Allergic and Irritant Dermatitis*,” 1996 National Occupational Research Agenda, DHHS (NIOSH) Publication Number 96-115, April 1996.

exposure. New and improved products (such as mix with ferrous sulfate) could also reduce exposure. Administrative controls should be examined too; for example, to schedule work so that (especially on a windy and hot day) those not directly involved with cement work, would not be exposed to cement dust on sweaty skin. Currently, personal protective equipment, primarily gloves, is the primary approach to prevention. Proper use of appropriate gloves should be combined with good hand washing with a pH neutral product, combined with increased worker training and awareness.

The two major health and safety activities for reducing incidence of the disease are (1) building awareness of workers and employers about the hazard and (2) reducing or eliminating exposure.⁶³ Although it is the skin on a worker's hands that primarily comes in contact with wet portland cement, other body parts such as forearms, elbows, face, feet, and knees may also be exposed. This paper focuses on the benefits of prevention through proper use of appropriately protective gloves, along with appropriate hand washing and use of pH neutral soap. One case of illness from wet portland cement can cost \$100,000 or more, when taking into account the burden to the worker and his/her family, the employer, the health insurer, and the government. If a young worker ends up on disability, the cost to taxpayers could easily rise above a million dollars.

A. Hazard Awareness

Awareness of the risks associated with wet portland cement is a key step in prevention. All bagged cement should be labeled with information about irritant and allergic contact dermatitis. Safety Data Sheets (SDSs) should fully inform workers of the risks, prevention, and first aid. Workers should be aware of the "best practices" for working with portland cement: using appropriate gloves and knowing the correct way to use them, hand-washing at work, and thorough body washing and changing out of work clothes before going home, as well as laundering clothes separately. Workers should know to seek medical advice immediately if signs and symptoms of dermatitis develop.

A web site ChooseHandSafety.org (<http://www.choosehandsafety.org/>), was developed by the Masonry Research to Practice (r2p) Partnership, a safety and health partnership, to raise awareness and reduce the incidence of occupational contact dermatitis.⁶⁴

B. Hand Protection

As noted earlier, evidence from Europe shows that adding ferrous sulfate to wet portland cement significantly lowers the risk of dermatitis from exposure to hexavalent chromium. Although required within the European Union, it is rarely used in the United States despite its proven efficacy in reducing occupational dermatitis among those who work with wet cement. Until such

⁶³ Ibid.

⁶⁴ Center for Construction Research and Training, "Masonry Research to Practice Partnership," <http://www.cpwr.com/research/masonry-research-practice-partnership>, retrieved July 2014. The partnership's membership comes from three main organizations: the International Council of Employers, the International Union of Bricklayers and Allied Craftworkers, and the International Masonry Institute.

time as changes are made in the composition of cement to reduce the hazard, use of gloves, properly chosen for exposure to wet cement, is the most important job-site prevention against cement-induced dermatitis.

Hand protection through the selection and use of appropriate gloves is the primary mode of prevention at the present time. Given the dermatitis and burn risks associated with exposure to wet cement, acquiring the proper gloves and using them appropriately and consistently is crucial. But, gloves are only effective in protecting workers from contact dermatitis if they are properly selected and properly used. Appropriate gloves are critical even though they should be worn for the shortest possible time.⁶⁵ Gloves, without proper hand washing, are a risk because unless hands are very clean when gloves are worn, trace amounts of cement can lead to elevated pH inside the workers' gloves.

Selecting the right gloves is challenging. A Canadian research institute studied glove protection and emphasized the complexity of choosing the proper glove.⁶⁶ This is particularly true for hexavalent chromium because the chemical is not listed on most glove choice tables. OSHA recommends that “gloves be selected based on the task that will be performed, the chemicals encountered, and the performance and construction characteristics of the glove material.”⁶⁷ The web site, “Choose Hand Safety,” identifies specific gloves for workers exposed to wet portland cement.⁶⁸ For those whose work is cement and mixing – pouring finishing cement, four generic glove types are described in rank order: PVC, natural rubber/latex, butyl, and nitrile gloves.

Gloves should fit well, be cleaned daily, be discarded when worn out or extremely contaminated, and be made of the correct material for use against wet cement. If gloves are worn, glove liners of thin cotton may increase the comfort level, because they absorb moisture and keep hands clean and dry. But they must not become contaminated by cement. Disposable gloves could make it easier to keep hands clean and they can be less expensive than reusable gloves.

⁶⁵ Peiser, M, Tralau, T., et al., “Allergic contact dermatitis: epidemiology, molecular mechanisms, in vitro methods and regulatory aspects,” *Cell... Mol. Life Sci.*, 2012.

⁶⁶ Institut de recherche Robert-Sauvé en santé et en sécurité du travail, “Information Document for Selecting Gloves for Protection against Mechanical Hazards,” June 2012, <http://www.irsst.qc.ca/gloves/en/InfoDocu.pdf>, retrieved June 2014. “Selecting protective gloves is a difficult compromise between the protection needed against various mechanical or other hazards and a set of considerations relative to issues of functionality and comfort [House, 2007]. In fact, it is impossible to find a glove that provides maximum protection against all the hazards faced, while having no effect at all on the task capability and sensations of the person wearing it.”

⁶⁷ U.S. Department of Labor, Occupational Safety and Health Administration, “Preventing Skin Problems from Working with Portland Cement,” 2008; <https://www.osha.gov/dsg/guidance/cement-guidance.html>; retrieved August 2014.

⁶⁸ ChooseHandSafety.org - “Choosing Gloves,” <http://www.choosehandsafety.org/choosing-gloves>, retrieved June 2014.

OSHA Directs Employers to Provide Appropriate Gloves to Workers Exposed to Wet Portland Cement

In 2007, following the issuance of the Chromium (VI) Standard, OSHA issued inspection procedures for construction sites using portland cement,⁶⁹ and in 2010 OSHA released a letter of interpretation on the use of gloves by masonry workers,⁷⁰ which reinforced the requirement under 29 CFR 1926.95(a) for employers to provide gloves to protect against a skin hazard.

The letter of interpretation addressed a request from the Masonry Contractors Association of America for their employees to be given an exemption from using gloves on jobs where workers were exposed to wet cement. The Association's position was that gloves were not required and the Association complained, on behalf of masonry contractors who had been cited by OSHA because bricklayers were not wearing gloves when doing masonry work. In denying the exemption, the then head of the Directorate of Enforcement Programs, Richard Fairfax, emphasized the importance of gloves whenever there is exposure to wet cement:

“Because of the dermal hazards potentially associated with masonry work, OSHA will not grant masons, mason laborers, or masonry work any formal exemptions.”

OSHA regulation, 29 CFR 1926.95 for personal protective equipment (PPE), requires employers “to ensure that appropriate PPE is provided, effectively used, and maintained.” In addition, according to OSHA, employers are responsible for:⁷¹

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards
- Identifying and providing appropriate PPE for employees
- Training employees in the use and care of the PPE
- Maintaining PPE, including replacing worn or damaged PPE
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

To aid in compliance, OSHA's publication “Preventing Skin Problems from Working with Portland Cement,” includes “Good Practice for Glove Selection and Use.”⁷² The ChooseHandSafety.org website provides training materials on the use of gloves and recommends

⁶⁹ OSHA Inspection Procedures for Construction Sites Using Portland Cement, April 16, 2007 On April 16, 2007. OSHA Director Edwin Foulke, Jr. wrote to OSHA's Regional Administrators and State Designees, as part of a settlement agreement with the Building and Construction Trades Department of the AFL-CIO, that 29 CFR 1926.95 requires employers to ensure that “appropriate PPE is provided, effectively used, and maintained. Appropriate PPE should include boots and gloves, and may also include eye protection, such as safety glasses with side shields or goggles, in some circumstances.” (https://www.osha.gov/dep/hexchrom/BCTD_settlement_memo_20070416.html); accessed August 2014.

⁷⁰ OSHA February 2, 2010 letter of interpretation to the Mason Contractors Association of America https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=27422, retrieved August 2014.

⁷¹ CPWR – The Center for Construction Research and Training, “Choosing Gloves,” http://www.choosehand_safety.org/choosing-gloves, retrieved June 2014.

⁷² OSHA, “Preventing Skin Problems...”

that “[e]veryone who performs tasks with products [including wet cement] or materials that contain potentially hazardous chemicals, including project managers, foremen, superintendents, and workers should receive training before being assigned work.”

Glove training should address:⁷³

- “The product/material and the task for which it will be used;
- The potential health and safety risk associated with the product/material, and safety measures required if there is the potential for skin or other exposure;
- The type(s) of gloves that will be provided;
- How to use and maintain the gloves – including how to put them on (don) and take them off (doff) to avoid skin contact with the product/material, and how to determine if the glove is no longer providing protection and needs to be replaced.”⁷⁴

The importance of training is also reflected in the 2008 agreement between the Portland Cement Association and the U.S. Mine Safety and Health Administration (MSHA) aimed at reducing injuries and illness in the mining industry, which includes a plan for developing and distributing educational materials.⁷⁵

C. Other Personal Protective Clothing and Equipment

In addition to gloves, other types of personal protective clothing and equipment can limit exposure to wet portland cement. According to NIOSH and OSHA, employers should require workers exposed to wet portland cement to also use impervious clothing, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solids or liquids containing insoluble wet cement.⁷⁶

D. The Importance of Hand Washing Facilities at Construction Sites

Hand washing is an important part of job-site prevention against cement-induced dermatitis. After preventing exposure by wearing gloves, the next level of protection is hand washing. Construction sites are required to have running water, hand soap, and either toweling or warm air blowers, as per the OSHA Sanitation Standard, 1926.51. The regulation states that, “each lavatory shall be provided with hot and cold water, or tepid running water. Hand soap or similar cleansing agents shall be provided. Individual hand towels or sections thereof, of cloth or paper, warm air blowers or clean individual sections of continuous cloth toweling, convenient to the lavatories, shall be provided.”

⁷³ CPWR – The Center for Construction Research and Training, “Choose Hand Safety,” <http://www.choosehandsafety.org/training-more/gloves>, retrieved July 2014.

⁷⁴ ChooseHandSafety.org, “Training and More: Gloves,” <http://choosehandsafety.org/training-more/gloves>, retrieved August 2014.

⁷⁵ Portland Cement Association, “Report on Sustainable Manufacturing: Workplace Health and Safety,” 2012.

⁷⁶ Mackison, F. W., Stricoff, R. S., and Partridge, L. J. Jr., eds., NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) Publication No. 81-123 (3 volumes), Government Printing Office, January 1981, as cited at <http://www.cdc.gov/niosh/docs/81-123/>.

The availability of clean water is crucial because, without it some workers might wash their hands with the water in the rinse buckets used to clean construction tools. Since the rinse water is contaminated with cement residue from tools, it is exactly the opposite of what a worker needs for prevention.

In addition to clean water, workers need to use pH neutral soaps to neutralize the alkalinity of cement.⁷⁷ Only pH neutral soaps should be used for washing hands. Using a pH neutral soap is better than using worksite cleaners for washing hands because such cleaners are often caustic and abrasive and may contain sensitizers, such as lanolin, limonene, perfume, or irritants like alcohol.⁷⁸ The following are examples of pH neutral soaps:⁷⁹

- Bar soaps: Dove, Caress, Oil of Olay
- Liquid soaps: Aloe Vera 80, Lever 2000, Neutrogena, Dove, Dial, Ivory, Jergens, Oil of Olay, Gillette Wash, Cetaphil, pHisoderm, Noxema, Softsoap, and Rainbath.

A buffering solution can also be used to maintain a constant pH when combined with acids or alkalis because it can neutralize both acids and alkalis. For workers exposed to portland cement, use of a buffering solution restores the acidic pH of skin exposed to wet cement, thereby permitting barrier repair and preventing skin problems.

E. Making Wet Portland Cement Itself Less Hazardous

A study by the Scientific Committee on Toxicity, Exotoxicity and the Environment, found that adding 0.35 percent ferrous sulfate to cement, changes the water soluble chromium VI to less soluble chromium III and “will reduce the prevalence of allergic cement eczema in workers.”⁸⁰ While companies in the United States rarely add ferrous sulfate to cement, significant progress has been made in Europe to make wet portland cement less hazardous by doing so.

As early as 1979, Danish scientists had suggested that reducing hexavalent water-soluble chromium to trivalent insoluble chromium by adding ferrous sulphate during production would prevent dermatitis from wet portland cement.⁸¹ In fact, Denmark passed legislation requiring the use of cement with lower levels of hexavalent chromium in 1983. Finland followed in 1987 and Sweden and Germany adopted administrative decisions in 1989 and 1993, respectively. The accepted level of water-soluble chromium in cement was determined to be less than 2 mg/kg for the four countries.

⁷⁷ Portland Cement Association “Report on Sustainable Manufacturing...”

⁷⁸ Ibid.

⁷⁹ The Center for Construction Research and Training, CPWR, “Gloves,” <http://www.choosehandsafety.org/safety-health/gloves>, retrieved June 2014.

⁸⁰ Scientific Committee on Toxicity, Exotoxicity and the Environment (CSTEE), “Opinion on Risks to Health from Chromium VI in Cement,” European Commission, Brussels, C2/AST/csteep/Chromium VI 27062992/D(02), June 27, 2002.

⁸¹ Fregert, Gruberger, and Sandahl, 1979, as cited in Rotto, Pekka “Case Studies ...”

The Finnish Institute of Occupational Health monitored the incidence of occupational dermatitis through the Finnish Register of Occupational Diseases from 1978 through 1992. The monitoring results indicated that chromium-induced hand dermatitis practically disappeared among construction workers, whereas the incidence of toxic contact dermatitis remained unchanged during the study period.⁸²

In Denmark, the prevalence of allergic cement eczema decreased significantly for cement workers between 1981 and 1987.⁸³

In January 2005, European Directive 2003/53/EC became binding in the United Kingdom and other EU member states. The directive:⁸⁴

“1) prohibits the placing on the market or use of cement or cement preparations which contain, when hydrated, more than 2 ppm (0.002%) of soluble Cr(VI); 2) requires that where cement or cement preparations have a soluble cr(VI) content of 2 ppm or less, when hydrated, due to the presence of a reducing agent, their packaging should be marked with information on the period of time for which the reducing agent remains effective...; and 3) permits the placing on the market and use of cement or cement preparation not meeting the two requirements above only when it is for use in totally automated and fully enclosed processes where there is no possibility of contact with the skin.”

A study of the European Directive by the University of Manchester in the United Kingdom (UK), found strong evidence that following the use of ferrous sulfate, there “was a significant decline in the incidence of ACD,”⁸⁵ and several subsequent studies support the benefits. A report from the UK’s Health and Safety Executive estimated a decrease of 66 to 100 percent in new cases of allergic chronic dermatitis for cement workers, when ferrous sulfate is added to cement.⁸⁶ Another British study published in 2011 found strong evidence for the benefits of

⁸² Roto et al., 1996, as cited in Roto, “Case Studies ...”

⁸³ Avnstorp cited in Scientific Committee on Toxicity, Exotoxicity and the Environment (CSTEE), “Opinion on Risks to Health from Chromium VI in Cement,” European Commission, Brussels, C2/AST/csteeop/Chromium VI 27062992/D(02), June 27, 2002.

⁸⁴ Hills, Linda and Johansen, Vagn, “Hexavalent Chromium in Cement Manufacturing: Literature Review,” Portland Cement Association, PCA R&D Serial No. 2983, 2007.

⁸⁵ Stocks, S.J., McNamee, R., Turner, S., Carder, M., and Agius, R.M., “Has European Union legislation to reduce exposure to chromate in cement been effective in reducing the incidence of allergic contact dermatitis attributed to chromate in the UK?,” Occup Environ Med, 69(2), February 2012, abstract.

⁸⁶ Government of the United Kingdom, Health and Safety Executive, “Final Regulatory Impact Assessment for Control of Substances Hazardous to the Health (Amendment) Regulations 2004 – Implementation of Cement Aspect of Council Directive 2003/53/EC (26th Amendment to Marketing and Use Directive),” 2004, p. 14.

adding ferrous sulfate to wet cement, concluding that the EU Directive “was successful in reducing exposure to chromate in the UK.”⁸⁷

Researchers in other countries have reached similar conclusions. A German study, published in 2011, found that sensitization to chromate decreased from 43 percent to 29 percent, from 1994 to 2008 due to the use of ferrous sulfate.⁸⁸

Noting such results, researchers in Taiwan – finding 65 of 97 cement workers suffering from contact dermatitis – concluded that there was “urgency to regulate the addition of ferrous sulfate to cement in Taiwan,”⁸⁹ and another Taiwanese study found that adding ferrous sulfate to cement not only reduced the prevalence of dermatitis, but also significantly reduced the total body burden of chromium.⁹⁰

In addition to ferrous sulfate, stannous sulfate, manganese sulfate, and stannous chloride can also reduce hexavalent chromium in cement. A German study of two bricklayers with chromate allergy and allergic dermatitis, found that within four weeks of working with grout treated tin sulphate, their skin conditions improved.⁹¹

The European experience leads researchers to urge promotion of ferrous sulfate.⁹²

Some U.S. manufacturers argue that adding ferrous sulfate alters properties of the cement, however, reports from the European experience indicate the process is economically feasible, and the properties of the cement do not change. It has been calculated that adding ferrous sulfate to cement increases the production costs by \$1.00 per ton. The reductive effect of ferrous sulfate lasts 6 months; the product must be kept dry before mixing because humidity neutralizes the effect of the ferrous sulfate.⁹³ A study by Avnstrop found that adding ferrous sulfate to reduce hexavalent chromium to not more than 2 parts per million of water-soluble chromate increased

⁸⁷ Stocks, S.J., McNamee, R., et al, “Has European Union legislation to reduce exposure to chromate in cement been effective in reducing the incidence of allergic contact dermatitis attributed to chromate in the UK?” *OEM Online First*, published on August 17, 2011 as 10.1136/oemed-2011-100220, received from author June 2014.

⁸⁸ Geier, J., Krautheim, A., et al., “Occupational contact allergy in the building trade in Germany: influence of preventive measures and changing exposure,” *International Archives of Occupational and Environmental Health*, abstract, Volume 84, Issue 4, April 2011.

⁸⁹ Wang, B.J., Wu, J.D., Sheu, S.C., Shigh, T.S., Chang, H.Y., Guo, Y. L., Wang, Y.J., Chou, T.C., “Occupational hand dermatitis among cement workers in Taiwan,” *J Formos Med Assoc*, 110(2), 2011, abstract.

⁹⁰ Chou, T.C., Chang, H.Y., Chen, C.J., Yu, H.S., Wu, J.D., Sheu, S.C., Shih, T.S., “Effect of hand dermatitis on the total body burden of chromium after ferrous sulfate application in cement among cement workers,” *Contact Dermatitis*, 59(3), September 2008, abstract.

⁹¹ Hills, Linda and Johansen, Vagn, “Hexavalent Chromium in Cement Manufacturing: Literature Review,” Portland Cement Association, PCA R&D Serial No. 2983, 2007.

⁹² Uter, W., Ruhl, R, et al., “Contact Allergy in Construction Workers: Results of a Multifactorial Analysis,” *ANN OccupHyg* (2004) 48(1), <http://annhyg.oxfordjournals.org/content/48/1/21.full.pdf+html>, retrieved June 2014.

⁹³ Ruto, Pekka, “Case Studies...”

the cost of cement by about 1 percent.⁹⁴ A British government study found, based on the experiences of producers in other countries, that there were no additional equipment costs, and that the ferrous sulfate process was simply incorporated into cement making using existing equipment.⁹⁵ Because the addition of ferrous sulfate to cement does not change its alkalinity, workers should continue to use proper skin protection when working with wet cement.

F. Improving Risk Information for Portland Cement Products

A 2012 study concluded: “MSDSs [now referred to as SDSs] are frequently criticized as being ineffective for evaluating potential OCD.”⁹⁶ A more recent review of multiple Safety Data Sheets (SDS) for products containing portland cement,⁹⁷ found most did not provide adequate information on the risk and how to prevent a dermal injury or illness. Few had information about specific gloves to use. Of the ten reviewed, only four went so far as to call for “waterproof, abrasion and alkali resistant” gloves. Three called for impervious gloves. Only one company said to “always” wear gloves. Two said to wear impervious gloves “when prolonged exposure to unhardened portland cement might occur.” Only a few SDSs went as far as to talk about alkali-resistant gloves and ones that resist abrasion. It is important for workers to have access to Safety Data Sheets, but, it is also important that the information included in the SDSs be accurate and complete.

The lack of specificity for gloves found on the SDSs was one of the reasons the Masonry r2p Partnership developed the ChooseHandSafety.org website. In developing the site, researchers conducted a review of SDSs first for information on gloves recommended and, if such information was not included or too vague, the products chemical composition was used to identify appropriate glove types.

VI. Economic Impact of Contact Dermatitis

Many have tried to estimate the cost of dermatitis, occupational contact dermatitis, and dermatitis from exposure to wet portland cement. These are summarized below. This report also makes its own estimate, based on six scenarios that follow.

⁹⁴ Avnstorp in Nicholson, et al., “Occupational contact dermatitis...”

⁹⁵ Government of the United Kingdom, Health and Safety Executive, “Final Regulatory Impact Assessment or Control of Substances Hazardous to the Health (Amendment) Regulations 2004, Implementation of Cement Aspect of Council Directive 2003/53/EC (Amendment to Marketing and Use Directive),” 2004, p.15.

⁹⁶ Cashman, M.W., Reutemann, P.A., and Ehrlich, A., “Contact Dermatitis in the United States: Epidemiology, Economic Impact, and Workplace Prevention,” *Dermatol Clin*, 2012 Jan; 30(1):87-98. Note: “...sensitizers, otherwise known as contact allergens, are often omitted because the manufacturer deemed them not toxic. Sensitizers at a concentration of less than 1% would not be listed on Safety Data Sheets in the United States; however, legislation requires sensitizers present at concentrations of more than 0.1% to be listed in the European Union.”

⁹⁷ Ashgrove, CALPORTLAND, Capital Cement, Cement Australia, Cemex, ESSROC, Hansen, LaFarge, Lehigh, Titan America.

Skin disease, generally, according to the American Academy of Dermatology, is one of the top 15 types of medical conditions for which prevalence and monetary cost rose the most between 1987 and 2000.⁹⁸ It was also the most prevalent occupational illness, at 15 percent of all occupational illness reports.⁹⁹ The estimated cost of skin disease in 2004 was \$39.3 billion -- \$29.1 billion in direct medical and \$10.2 billion in lost productivity. In addition, using a willingness to pay methodology, the additional economic burden of skin disease on quality of life was \$56.2 billion, leaving a 2004 burden of \$96 billion, or \$120 billion in 2014 dollars.¹⁰⁰

The estimated annual cost of occupational contact dermatitis, based on the study cited by Lewin is \$1.918 billion, or \$2.33 billion in 2014 dollars.¹⁰¹ A 2005 study, done by the Lewin Group¹⁰² found direct costs of all OCDs to be \$1.4 billion, or \$1.7 billion in 2014 dollars. These costs were for physician and clinic services, for treatments and prescription drugs, and for indirect costs, including lost work days, the lost work days of caregivers, and for restricted activity days.

Another study, by Lushniak for NIOSH,¹⁰³ found the cost of all occupational skin diseases as high as \$1 billion in 1984 or, updated in 2014 dollars, \$2.3 billion.¹⁰⁴

One case of irritant or allergic dermatitis can be devastating to the life of a worker. It may even threaten the means to earn a living and support a family. The following illness scenarios estimate individual costs once an illness requires medical attention. The total cost estimates range anywhere from \$2,106 to \$95,568 – in a combination of medical costs, other out-of-pocket expenses, and foregone wages. (See Table 5.) Total cost to an individual worker ranges from \$1,196 to \$61,288 (See Table 8), in a combination of medical costs, other out-of-pocket expenses, and foregone wages. The cost to government and Workers' Compensation systems are estimated to be anywhere from no cost to \$52,233 per case per year. These costs include, where applicable, Workers' Compensation medical payments, Workers' Compensation cash payments, Temporary Assistance to Needy Families (TANF) payments, Unemployment Insurance, Food

⁹⁸ Bickers, D., Lim, H., Margolis, D., et al., "The burden of skin diseases: 2004," abstract, *Journal of the American Academy of Dermatology*, Vol. 55, Issue 3, September 2006.

⁹⁹ U.S. Department of Labor, Bureau of Labor Statistics, "2012 Survey of Occupational Injuries and Illnesses: Summary Estimates Charts Package," November 7, 2013, <http://www.bls.gov/iif/oshwc/osh/os/osch0049.pdf>, retrieved July 2014, with corrections by BLS in December 2014.

¹⁰⁰ Bickers, et al.

¹⁰¹ Thorpe, Florence, Joski cited in The Lewin Group, Inc. "The burden of skin diseases 2005," prepared for The Society for Investigative Dermatology and the American Academy of Dermatology Association; 2005, available at http://www.lewin.com/~media/lewin/site_sections/publications/april2005skin_disease.

¹⁰² The Lewin Group, Inc., 2005.

¹⁰³ Lushniak in Cashman, M.W., Reutemann, P.A., Ehrlich, A., "Contact dermatitis in the United States: epidemiology, economic impact, and workplace prevention," *Dermatol Clin.* 2012 Jan; 30(1):87-98.

¹⁰⁴ In 1984, estimates ranged from \$222 million to \$1 billion, or \$507 million to \$2.3 billion in 2014 dollars.

Stamps (SNAP), and job retraining. Beyond the economic impact, the social and psychological implications of occupational contact dermatitis are also high.¹⁰⁵

Of all occupational illnesses reported to Workers' Compensation, by far the largest number is for occupational skin disorders. A review of the Washington State system, 1989-1993, found 7,445 claims for occupational skin disorders, representing 7,058 individuals.¹⁰⁶ Medical benefits only were provided for 5,020 (88.1 percent) of the 5,695 accepted claims. Total medical bills, including pharmacy benefits, were \$1.22 million, with a median claim payment of \$97 and an average claim payment of \$243. Time loss payments were \$1.23 million (workers in Washington State receive wage replacement when they lose more than three days of work). The 652 time loss claims accounted for 38,623 days of lost time. The average time loss payment was \$1,881 for 59 lost days; the median amount of lost time for these claims was 11 days. Five occupational categories accounted for nearly 40 percent of these claims, one of them being special trade construction contractors. Special trade construction contractors accounted for just over 6 percent of the accepted occupational skin disorder claims that could be classified by occupation (343 of 5657).

A 2005 study of Workers Compensation data in Oregon¹⁰⁷ found that the average cost per claim for contact dermatitis in construction, cost \$4,968 (in 1997 dollars of the last data year in the study), or \$7,364 in 2014 dollars.

An analysis of BLS data from 1984¹⁰⁸ estimated annual medical costs associated with occupational skin disease of over \$4.7 million, or \$10.8 million in 2014 dollars (probably conservative since the cost of medical services has risen faster than prices in general). This is \$67 per case, or \$154 in 2014 dollars. Workers' Compensation claim awards of \$14.4 million in 2014 dollars. This is \$3,647 per case in 2014 dollars. The estimated annual indirect cost of lost productivity due to occupational skin diseases in 1984 was estimated to be \$11 million, or \$25 million in 2014 dollars. This is \$1,605 per case in 2014 dollars. Thus, in 1984 the estimated annual direct and indirect costs associated with occupational dermatitis exceeded \$50 million (in 2014 dollars). But considering that the actual annual incidence figures may be 10 to 50 times greater than reported in the BLS data, the total annual cost of occupational skin diseases, based on this source may range from \$510 million to \$1.7 billion¹⁰⁹ in 2014 dollars. These estimates do not include costs of occupational retraining, costs attributable to the effects on quality of life, or reimbursements from the government (e.g., Unemployment Insurance, food stamps, Temporary Aid for Needy Families (TANF) payments, or Social Security's Supplemental

¹⁰⁵ Fritsch, et al., "Skin Diseases..."

¹⁰⁶ Kaufman, et al., p. 1048.

¹⁰⁷ McCall, B.P., Horwitz, I.B., Feldman, S.R., Balkrishan, R., "Incidence rates, costs, severity, and work-related factors of occupational dermatitis: a workers' compensation analysis of Oregon, 1990-1997," Archives of Dermatology, 141(6), 2005.

¹⁰⁸ Mathias, C. G., "The Cost of Occupational Skin Disease," Archives of Dermatological Research, Vol. 121, March 1985.

¹⁰⁹ Ibid.

Security Income program).

According to the estimates developed for this paper, if the number of cement-related dermatitis cases is 5,960 to 29,840 per year, then the total burden to affected workers (cost minus compensation and services from the government and workers compensation) is likely to be as high as \$1.8 billion, with a cost to government and Workers' Compensation systems of as much as \$1.6 billion. If a severely affected and totally disabled worker, would have had another 35 years of gainful employment without disability, the Social Security system would be paying out as much as \$1 million or more for just one individual.

If using the OSHA calculator,¹¹⁰ the direct costs of a dermatitis case are \$9,294 and the indirect costs are \$11, 152, for a total of \$20,446 per case. If there are 5,960 cases per year, the total cost would be \$121.9 million. If, however, there are 29,840 cases a year, the OSHA estimator would predict an annual cost of \$6.1 billion.

Not included in this study's cost estimates are those associated with severe cement burns. These cases, as described in law suits, when severe burns occur can each cost tens of thousands of dollars, even more. But data to estimate the number of such burn cases, due to wet portland cement, are not available. An Irish study found that cement burn patients that ended up in the hospital had an average stay of 21 days with 4 months away from work, and that the incidence of cement burns in the hospital had increased to 5 percent of admissions over a one-year period.¹¹¹

The economic impact of a disease includes direct and indirect costs, to a broad range of groups – workers, employers, insurers, and the government. While not included here, cement manufacturers, as well as construction contractors, may have liability costs. Direct costs include costs of medical care, Workers' Compensation, and disability payments. Indirect costs include costs associated with lost workdays and lost productivity.¹¹²

Costs to workers associated with contact dermatitis are not only the medical treatment costs, but also loss of time from work, need for retraining to avoid exposure to wet cement, and a range of out-of-pocket costs. (See Table 6.) Some workers may need to leave their trade altogether. Some, with severe symptoms, may suffer chronic unemployment. The remainder of this paper identifies these costs as well as the costs of prevention – and compares the two, finding that, by far, prevention is cheaper.

A. Background to a More Comprehensive Way to Estimate Costs Associated With Cement-Related Skin Diseases

Costs associated with cement-related skin diseases clearly vary by the duration and seriousness of a case. To describe the range of skin problems, their seriousness, and their associated costs,

¹¹⁰ U.S. Department of Labor, Occupational Safety and Health Administration, "OSHA Safety Pays Program," <https://www.osha.gov/dcsp/smallbusiness/safetypays/estimator.html>, retrieved June 2014.

¹¹¹ Alam, M. et al.

¹¹² NIOSH, "Occupational Dermatoses..."

six scenarios (synthesized from a number of actual cases and circumstances) are presented in this section, along with estimated medical costs for each of them, as they would be in six states across the country.¹¹³ Other personal costs to the affected worker -- as well as costs to the government, insurers, and employers -- are also discussed.

B. Medical Costs Associated with Provision of Medical Services for Treatment and Diagnosis (excluding medication) of Cement-Related Dermatitis Based on Six Scenarios

In order to better estimate the range of medical costs associated with dermatitis, this paper identifies different degrees of illness and estimates the costs of treatment at a variety of locations across the country (including Alabama, California, Massachusetts, Oklahoma, Washington and Wisconsin). Six scenarios outline possible sequential events leading to development of irritant or contact dermatitis in workers exposed to wet portland cement. Cement masons, concrete finishers, bricklayers, and laborers are among those most often exposed to wet cement, and workers from these trades are in the scenarios. The scenarios acknowledge that different workers exposed to wet cement will exhibit differences in the severity and type of dermatitis they develop due to variations in individual susceptibilities, duration of exposure, use of PPE, and the stage at which successful medical diagnosis of their condition and the appropriate medical intervention occurs. The scenarios range from immediate diagnosis with a single doctor visit and reasonably quick resolution of the problem to delayed diagnosis leading to a severe disease and the need to leave the trade. Clearly not all cases of dermatitis have associated medical costs. Some cases, especially cement burns, which result in significant hospitalizations and surgeries would cost far more than the scenarios described below.

To determine medical costs associated with cement dermatitis, the Current Procedural Terminology (CPT®)¹¹⁴ was used to identify codes used in the medical insurance industry for services and procedures associated with diagnosis and treatment of dermatitis. Medical utilization software was used to identify the 80th percentile of cost (commonly used by insurance companies) for the appropriate medical treatment and service codes in the range of six geographical locations selected. For the exact same services, medical costs in one location can be double or even quadruple the costs in another. (See Table 7.)

¹¹³ Based on the variations in total health insurance premiums for single and family coverage in different states, the authors of this report chose zip codes in six cities – Foley, AL; Brookline, MA; Los Angeles, CA; Stilwell, OK; Seattle, WA; and Milwaukee, WI – to estimate a broad range of dermatitis-related medical costs. These zip codes were chosen only to roughly demonstrate the large differences in medical cost across the United States. There is no significance to any one geographic selection.

¹¹⁴ The CPT is published by the American Medical Association. It is a listing of descriptive terms and identifying codes for reporting medical services and procedures performed by physicians. CPT is the most widely accepted nomenclature for the reporting of physician procedures and services under government and private health insurance programs. CPT is also useful for administrative management purposes such as claims processing and for development of guidelines for medical care review. American Medical Association (AMA), “CPT® Process - How a Code Becomes a Code,” <http://www.ama-assn.org/ama/pub/physician-resources/solutions-managing-your-practice/coding-billing-insurance/cpt/cpt-process-faq/code-becomes-cpt.page> and “About CPT®,” <http://www.ama-assn.org/ama/pub/physician-resources/solutions-managing-your-practice/coding-billing-insurance/cpt/about-cpt.page?>, retrieved July 2014.

A worker with unresolved dermatitis can be unable to continue work, and may need to depend on Workers' Compensation, unemployment benefits, TANF, or Social Security's Supplemental Security Income program, to fulfill personal and family financial needs. The worker may be on total disability if the dermatitis is severe and the individual is unable to acquire skills to change trades in order to avoid cement exposure. These and other situations are explored later in this paper.

Direct health care costs, without lost work time, or third party benefits -- such as Unemployment Insurance, Workers' Compensation, or welfare, range in these scenarios, from \$423 to \$13,919 per worker. (See Table 7.) Non-medical, as well as medical, costs are below.

- **Scenario I: Quick diagnosis, followed by treatment, and precautions on return to work**

Mark is a 20 year old cement mason who notices irritation and itching on his hands and forearms after being exposed to wet portland cement during work. Mark's work involves placing and finishing concrete. During work, Mark does not use gloves and does not wash off any wet cement that gets on his hands and forearms. After a few more days of work, Mark notices that the skin on his hands looks extremely red and scaly, is blistered and inflamed, and there is a watery discharge from the skin. Mark finds it difficult to continue with his work and decides to visit his physician. Fellow workers tell him that his skin condition may be because of contact with wet cement and he reports this to his doctor. He is diagnosed with irritant contact dermatitis during his initial visit to the physician. He is successfully treated for it and the disease resolves in about 4 weeks. Mark is out of work for four weeks and loses four weeks of pay. During this time, Mark is unable to work because he has to avoid exposure to wet cement. When he returns to work, he takes precautions to avoid exposure, by wearing proper gloves and shoes and washing his hands and arms with pH neutral soap and water periodically during the workday. He succeeds in resuming work without any subsequent adverse consequences.

Medical costs for Scenario I. This is one of the simplest scenarios, where the exposed worker develops irritant dermatitis, but it is diagnosed quickly and he is able to resume work by using proper personal protection and following safe work practices. Medical costs ranged from \$423 to \$868 for a worker who develops irritant contact dermatitis and is correctly diagnosed during an initial visit to the physician. The costs include a single doctor visit, with work-related or medical disability evaluation services. (See Table 7, Scenario I.) The full costs range from \$3,413 to \$5,325. (See Table 8, Scenario I, column "Total Cost of Worker Illness.")

- **Scenario II: Complications associated with irritant contact dermatitis lead to loss of earnings and search for new job**

Sarah, a 35-year old concrete finisher, has been working with portland cement for 15 years. She is married with one child. Usually the use of gloves was either minimal or absent. There was rarely regular hand washing, due to lack of clean running water on construction sites. She suffered from episodes of hand eczema

off and on and was diagnosed with irritant dermatitis. But during the last episode, she developed secondary bacterial infection from the primary dermatitis. She suffered cell damage due to the infection, and it has taken more than a year to heal. In the meantime, she is not working and expects that it will take her four to six months to be retrained and to find a job where she can avoid exposure, because her skills and experience are all with cement work. Sarah applied for and received Workers' Compensation for 12 months for temporary total disability. Her economic needs caused her to apply for Medicaid and food stamps as well. She will receive them for 16 months, until she is earning an income again. Federal job training for Sarah costs the government, on average, \$6,127.¹¹⁵

Medical cost for Scenario II. Once diagnosed, irritant contact dermatitis can be treated successfully, but complications, such as secondary bacterial infection may arise from the primary dermatitis, including cell damage. Medical costs range from \$2,005 to \$4,126 across the six states. (See Table 7, Scenario II.) Full costs of her illness range from \$64,827 to \$95,568. (See Table 8, Scenario II, column "Total Cost of Worker Illness.")

- **Scenario III: Continuing cement work after development of dermatitis, delayed diagnosis of allergy to chromate, but work resumed with use of proper controls**

Jason is a 28 year old cement mason who has been exposed to wet cement for most of his work life. He did not wear gloves. A few years back, he noticed eczema on his hands and knees. The treatment prescribed by his doctor was unsuccessful in healing his lesions and Jason continued to work. His exposure to wet portland cement continued during this period of time. The eczema lesions spread to his arms and thighs. After subsequent visits to his doctor, he was referred to a skin specialist. The specialist confirmed that the initial irritant contact dermatitis had become allergic dermatitis after a patch test confirmed that Jason was chromate sensitive. The specialist determined that his eczema was related to his occupation. Jason was put on a regimen of systemic steroids and advised to strictly avoid all exposure to wet cement. Fortunately, Jason's allergic dermatitis has been controlled and he is able to continue work. He now uses gloves and kneepads, does not allow his clothes to get saturated with wet cement, and washes his hands a number of times a day with clean water and a buffering solution.

Medical costs for Scenario III. For a cement mason whose initial irritant dermatitis becomes allergic dermatitis, the costs of medical treatment are likely to range from \$1,300 to \$2,832. However, in this scenario, the worker's allergic dermatitis was successfully controlled by use of systemic steroids. The worker was also able to return to his old job and continue to work by avoiding all exposure to wet cement. Medical costs would be much higher for treatment of other possible complications that might result from uncontrolled allergic dermatitis. (See Table 7,

¹¹⁵ See section ahead on retraining.

Scenario III.) Full costs of his disease are \$2,106 to \$3,638. (See Table 8, Scenario III, column “Total Cost of Worker Illness.”)

- **Scenario IV: Cement burns and chromate sensitivity, with recommendation for changing profession**

Ted is 18 years of age and beginning his career as an apprentice cement mason, for a contractor laying a concrete driveway. Ted is not made aware of the hazards associated with coming into contact with wet cement nor provided with nor advised to use personal protective equipment – gloves, boots, knee pads. Because he is not using gloves or other PPE, his hands, lower arms, feet, calves, and knees are exposed to wet cement. Ted neglects to wash the body parts which have come in contact with wet cement. At the end of the day, he notices that the skin on these areas looks black and is covered with blisters, even small lesions. Ted has received serious cement burns on his hands, knees, and feet due to contact with wet cement. He is treated in a hospital emergency room but the skin burns and ulcers take several months to heal, and his hands are scarred. The doctor says that he may need skin grafting. Ted also discovers that he has chromate sensitivity and that is what may have exacerbated the severity of the cement burns. He is told that he might be able to return to work as a cement mason if he uses the right types of skin protection but that his allergic dermatitis could flare up at any time. A new profession is recommended. But until his skin improves he is unable to support himself. He registers for Medicaid and food stamps, but finds himself in increasing debt and in need of job training.

Medical Costs for Scenario IV. In this scenario, the worker receives cement burns on his hands, knees, and feet due to contact with wet cement. He is treated in a hospital emergency room but the skin burns and ulcers take several months to heal, and his hands are scarred. There is a possibility that he may need skin grafting and he also discovers that he has chromate sensitivity. The cost of medical service in such a potentially complicated scenario may be much higher than other cases involving treatment of simple irritant dermatitis. A worker in the situation similar to that described in this scenario may incur costs ranging from \$5,544 to \$13,919. (See Table 7, Scenario IV.) These costs include outpatient services, burn treatment, office consultation, nursing facility services, emergency department visit, testing, disability evaluation services, tissue and skin grafts with anesthesia. The full cost of his disease is \$54,780 to \$79,342. (See Table 8, Scenario IV, column “Total Cost of Worker Illness.”)

- **Scenario V: Delayed diagnosis, lack of adequate medical coverage, acquiring new skills, but eventual loss of income**

Sam is a 40-year old bricklayer at construction sites under contract to his employer. His work almost always exposes him to wet cement (including mortars and grouts). Sam does not always use gloves. He has noticed an itchy, scaly rash on his hands that has become worse over time. Numerous visits to the doctor and the prescribed treatments have yielded no improvement (and so he visits a dermatologist at his own expense.) A successful diagnosis is eventually made, when he is referred to yet another specialist. The diagnosis: Sam suffers from

allergic dermatitis and is chromate sensitive. For missing so much work, he is terminated from what had been a job of several years. He loses benefits, including health insurance. The dermatitis is quite severe by this time and he undergoes treatment with steroids for which he pays out-of-pocket. He is advised to avoid all possible exposure to wet cement, but has no other option. Eventually, Sam is unable to continue as a bricklayer because the dermatitis gets progressively worse. He applies for unemployment insurance, which he receives for six months, and then finally, after a considerable amount of time he finds a job that does not involve cement work. His hourly rate is \$9 per hour lower than it was as a bricklayer. He has no benefits, and he continues to have symptoms.

Medical Costs for Scenario V. A delayed diagnosis is more costly in terms of medical service and overall patient health than a quick initial diagnosis. For the worker in this scenario, costs range from \$1,056 to \$2,180. And, there is considerable expense to him and to public sector training in acquiring new skills and finding non-cement related work. (See Table 7, Scenario V.) The full cost of his disease is \$29,421 to \$41,128. (See Table 8, Scenario V, column “Total Cost of Worker Illness.”)

- **Scenario VI: Language barrier and lack of information, no medical insurance, continuing work with symptoms, and delayed diagnosis. Failure to respond to treatment, joblessness, and disability**

Forty-five year old José has been working at a construction site for about five months as a laborer. The construction contractor he works for requires José to mix the portland cement, which is used for concrete flooring. Other workers doing work similar to José’s, use gloves and water to wash their limbs and advise him to do the same. José does not understand English very well and because the hazards associated with exposure to wet cement are not clear to him, he never uses gloves and does not always wash his hands and forearms promptly when they are exposed to wet cement. José has had an itchy, scaly rash on his hands and forearms for a few months now, which seems to get better when he is not mixing or otherwise working with wet cement, but then reappears when he returns to cement mixing. The last episode was particularly bad and even though José does not have health insurance, he visited the doctor. The doctor treated him for dermatitis but was unaware of José’s occupational exposure. José continued to work throughout the treatment because his earnings support an extended family of eight. After a number of visits to the general practitioner, he is referred to an allergist. The allergist, who takes a comprehensive work history, is able to associate José’s allergic dermatitis to his occupational exposure. However, the treatment is not very successful and José’s dermatitis has gone from bad to worse. He is unable to continue to work because of the worsening dermatitis on his hands and arms. He has to ultimately leave his job to avoid all exposure. José is unable to find a job outside of his present trade because of lack of skills and continuing illness. He applies for TANF benefits. He goes through a period of medical recovery and unemployment, and finally gets a job at minimum wage.

Medical Costs for Scenario VI. For an immigrant worker who also faces a language barrier, understanding the hazards associated with exposure to wet cement can be difficult. In this scenario, the worker, after persistent symptoms of dermatitis, incurs out-of-pocket expenses to visit a physician a number of times and eventually a specialist who diagnoses his condition. These costs can range from \$1,180 to \$2,485 across the six states. In this scenario, the worker would also incur other out-of-pocket expenses, such as prescription and over-the-counter medication. The costs associated with lost work, reduced wages, Workers' Compensation, and TANF systems are considerably higher than the medical costs alone, because of the loss of earnings and eventual disability the worker faces. (See Table 7, Scenario VI.) Had he faced permanent disability, the costs of Social Security's Supplemental Security Income program would range in the hundreds of thousands of dollars. The total cost of his disease is \$41,697 to \$64,096. (See Table 8, Scenario VI, column "Total Cost of Worker Illness.")

The Cost of Diagnosis

For serious dermatitis to be most effectively treated, the affected worker must visit a physician in a timely way. Even so, diagnosis may involve several visits to the physician/physicians. But, workers with dermatitis may wait a long time to seek medical care and chromate sensitivity may not be easy to identify. A dermatologist or an allergist may not make the occupational link. It is unlikely that a worker would go to an occupational health clinic. Focus on occupational exposure may not occur. In cases where a worker sustains severe cement burns, treatment in the emergency room may be necessary. Workers with severe cases of dermatitis may also require hospitalization and use of nursing services. Workers may need restorative surgery including procedures such as skin grafting. The costs of diagnosis depend on how quickly chromate exposure is considered in understanding the patient's illness.

Cost of Patch Tests for Allergic Contact Dermatitis

A typical full allergy work up usually costs \$200 to \$1,000,¹¹⁶ but can run much higher. The cost for each individual part of a work up can be found in Table 7.

C. Other Costs

Apart from medical costs associated with the treatment and management of dermatitis, there may be many additional costs to all parties involved – the worker, employer, health insurer, government, and cement and related product manufacturers.

1. Costs to the Affected Worker

A worker with contact dermatitis suffers discomfort and disability. Besides medical costs not covered by insurance or other programs, there may be non-medical costs such as lost work time, lost job and career, costs for retraining, lost quality of life, and impacts on one's family members.

¹¹⁶ Cost Helper Health, "How Much Does Allergy Testing Cost?" <http://health.costhelper.com/allergy-testing.html>, retrieved July 2014.

a. Out-of-Pocket Medical Costs. Workers' access to job-related health insurance, the cost of that insurance, and the choice of health plans available vary widely. Although the Affordable Care Act is offering new options, workers who do not have job-related insurance can face significant, potentially crippling, medical costs when faced with a debilitating condition like dermatitis. Many employers may not offer health insurance, and even when they do so, the cost of the premium portion that the worker must pay may leave the worker with a high deductible policy. Even with comprehensive insurance there are almost always copays and deductibles for doctor visits, medication, hospitalization, and treatments. There are expenses associated with transportation and parking, over the counter ointments, and bandages.

A worker who unwittingly carries cement home on his/her clothes, or launders the contaminated clothing with the clothing of others in the household, runs the risk of family members developing allergic dermatitis, leading to medical costs for family members as well.

For the six scenarios presented in this paper, "other out-of-pocket" costs are estimated in each case, based on length of illness, medicines and salves likely to be required, amount of transportation to and from medical services, etc. They ranged from \$67 in Scenario I to \$3,224 in Scenarios IV and VI.¹¹⁷ (See Table 8.)

b. Non-Medical Costs to the Worker

The costs of cement-related skin disease are far greater than the medical costs alone. Sick workers lose work time, for which there may be no compensation. They may lose their job or even their career. They may personally pay the costs associated with retraining, or the government may pay through a subsidized job training program. A sick worker may have a reduced quality of life for the duration of a short, acute illness – or maybe even for life. And, with severe impacts on an individual worker, come burdens to the worker's family as well. A 2007 study found that when asked about psychological, social, economic, and subjective issues related to their disease, all 70 occupational contact dermatitis (OCD) patients reported that their disease affected their daily living activities, self-image, economic status, and interpersonal relationships in the family.¹¹⁸ One review of multiple studies found that skin disease caused problems in interactions with co-workers and nearly 20 percent reported problems in family relationships, including rejection by a spouse and even divorce.¹¹⁹

A British study, in 2010, found that 18 to 46 percent of those with OCD reported "impaired quality of life, daily function leisure activities or relationships at home."¹²⁰

¹¹⁷ Corrected for inflation from 2001 to 2014.

¹¹⁸ Rabin B, Fraidlin N., "Patients with occupational contact dermatitis in Israel: quality of life and social implications," Soc Work Health Care, 2007; 45, abstract.

¹¹⁹ Lau, M.Y.Z, Burgess J.A., et al., "A Review of the Impact of Occupational Contact Dermatitis on Quality of Life," *Journal of Allergy*, Vol. 2011 Article ID 964509, 2011.

¹²⁰ Nicholson, et al., "Occupational contact dermatitis & urticaria," p. 18.

An Australian study,¹²¹ in 2011, found profound impacts of occupational contact dermatitis on quality of life:

“The impact of OCD is often underestimated because the course of the disease is not life-threatening and minor degrees of OCD are accepted as “part of the job”. However, OCD can have profound effects involving the need to change occupation and take prolonged sick leave, as well as limiting leisure activities, interfering with the ability to perform household chores and the necessity to pursue time-consuming treatment. These all affect the quality of life.”

Surveys reviewed as part of the Australian study included such quality of life factors as physical functioning, role limitation as a result of physical functioning, bodily pain, general health, vitality, social functioning, role limitation because of emotional difficulties, mental health, leisure, work, frustration, embarrassment, depression, and personal relationships.

i. Loss of Time From Work

A typical worker with irritant contact dermatitis will remain on the job. If exposure continues, the irritation is likely to increase and allergic dermatitis may develop. Early symptoms are often ignored, but should receive immediate attention because they can lead to a more serious disease, and one that is harder to cure. A worker may lose wages due to time away from work. In an extreme case, a worker may face unemployment and even permanent disability.

A study published in Contact Dermatitis found that 21 percent of those with occupational contact dermatitis – allergic, irritant, or mixed – took sick leave.¹²²

An Australian study¹²³ found that one-third of all patients with pervasive post-occupational dermatitis continued to be moderately to seriously impaired by their symptoms, with not only lost work-time but also long-term unemployment.

For the six scenarios presented in this paper, the costs of lost work time are based on construction wage rates specific to the individual’s craft and state. (See Table 9.) The assumption is loss of full time work for the duration of illness. For the six scenarios, these lost wages are from \$0 to over \$77,000 (for a 16 month absence from work in Scenario II).

In two of the six scenarios, sick workers returned to work at lower paying jobs, with half year losses as high as \$36,000. (See Table 8.)

¹²¹ Lau, Burgess, et al.

¹²² Adishes, J. D. Meyer and N. M. Cherry, “Prognosis and work absence due to occupational contact dermatitis,” *Contact Dermatitis*, Volume 46, Issue 5, May 2002, abstract, <http://onlinelibrary.wiley.com/doi/10.1034/j.1600-0536.2002.460505.x/abstract?deniedAccessCustomisedMessage=&userIsAuthenticated=false>.

¹²³ Halbert et al., p. 217.

Figured another way, if workers in the seven crafts most exposed to wet cement (See Table 1) have average hourly wages of \$17.69¹²⁴ and work an eight hour day (\$141.52 per day), then each case with an estimated four to 32 days away from work costs, in lost wages, \$566 to \$4,529. If there are 5,960 to 29,840 cases per year and an estimated 20.1 percent of cases have lost work days, then the estimated total cost of lost wages would be between \$678,000 and \$27,164,217 per year. Lost earnings are even higher. With average earnings for the seven crafts at \$19.97,¹²⁵ the losses in earnings would be \$765,000 to \$30,668,401.

ii. Loss of Job and Career

A typical worker with allergic dermatitis continues to be sensitive to hexavalent chromium and will likely develop more serious symptoms if exposure continues. When symptoms are severe and persistent, a worker may have to leave the trade altogether. Leaving the trade may be the only way for sensitized workers to avoid exposure to the wet portland cement that is making them ill. This is especially true when there is a failure to diagnose the disease early and an allergic reaction develops.

A 2006 study by Lazarov et al. found significant lost work, change of job, and disability claims for occupational contact dermatitis.¹²⁶ Of those studied, 28 percent resigned because of a worsening condition and 52 percent changed occupations, while 47 percent remained in the same job although they had been advised otherwise and 33 percent were unemployed by the time of the study. Disability compensation was claimed by 41 percent.

British researchers in 2010 found that between 6 and 80 percent of people with OCD have to either change jobs or stop working with the agents that cause their dermatitis.¹²⁷

iii. Costs for Retraining

Some individuals have to leave their trade altogether – losing the benefit of their years of experience and training in cement work and needing to train for another trade. The costs of earlier apprenticeship training are lost and costs of new training are incurred. For the purposes of this paper and the six scenarios presented it is assumed that those costs are borne by government job training programs and amount to an average of \$6,127 per year. In 2013, the Employment and Training Administration of the Department of Labor funded a program to train

¹²⁴ Weighted average of wages for the seven crafts.

¹²⁵ See Table 1 footnote for relationship between wages and earnings.

¹²⁶ Lazarov, A., Rabin, B. et al., “Medical and psychological outcome of patients with occupational contact dermatitis in Israel,” *Journal of the European Academy of Dermatology and Venereology*, Volume 20 Issue 5, October 2006, p. 1062-3.

¹²⁷ Nicholson, et al., “Occupational contact dermatitis & urticaria,” p. 18.

workers for re-entry into the job market and estimated the per participant cost to be between \$4,000 and \$8,000.¹²⁸ An average of \$6,000 in 2013 would be \$6,127 in May 2014.

In addition, the worker expends time and money for out-of-pocket expenses associated with searching for a new job. These costs are not added to the scenarios presented in the paper, but it should be remembered that each month not working can cost an individual as much as \$4,800 or more. (See Table 9.)

iv. Lost Quality of Life

Lost quality is the result of reduced employability and the inability to participate in a number of leisure time activities, and changes in social and other personal relationships. A survey of 235 workers with occupational diseases found that the disease interfered with work activities in 37 percent of respondents, with household work in 29 percent, and with leisure activities in 23 percent.¹²⁹ No dollar value can appropriately be applied to these losses.

A 2012 study found that there were many psychosocial aspects of occupational dermatitis. The hands are critical for human communication and expression, and hesitancy in using ones hands can lead to anxiety, depression and psychosocial phobias.¹³⁰ That same study found that approximately 75 percent of those with contact dermatitis had issues with self- perception and 50 percent suffered interference with daily living. Thirty-five percent reported interference with work.¹³¹

A study published in the Journal of the American Academy of Dermatology, found that allergic contact dermatitis (ACD) has a significant effect on quality of life, especially when it affects the hands, the face, or is occupationally related. Emotional impact was deemed the most serious among impacts measured. Individuals who changed jobs because of their skin condition had a greater negative impact on their quality of life.¹³²

A 2007 British study found that nearly 50 percent of OCD victims reported feelings of shame and rejection. Nearly 25 percent reported that their dermatitis affected their mental health – including depression, sleep problems, irritability, and “great anguish.”¹³³

¹²⁸ U.S. Department of Labor, Employment and Training Administration, “Notice of Availability of Funds and Solicitation for Grant Applications for Training to Work - Adult Reentry,” 2013.

¹²⁹ Holness, D. L. and Nethercott, J. R., “Work outcome in workers with occupational skin disease,” American Journal of Industrial Medicine 27:807-815, 1995, in Lushniak, p. 353.

¹³⁰ Clark and Zirwas in Cashman, M.W., Reutemann, P.A, Ehrlich, A., “Contact dermatitis in the United States: epidemiology, economic impact, and workplace prevention,” Dermatol Clin. 2012 Jan; 30(1):87-98.

¹³¹ Holness and Anderson and Rajagopalan in Cashman.

¹³² Kadyk, D. L. MD, McCarter, K. PhD, Achen, F. BA, Belsito, DMD, MBA, “Quality of life in patients with allergic contact dermatitis,” Journal of the American Academy of Dermatology, Volume 49, Issue 6, December 2003.

¹³³ Rabin, quoted in Nicholson, et al., “Occupational contact dermatitis & urticaria,”p.41.

v. Impact on Family

When the primary wage earner loses wages or a job, it affects the financial stability of the entire family. There may be additional consequences of job loss, such as increased debt or the family losing its home. If a worker is disabled and unable to continue to work, the family also faces the psychological impact of disability among a family member. Even the most devoted family can become weary when basic functions such as rearing children, maintaining a home, and earning a living must be performed in addition to caring for a member who is chronically ill.¹³⁴ In this way, chronic illnesses can be enormously difficult for the lives of patients and their families,¹³⁵ with family members, as well as the victim, suffering losses in their careers, marriages, and daily life. A 2010 study found that children with a chronically ill parent were at increased risk for “depressive, anxious, and somatic symptoms,” and a range of problem behaviors.¹³⁶ A 2012 doctoral dissertation¹³⁷ found that children with chronically ill parents had lower grade point averages. Chronic illness in the family often leads to divorce.

Furthermore, in marginal families, illnesses, which reduce earnings or increase expenses, frequently destroy hopes and dreams for the future.¹³⁸ These marginal families suffer more than others in similar situations, with little money and few connections to the community or extended family.¹³⁹ No dollar value can measure these losses.

2. Costs to Workers’ Compensation Insurers for Lost Wages

Workers’ Compensation is a state-mandated program for all employers to provide compensation benefits to employees who become sick or injured on the job. Workers’ Compensation insurers, beyond medical costs, pay four different categories of wage replacement benefits: permanent total, permanent partial, temporary total, and temporary partial disability.

Workers’ Compensation benefits vary widely from state to state and, in many states, compensation is meager. There are variations across states in the waiting period to become eligible for Workers’ Compensation benefits. For the six states used in the scenarios of this paper, there is no benefit payment for the first three to seven days until the time off exceeds a certain number of days (varying by state). Depending on the severity of the dermatitis, disability for workers afflicted with cement-related dermatitis may be classified as temporary partial, temporary total, permanent partial, or permanent total.

¹³⁴ Griffin in Miller and Janosik.

¹³⁵ Corbin, Juliet and Strauss, Anselm, Unending Work and Care: Managing Chronic Illness at Home, Jossey-Bass: San Francisco, 1988.

¹³⁶ Sieh, D.S., Meijer, A.M. et al., “Problem Behavior in Children of Chronically Ill Parents: A Meta-Analysis,” *Clin Child Fam Psychol Rev* (2010) 13, July 17, 2010.

¹³⁷ Sieh, D.S., “The Impact of Children’s Chronic Medical Condition on Parents,” FMG: Research Institute Child Development and Education, 2012, <http://dare.uva.nl/en/record/426374>, retrieved June 2014.

¹³⁸ Griffin in Miller and Janosik.

¹³⁹ Ibid.

3. Costs to the Employer

Workers are not the only ones to suffer when faced with cement-related skin conditions. Employers with health plans will have associated costs. They may also face the negative effects of lower productivity. In some states the employer may be responsible for rehabilitation costs faced by a sick worker.

a. Lower Productivity. Construction employers lose income when productivity falls and the work schedule is interrupted due to injuries and illnesses. Lost workdays due to contact dermatitis have been found to affect productivity.¹⁴⁰ At least one study found lost productivity costs almost as high as medical costs.

Besides actual lost work days, individuals, because of skin disease, may accomplish less work than expected, may have limitations on the kind of work they can do, and may have difficulties performing the work. In fact, one study showed that 43 percent of affected individuals had interference with work and 39 percent reported severe impact on work. Twenty percent could not work.¹⁴¹

A worker with contact or allergic dermatitis may be less productive than a healthy worker. Workers whose hands hurt simply cannot perform as efficiently or effectively as when they are healthy. There may be lost workdays, which could put an employer behind schedule or require the hiring of someone less familiar with a job already started or less skilled in the craft.

b. Turnover Costs. Turnover costs can be extraordinarily high – some estimate nearly double a person’s salary. The Houston Chronicle, in 2010, reported on the results of review of 15 studies on the costs to replace an \$8 per hour employee, and the average was \$9,444 per turnover. Even when the top one-third of estimates were eliminated from the calculation,¹⁴² replacement costs were \$5,506 per turnover.

The Society for Human Resource Management, estimated a cost of \$3,500 to replace one \$8 per hour employee when all costs -- recruiting, interviewing, hiring, training, reduced productivity, etc. --, were considered. This estimate was the lowest of 17 nationally respected companies who calculate this cost.¹⁴³ The value of avoiding turnover can be many times greater than the cost of losing an employee, because turning someone into a 20-year employee can save many turnovers on a front line job, saving literally tens of thousands of dollars.

¹⁴⁰ Goh, C. L. and Gan, S. L., Ministry of Labour, Singapore, “Change in Cement in Manufacturing Process, a Cause for Decline in Chromate Allergy,” Contact Dermatitis, 1996, p. 28.

¹⁴¹ Lau, M.Y.Z, Burgess J.A., et al., “A Review of the Impact of Occupational Contact Dermatitis on Quality of Life,” *Journal of Allergy*, Vol. 2011 Article ID 964509, 2011.

¹⁴² Houston Chronicle, “The Average Cost to Train a New Employee,” undated, <http://smallbusiness.chron.com/average-cost-train-new-employee-44072.html>, retrieved June 2014.

¹⁴³ WebProNews, “Employee Retention: What Employee Turnover Really Costs Your Company,” July 24, 2006, <http://www.webpronews.com/employee-retention-what-employee-turnover-really-costs-your-company-2006-07>, retrieved August 2014.

c. Rehabilitation Costs. Depending on the statutes of the individual state in which the worker is injured, when a workplace injury or illness prevents a worker from earning wages equal to wages earned prior to the injury, the worker may be entitled to rehabilitation services. For instance, Section 440.49(1)(a), Florida Statutes states that when an employee has suffered an injury covered by this chapter that precludes the employee from earning wages equal to wages earned prior to the injury, the employer or carrier shall provide such injured employee with appropriate training and education at its own expense, for his/her suitable gainful employment and vocational rehabilitation.¹⁴⁴

4. Costs to the Construction Industry and Potential Liability for Cement Manufacturers

Cement manufacturers may incur significant costs if they are found liable due to damage to those who work with their products. The Vice President of Engineering for the National Ready Mixed Concrete Association, writing in The Concrete Producer, warned producers:¹⁴⁵

“In many recent cases, courts have found concrete producers liable for failing to provide an adequate warning of cement-burn hazards.”

He went on to say that adequate product warnings are required under various federal laws and regulations, including the Consumer Product Safety Act, the Federal Hazardous Substance Act, and the Hazard Communication Standard of the Occupational Safety and Health Administration.

A far back as 45 years ago, in cases¹⁴⁶ of product liability, the courts have found cement manufacturers liable, even when the injured party developed severe cement burns while performing construction work using cement at his own house. The courts have found the supplier subject to liability in these cases, because “the supplier has reason to know that the product he furnishes is likely to be dangerous for the use for which it is supplied; has no reason to believe the user will realize its dangerous condition; and fails to exercise reasonable care to inform the user of the facts which make the product likely to be dangerous.”¹⁴⁷

While some courts have found no duty on the part of the supplier or employer to inform workers or consumers of the risk of working with portland cement, some courts have found the opposite. In 1973, the Supreme Court of Wisconsin awarded permanent partial disability to a skilled tile

¹⁴⁴ For purposes of this section, "suitable gainful employment" means employment or self-employment which is reasonably attainable in light of the individual's age, education, previous occupation, and injury and which offers an opportunity to restore the individual as soon as practicable and as nearly as possible to his average weekly earnings at the time of injury.

¹⁴⁵ Mullarky, “How to Save Your Customer’s Skin,” The Concrete Producer, October 1997.

¹⁴⁶ 435 So. 2d 575; 1983 La. App. June 29, 1983.
52 A.D.2d 202; 383 N.Y.S.2d 729; 1976 N.Y. App. Div. May 21, 1976.
353 S.W.2d 108; 1961 Mo. App. November 6, 1961.
46 Cal. 2d 190; 293 P.2d 26; 1956 Cal. February 10, 1956.

¹⁴⁷ 52 A.D.2d 202; 383 N.Y.S.2d 729; 1976 N.Y. App. Div. May 21, 1976.

setter who, after 15 years in the trade, developed allergic dermatitis.¹⁴⁸ In 1983, the Court of Appeal for Louisiana found that in the case of the plaintiff sustaining severe concrete burns, “Louisiana Industries’ failure to warn of the dangerous propensity of wet concrete to burn skin was conduct which renders it liable in the case.”¹⁴⁹

5. Costs to Government

When a worker is unable to work for a long duration of time due to dermatitis, or is unable to successfully train to get a job with no cement exposure, there may be unemployment costs and the costs of other government-supported subsidy programs like food stamps, Medicaid, welfare, and disability. All of these programs, besides having an impact on federal expenditures, represent a burden to taxpayers – potentially hundreds of millions of dollars paid out because workers lack a safe workplace when doing cement work.

a. Unemployment Insurance

Unemployment insurance provides workers, whose jobs have been terminated through no fault of their own, monetary payments for a given period of time or until they find a new job. Unemployment compensation provides an unemployed worker time to find a new job. Benefits are based on earnings from the last job and usually last up to 26 weeks. Benefits vary greatly from state to state. (See Table 11 for a few examples.) While not representing the full range of benefits, for the one scenario where a sick worker receives 26 weeks of unemployment benefits, the costs range from \$7,000 to \$17,000.

Each state administers a separate unemployment insurance program. Which employees are eligible for compensation, the amount they receive, and the period of time benefits are paid are determined by a mix of federal and state law. Some states provide additional unemployment benefits to workers who are disabled.

b. Food Stamps

Under the Personal Responsibility and Work Opportunity Reconciliation Act of 1996, the Food Stamp Program (now called the Supplemental Nutrition Assistance Program, or SNAP) was substantially scaled back and includes changes in eligibility and income criteria for families. In subsequent legislation, Congress restored some benefits to select populations and gave states options to restore benefits and provide work and training opportunities to able-bodied adults without dependents and other populations excluded from the federal program.

For those qualifying for food stamps, benefits run \$189 per month for an individual, \$497 for a family of three, or up to \$1,137 for a family of eight.¹⁵⁰ If one is legally disabled, there is no pre-

¹⁴⁸ 57 Wis. 2d 190; 203 N.W.2d 687; 1973 Wisc. LEXIS 1538.

¹⁴⁹ 435 So. 2d 575; 1983 La. App. June 29, 1983.

¹⁵⁰ United States Department of Agriculture (USDA), Supplemental Nutrition Assistance Program (SNAP), http://www.fns.usda.gov/snap/applicant_recipients/BEN.HTM, retrieved July 2014.

qualification process. Otherwise, one's assets, including, in some states, the value of one's automobile, are considered as well as earned and unearned income.

In the six scenarios presented in this paper, where sick workers are eligible for food stamps, it is assumed that they receive the maximum allowable amount.

c. Medicaid

Medicaid is a jointly funded, Federal-State health insurance program for low-income and needy people.¹⁵¹ Medicaid provides care for more than 60 million individuals.¹⁵² The Affordable Care Act has made Medicaid eligibility less complicated.

d. Welfare Benefits

The Personal Responsibility and Work Opportunity Reconciliation Act ended the federal entitlement of individuals to cash assistance under Title IV-A (AFDC), giving states complete flexibility to determine eligibility and benefits levels. Under the new law, Title IV-A funds are replaced with block grants for Temporary Assistance for Needy Families (TANF). The federal law limits the provision of TANF to families with a minor child or pregnant woman and imposes a time limit on the receipt of benefits, in addition to other requirements to qualify for benefits. Federal law prohibits states from using federal TANF funds to provide assistance to a family with an adult who has received assistance for 60 months. This is a permanent or lifetime bar on the use of federal TANF funds to provide assistance, although there are some exceptions.

Benefits vary greatly from state to state. While not representing the full range of benefits, for the six states studied in the scenarios in this paper, monthly gross income cut offs for a family of three ranged from a low of \$215 a month in Alabama to a high of \$673 in Wisconsin. Cash payments from TANF for the sixth scenario ranged from \$1,290 to \$4,038 for six months. (See Tables 12 and 8.) In addition, the TANF program is involved not only with Medicaid and food stamps, but also with housing subsidies and day care opportunities. The latter two could be needed by seriously ill construction workers, but are not included in any of the six scenarios.

e. Disability Benefits

The Social Security Administration pays disability benefits under two programs: the Social Security Disability Insurance (SSDI) program, that is part of the Old Age, Survivors and Disability Insurance (OASDI)¹⁵³ program, and the Supplemental Security Income (SSI) program.

¹⁵¹ Social Security Administration, "Medicaid Information," <http://www.socialsecurity.gov/disabilityresearch/wi/medicaid.htm>, retrieved July 2014.

¹⁵² U.S. Department of Health and Human Services, Centers for Medicare and Medicaid Services, "Medicaid Moving Forward," 2014, <http://www.medicare.gov/AffordableCareAct/Medicaid-Moving-Forward-2014/Downloads/MMF-2013.pdf>, retrieved July 2014.

¹⁵³ The Old-Age, Survivors, and Disability Insurance (OASDI) program provides protection against the loss of earnings due to retirement, death, or disability. The OASDI program consists of two separate parts which pay monthly benefits to workers and their families, Old-Age and Survivors Insurance (OASI) and Disability

SSA defines "disability"¹⁵⁴ in the same way for all adults receiving Social Security benefits (OASDI and SSI). The medical requirements for disability payments are the same under both programs and a person's disability is determined by the same process. While eligibility for Social Security disability is based on prior work under Social Security, SSI disability payments are made on the basis of financial need.

To qualify for disability benefits from Social Security, an applicant must have a physical or mental impairment severe enough to keep him/her from "substantial" work for at least a year.¹⁵⁵ No provisions exist for temporary or partial disabilities under Social Security.

The requirements consider not only whether the individual is unable to do work previously performed, but also if he or she is able to do any other type of work. An individual's age, education, past experience, and transferable skills are all considered in determining eligibility to Social Security disability benefits.

Second, in addition to the medical requirement of the law, an individual must have worked long enough and recently enough to be eligible for benefits based on the age at which they became disabled. Younger workers generally need fewer years of work to qualify. If there are disability payments, such as Workers' Compensation, the workers and their families' Social Security benefits may be reduced so that the combined amount of the Social Security benefit plus Workers' Compensation payment and/or other disability payment does not exceed 80 percent of average current earnings. (The unreduced benefit amount is counted for income tax purposes.)¹⁵⁶

If SSI had been included in one of the six scenarios in this paper, annual benefits, based on current Social Security calculations, would have been far higher.

VII. Costs Associated with Health and Safety Activities

As already established, skin disease is a major burden to workers, and it is costly to them, their employers, insurers, and the government (and taxpayers). These economic costs need to be

Insurance (DI). Under OASI, monthly benefits are paid to retired workers and their families and to survivors of deceased workers.

¹⁵⁴ Disability is defined as the inability to engage in substantial gainful activity by reason of any medically determinable physical or mental impairment that can be expected to result in death or to last for a continuous period of not less than 12 months. This means: "for a non-blind disabled worker, a blind worker under age 55, a disabled adult child, or a disabled widow, widower or surviving divorced spouse, the inability to engage in substantial gainful activity. A person must not only be unable to do his or her previous work but cannot, considering age, education, and work experience, engage in any other kind of substantial gainful work which exists in the national economy." Before 1991, a stricter disability definition applied to disabled widow(er)s. A widow(er) needed to have a disability severe enough to prevent him or her from engaging in "any gainful activity."

¹⁵⁵ Social Security Administration, "Disability Planner: How You Qualify for Social Security Disability Benefits," <http://www.ssa.gov/dibplan/dqualify.htm>, retrieved June 2014.

¹⁵⁶ Social Security Administration, "How Worker's Compensation and Other Disability Payments May Affect Your Benefits," SSA Publication No. 05-10018, <http://www.ssa.gov/pubs/10018.html>, retrieved June 2014.

compared to the costs of prevention, which should be zero, since all prevention measures are already required by existing OSHA regulations. Key is enforcement by OSHA.

A. Importance and Effectiveness of Prevention Activities

There is evidence that educating workers about health hazards associated with dermatitis yields results – saving both health and money. Cashman in a 2012 study established the effectiveness of prevention programs for hand dermatitis.¹⁵⁷ He also explained how the Centers for Disease Control and Prevention has determined that employers need to eliminate exposure, install engineering controls, and provide personal protective equipment, and also hold educational training programs. In fact, because of the increasing incidence of occupational dermatitis, Cashman points to public health interventions and workplace education developed by insurance companies, legislators, and public health institutions – all designed to curb worker exposure to chemicals that cause OCD.¹⁵⁸

In 2013, under the direction of the Masonry r2p Partnership, the ChooseHandSafety.org website was launched to provide employers and workers with comprehensive information on the hazard, treatment, and recommendations for proper PPE and hygiene associated with working with wet cement. (As noted earlier, the website also provides training materials on protecting skin, donning and doffing gloves and other important skin related issues -- see <http://www.choosehandsafety.org>.)

Proper supplies at the job site are vital to insuring a safe environment. These items include:

- Snug-fitting alkali-resistant gloves
- At least 5 to 7 gallons of clean running water per day per worker
- pH-neutral soap to help neutralize the effect of caustic cement (prohibit workplace cleaners that are caustic and abrasive or contain sensitizers like lanolin, limonene or perfume, and irritants like alcohol)
- Clean towels
- Full range (pH 1-14) pH indicator papers to get reasonably accurate measurements of the pH of the skin, work areas, work clothes, skin surfaces, car interior surfaces and other potential contact areas.
- Full-cover goggles or safety glasses with side shields to protect against blowing dust (the moisture in the eyes will mix with the dust, making it caustic), splattering concrete and other foreign objects
- Long-sleeve buttoned shirts taped inside gloves
- Overalls or long pants taped into water-repellent boots
- Waterproof pads to be worn between the fresh concrete surfaces and the knees, elbows and hands – the areas of the body most frequently burned.
- Removal of all jewelry, watches, belts, etc., since the wet concrete can become trapped against the skin.

¹⁵⁷ Cashman.

¹⁵⁸ Weisshaar, Radulescu, and Soder; Seyfarth, Schliemann, and Antonov; and Centers for Disease Control in Cashman.

Workers need to be especially careful when removing gloves, boots, and other work clothes so as not to contaminate themselves or other areas routinely exposed to the caustic product. Each time gloves or boots are removed, workers should wash and thoroughly dry hands with clean towels. It is crucial that gloves and boots are cleaned daily and stored in a dry place away from tools and other work or home items.

There is also evidence that skin care programs that build awareness in workers of the health risks associated with their work, can lead to a significant change in behavior. A study in Denmark found that an educational intervention “was successful with respect to information level, behavior, and clinical symptoms,” concluding that “implementation of a skin care program as part of an occupational health and safety management system is recommended as a prophylactic measure for employees in wet occupations.”¹⁵⁹

A study in Switzerland found a reduction of cement eczema from 1000 cases in 1963 to 100 cases in 1993, as the result of education and personal protective measures.¹⁶⁰

Washing hands and other exposed areas is valuable, but alone are of questionable value when protecting against irritants.¹⁶¹ Clean water and toweling are also required by OSHA at construction sites, so there is no additional cost added for this intervention.¹⁶²

B. Costs of Gloves

Gloves are the first line of defense in preventing contact dermatitis. The length of time until a pair of gloves needs replacement varies based on the individual, techniques used, and condition of work and there are many different prices for gloves. Based on conversations with both workers and contractors, seven work days seems to be a reasonable estimate for the length of time an individual can use a pair of gloves when working with wet portland cement. Workers would need approximately 37 pair of gloves a year if they worked with cement daily and 18 if they work with wet cement half the time. A pair of nitrile gloves, PalmFlex Atlas 350 NitrileFit, if bought in bulk, costs \$2.25.¹⁶³ If no cement-exposed worker is currently using gloves and if each of those workers has full-time work; i.e., 260 days a year – both unrealistic circumstances,

¹⁵⁹ Held, E., Mygind, K., Wolff, C., Gyntelberg, F., Agner, T., “Prevention of work related skin problems: an intervention study in wet work employees,” Occup Env Med 2002.

¹⁶⁰ Hunkeler and Jacobs cited in Scientific Committee on Toxicity, Exotoxicity and the Environment (CSTEE), “Opinion on Risks to Health from Chromium VI in Cement,” European Commission, Brussels, C2/AST/csteep/Chromium VI 27062992/D(02), June 27, 2002.

¹⁶¹ Cited in Bourke, J., Coulson, I., English, J., “Guidelines for the management of contact dermatitis: an update,” British Journal of Dermatology, 160, 2009, p.950.

¹⁶² Again, this paper focuses on work place intervention. Those in public policy and manufacturers should give serious consideration to European control strategies that reduce the level of hexavalent chromium in cement by adding ferrous sulfate. Reductions in disease have been significant.

¹⁶³ PalmFlex, atlas 350 NitrileFit Gloves, <https://www.palmflex.com/atlas-350-nitrilefit-gloves-dozen.html?gclid=Cj0KEQjwveufBRDlsNb3kb-twMIBEiQASNH0xqN8OaACJb2qQS8qQH5PDZ5S1YPMYbkr7GZXPWP7pQ4aAgJh8P8HAQk>, retrieved September 2014.

then gloves for a year would cost \$171 million nationwide. While a large sum, it is a very low percentage of the annual cost of cement-induced dermatitis. All of these costs, however, should already be incorporated into business plans, since the personal protective equipment requirement of OSHA already mandates these protections.

And, besides protecting workers from wet portland cement, they may also protect from other irritants and allergies as well as protect from abrasive surfaces and materials.

C. Costs Associated with Hand Washing

OSHA standards “require employers to provide “clean water, non-alkaline soap, and clean towels” at worksites where employees are working with portland cement.”¹⁶⁴ Therefore, there are no additional costs associated with hand washing, non-alkaline soap, and providing clean towel. Nonetheless, there will be immediate costs for providing hand washing, when employers are out of compliance and this could be an issue or resistance (even though non-compliance means that employers have avoided past required expenditures.)

D. Costs for Cleaning Equipment

Cement and concrete workers need to use low pH soaps, with pH of about 1.5 to 3.0, to clean their equipment, tools, and dumping trucks, but these actions clearly add to the useful life of this capital.

E. Cost of an Intervention

The cost of preventing cement-related burns and dermatitis to the hands is zero, based on existing OSHA requirements. All hand-washing, non-alkaline soap, and clean towel are already required by OSHA regulation. The cost of gloves is only \$2.25 per week, or 32 cents per day, and these too are required under regulations for providing personal protective equipment. If in compliance with OSHA regulations, the cost of gloves, clean water, and appropriate soap is already being borne by employers.

VIII. Conclusions

The cost of cement-related skin disease, direct and indirect, reaches \$2.9 billion per year – with costs to governments, workers compensation and other reimbursing parties of \$1.6 billion and costs to workers of \$1.8 billion. Yet, the cost of prevention should be zero, if construction sites are in compliance with OSHA regulations. Significant costs are borne by medical insurance companies, employers, and government and taxpayers when workers contract cement-related dermatitis. Workers, themselves, suffer the most. The cost-benefit equation is clear. In addition, with prevention, employers gain healthier workers, perhaps with lower insurance rates,

¹⁶⁴ U.S. Department of Labor, Occupational Safety and Health Administration, Letter of Interpretation from Richard Fairfax, Director, Directorate of Enforcement Programs to Gerald Ryan, Director of Training, Health and Safety, Operative Plasterers' and Cement Masons' International Association (OPCMIA) April 11, 2008, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=27271, retrieved September 2014.

and cement manufacturers reduce their potential legal liability. Most importantly, workers can maintain their careers, their health, and their economic well-being.

Table 1

**Average Annual Wages and Earnings, By State
for Seven Cement-Exposed Construction Occupations,
May 2013**

Occupations		U.S.	AL	CA	MA	OK	WA	WI
Brickmasons & Blockmasons 47-2021	# workers	58,730	530	4,340	1,420	530	710	1,060
	Ave. hourly wage	\$24.37	\$16.74	\$30.88	\$35.76	\$19.91	\$31.15	\$26.44
	Ave. annual wage	\$50,700	\$34,820	\$64,230	\$74,390	\$41,410	\$64,780	\$55,000
	Ave. ann. earnings	\$57,240	-	-	-	-	-	-
Stonemasons 47-2022	# workers	10,410	70	910	440	120	130	70
	Ave. hourly wage	\$19.23	\$15.92	\$21.45	\$25.03	\$21.19	\$21.49	\$18.95
	Ave. annual wage	\$39,990	\$33,110	\$44,610	\$52,060	\$44,080	\$44,710	\$39,420
	Ave. ann. earnings	\$44,509	-	-	-	-	-	-
Cement Masons & Concrete Finishers 47-2051	# workers	141,910	1,470	15,120	1,330	2,870	2,320	3,570
	Ave. hourly wages	\$19.52	\$16.90	\$24.73	\$22.50	\$15.29	\$22.62	\$21.80
	Ave. annual wage	\$40,610	\$35,150	\$51,430	\$46,900	\$21,810	\$47,050	\$45,350
	Ave. ann. earnings	\$45,149	-	-	-	-	-	-
Terrazzo Workers & Finishers 47-2053	# workers	3,220	Na	1,120	na	na	na-	80
	Ave. hourly wage	\$20.69	-	\$21.59	-	-	-	\$22.85
	Ave. annual wage	\$43,030	-	\$44,910	-	-	-	\$47,540
	Ave. ann. earnings	\$48,581	-	-	-	-	-	-
Construction Laborers 47-2061	# workers	824,970	9,040	87,000	16,540	12,610	15,510	11,830
	Ave. hourly wage	\$16.84	\$12.80	\$20.45	\$22.97	\$13.39	\$19.98	\$18.74
	Ave. annual wage	\$35,020	\$26,610	\$42,530	\$47,780	\$27,850	\$41,560	\$38,980
	Ave. ann. earnings	\$39,538	-	-	-	-	-	-
Helpers-brickmasons, blockmasons, stonemasons, & tile & marblers 47-3011	# workers	24,280	310	3,120	520	370	410	230
	Ave. hourly wage	\$14.83	\$13.54	\$16.01	\$21.23	\$12.32	\$23.21	\$18.93
	Ave. annual wage	\$30,860	\$28,160	\$33,300	\$44,150	\$25,620	\$48,280	\$39,370
	Ave. ann. earnings	\$34,841	-	-	-	-	-	-
Tile & Marble Setters 47-2044	# workers	30,090	370	6,330	570	290	na	450
	Ave. hourly wage	\$20.68	\$14.28	\$20.35	\$37.69	\$16.16	-	\$24.72
	Ave. annual wage	\$43,010	\$29,700	\$43,320	\$78,390	\$33,610	-	\$51,410
	Ave. ann. earnings	\$48,558	-	-	-	-	-	-

Note: Average hourly earnings for crafts in this table are assumed to have the same relationship to mean hourly wage as for construction employment generally. It is also assumed that that ratio is the same across the six states studied. Hence, earnings are calculated to have the same ratio as \$24.17 (Aug 2013) for average hourly earnings and \$21.40 for mean hourly wage; i.e. 1.129.

Sources: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, May 2013 State Occupational Employment and Wage Estimates, <http://www.bls.gov/oes/current/oesrcst.htm>, retrieved July 21, 2014; U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, <http://www.bls.gov/news.release/empsit.t24.htm>; http://www.bls.gov/oes/2013/may/oes_nat.htm#47-0000, <http://www.bls.gov/news.release/empsit24.htm>, retrieved September, 2014.

Table 2
Construction Trades Assumed to Have 50 Percent of Employees
Involved in Concrete Work

May 2013

Occup. Code	Construction Trade	Employment	Ave. Hrly Wage	Ave. Annual Wage
47-2011	Boilermakers	15,950	\$27.85	\$57,920
47-2031	Carpenters	580,570	\$21.62	\$44,980
47-2070	Construction Equipment Operators	400,280	\$22.31	\$46,410
47-2080	Drywall Installers, Ceiling Tile Installers, and Tapers	96,080	\$21.20	\$44,090
47-2150	Pipelayers, Plumbers, Pipefitters, and Steamfitters	392,460	\$25.19	\$52,390
47-2161	Plasterers and Stucco Masons	20,600	\$19.95	\$41,490
47-2171	Reinforcing Iron and Rebar Workers	17,280	\$26.17	\$54,430
47-2221	Structural Iron and Steel Workers	57,480	\$24.80	\$51,590
47-3012	Helpers--Carpenters	37,400	\$13.20	\$27,450
47-3014	Helpers--Painters, Paperhangers, Plasterers, and Stucco Masons	11,640	\$12.68	\$26,370
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	47,160	\$13.69	\$28,460
47-3019	Helpers, Construction Trades, All Other	19,050	\$13.54	\$28,160
47-4051	Highway Maintenance Workers	139,070	\$17.78	\$36,980
47-4061	Rail-Track Laying and Maintenance Equipment Operators	15,590	\$22.24	\$46,260
47-4090	Miscellaneous Construction and Related Workers	31,920	\$18.51	\$38,510
47-4091	Segmental Pavers	1,110	\$16.97	\$35,290
47-4099	Construction and Related Workers, All Other	30,810	\$18.57	\$38,620

Source: U.S. Department of Labor, Bureau of Labor Statistics, "Occupational Employment Statistics, May 2013, National Occupational Employment and Wage Estimates, United States," http://www.bls.gov/oes/current/oes_nat.htm, retrieved September 2014.

Table 3**Construction Trades Assumed to Have Few, If Any, Workers Involved in Concrete Work**

Occup. Code	Construction Trade	Employment	Ave. Hrly Wage	Ave. Annual Wage
47-2041	Carpet Installers	24,640	\$19.39	\$40,330
47-2042	Floor Layers, Except Carpet, Wood, & Hard Tiles	10,020	\$19.15	\$39,840
47-2043	Floor Sanders and Finishers	4,200	\$17.70	\$36,810
47-2111	Electricians	542,680	\$25.75	\$53,560
47-2121	Glaziers	44,050	\$20.46	\$42,560
47-2130	Insulation Workers	51,600	\$20.38	\$42,380
47-2140	Painters and Paperhangers	196,350	\$18.88	\$39,280
47-2181	Roofers	99,060	\$18.65	\$38,790
47-2211	Sheet Metal Workers	134,110	\$22.81	\$47,440
47-2231	Solar Photovoltaic Installers	4,130	\$20.11	\$41,820
47-3013	Helpers--Electricians	63,660	\$13.91	\$28,920
47-3016	Helpers--Roofers	13,130	\$12.46	\$25,910
47-4011	Construction and Building Inspectors	87,620	\$27.13	\$56,430
47-4021	Elevator Installers and Repairers	21,270	\$36.64	\$76,220
47-4031	Fence Erectors	19,960	\$15.87	\$33,000
47-4041	Hazardous Materials Removal Workers	40,290	\$20.30	\$42,220
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	24,030	\$17.63	\$36,660

Source: U.S. Department of Labor, Bureau of Labor Statistics, "Occupational Employment Statistics, May 2013, National Occupational Employment and Wage Estimates, United States," http://www.bls.gov/oes/current/oes_nat.htm, retrieved September 2014.

Table 4

**Projected Employment Growth for the Seven Trades that Work Most Closely
with Wet Cement, % Change 2012-2022**

Occupation	Projected Employment Growth - % Change 2012-2022
Brickmasons and Blockmasons	35.5%
Stonemasons	29.2%
Cement Masons and Concrete Finishers	29.1%
Construction Laborers	24.3%
Helpers--Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	43.0%
Terrazzo Workers and Finishers	19.8%
Tile and Marble Setters	15.0%
<i>All Construction & Extractions</i>	<i>21.4%</i>

Source: Monthly Labor Review, "Occupational Employment Projections to 2022," December 2013; <http://www.bls.gov/opub/mlr/2013/article/occupational-employment-projections-to-2022.htm>; BLS Employment Projections Home Page (<http://data.bls.gov/projections/occupationProj>)

Table 5

**Summary of Estimated Short-Run Costs of Dermatitis
Due to Cement Exposure
Based on Six Disease Scenarios**

For a Single Disease	Low	High
Costs to Government, Workers' Compensation, and other Reimbursements	0	\$52,233
Total Cost to Individual Worker	\$1,196	\$61,288
Total Cost of a Worker Illness	\$2,106	\$95,568
National Cost Per Year	If 5,960 Cases	If 29,840 Cases
Cost to Government, Workers' Compensation, and other Reimbursements	0	\$1,558,632,720
Total Cost to Affected Workers	\$7,128,160	\$1,828,833,920
Total Cost of Worker Illnesses	\$12,551,760	\$2,851,749,120

Notes: (1) For more detail see the costs estimates for each of the six scenarios in Table 8. (2) Government, Workers' Compensation, and other reimbursement costs do not include costs to Social Security Disability. (3) Total cost of worker illness, in any single scenario, is the summation of total cost to affected workers plus cost to government, Workers' Compensation, and other reimbursements. But, because the proportion of these costs varies from scenario to scenario, the summative total cost of worker illnesses (\$2.9 billion) is not the sum of these parts (\$1.8 billion and \$1.6 billion). It is calculated by the highest cost of services in a scenario.

Source: Data presented and developed in this study.

Table 6

Types of Costs Associated With Burns and Dermatitis Due to Exposure to Wet Portland Cement

Medical Costs, Whether to Worker or Insurer:
Allergy testing
Emergency room visit
Medication
Nursing services
Physician visits (general physician and specialist)
Skin grafting
Surgery
Work-related or disability evaluation
Productivity Costs:
Cost to hire and train replacement workers
Loss of productivity for employer
Costs to Worker:
Impact on family
Loss of job
Loss of wages
Partial/total disability
Possible loss of home
Possible retraining and learning new skills
Reduced quality of life
Other Costs:
Day care support
Food stamps
Housing subsidy
Job training
Medicaid
Social Security's Supplemental Security Income program
Temporary Assistance to Needy Families (TANF) cash support
Unemployment Insurance
Workers' Compensation

**Table 7
Medical Costs for Six Scenarios**

SCENARIO I						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Foley, AL	36535	99203	Outpatient Services	\$123.06	\$86.14	\$36.92
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01
TOTAL COST				\$423.10	\$296.17	\$126.93
Stilwell, OK	74960	99203	Outpatient Services	\$182.98	\$128.09	\$54.89
		99455	Work related or medical disability evaluation services	\$399.88	\$279.92	\$119.96
TOTAL COST				\$582.86	\$408.01	\$174.85
Seattle, WA	98144	99203	Outpatient Services	\$267.26	\$187.08	\$80.18
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49
TOTAL COST				\$682.22	\$477.55	\$204.67
Milwaukee, WI	53222	99203	Outpatient Services	\$286.02	\$200.21	\$85.81
		99455	Work related or medical disability evaluation services	\$391.04	\$273.73	\$117.31
TOTAL COST				\$677.06	\$473.94	\$203.12
Brookline, MA	02446	99203	Outpatient Services	\$305.06	\$213.54	\$91.52
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03
TOTAL COST				\$868.48	\$607.93	\$260.55
Los Angeles, CA	90034	99203	Outpatient Services	\$300.02	\$210.01	\$90.01
		99455	Work related or medical disability evaluation services	\$491.92	\$344.34	\$147.58
TOTAL COST				\$791.94	\$554.35	\$237.59

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php

Note: The following notes apply to all scenarios on Table 7

* The estimated charge is based on the 80th percentile of charges in the FAIR Health Database.

The estimated reimbursement is based on 70% or a percentage of the Medicare fee for each procedure.

Table 7
Medical Costs for Six Scenarios

SCENARIO II						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement#	Out-of-Pocket Costs
Foley, AL	36535	99203	Outpatient Services (3 times)	(\$123.06x3)= \$369.18	(\$86.14x3)= \$258.42	(\$36.92x3)= \$110.76
		99244	Office consultation	\$267.96	\$187.57	\$80.39
		99305	Initial nursing facility, typically 35 minutes per day**	\$132.96	\$93.07	\$39.89
		99354	Prolonged physician service with direct patient contact	\$220.00	\$154.00	\$66.00
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$75.00	\$52.50	\$22.50
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$639.99	\$447.99	\$192.00
			TOTAL COST	\$2,005.13	\$1,403.58	\$601.55
Stilwell, OK	74960	99203	Outpatient Services (3 times)	(\$182.98x3)= \$548.94	(\$128.09x3)= \$384.27	(\$54.89x3)= \$164.67
		99244	Office consultation	\$372.12	\$260.48	\$111.64
		99305	Initial nursing facility, typically 35 minutes per day	\$164.96	\$115.47	\$49.49
		99354	Prolonged physician service with direct patient contact	\$160.00	\$112.00	\$48.00
		99455	Work related or medical disability evaluation services	\$399.88	\$279.92	\$119.96
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$98.00	\$68.60	\$29.40
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$813.99	\$569.79	\$244.20
			TOTAL COST	\$2,557.89	\$1,790.53	\$767.36
Seattle, WA	98144	99203	Outpatient Services (3 times)	(\$267.26x3)= \$801.78	(\$187.08x3)= \$561.24	(\$80.18x3)= \$240.54
		99244	Office consultation	\$505.12	\$353.58	\$151.54
		99305	Initial nursing facility, typically 35 minutes per day	\$276.00	\$193.20	\$82.80
		99354	Prolonged physician service with direct patient contact	\$230.00	\$161.00	\$69.00
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$148.00	\$103.60	\$44.40
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$990.00	\$693.00	\$297.00
			TOTAL COST	\$3,365.86	\$2,356.09	\$1,009.77

Table 7
Medical Costs for Six Scenarios

SCENARIO II						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge *	Estimated Reimbursement [#]	Out-of-Pocket Costs
Milwaukee, WI	53222	99203	Outpatient Services (3 times)	(\$286.02x3)= \$858.06	(\$200.21x3)= \$600.63	(\$85.81x3)= \$257.43
		99244	Office consultation	\$521.08	\$364.76	\$156.32
		99305	Initial nursing facility, typically 35 minutes per day	\$310.08	\$217.06	\$93.02
		99354	Prolonged physician service with direct patient contact	\$400.00	\$280.00	\$120.00
		99455	Work related or medical disability evaluation services	\$391.04	\$273.73	\$117.31
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$196.00	\$137.20	\$58.80
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$1,449.99	\$1,014.99	\$435.00
			TOTAL COST	\$4,126.25	\$2,888.37	\$1,237.88
Brookline, MA	02446	99203	Outpatient Services (3 times)	(\$305.06x3)= \$915.18	(\$213.54x3)= \$640.62	(\$91.52x3)= \$274.56
		99244	Office consultation	\$654.92	\$458.44	\$196.48
		99305	Initial nursing facility, typically 35 minutes per day	\$300.00	\$210.00	\$90.00
		99354	Prolonged physician service with direct patient contact	\$350.00	\$245.00	\$105.00
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$158.00	\$110.60	\$47.40
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$1,040.01	\$728.01	\$312.00
			TOTAL COST	\$3,981.53	\$2,787.06	\$1,194.47
Los Angeles, CA	90034	99203	Outpatient Services (3 times)	(\$300.02x3)= \$900.06	(\$210.01x3)= \$630.03	(\$90.01x3)= \$270.03
		99244	Office consultation	\$565.04	\$395.53	\$169.51
		99305	Initial nursing facility, typically 35 minutes per day	\$250.08	\$175.06	\$75.02
		99354	Prolonged physician service with direct patient contact	\$256.80	\$179.76	\$77.04
		99455	Work related or medical disability evaluation services	\$491.92	\$344.34	\$147.58
		11000	Debridement of extensive eczematous or infected skin; up to 10% of body surface	\$250.00	\$175.00	\$75.00
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$1,050.00	\$735.00	\$315.00
			TOTAL COST	\$3,763.90	\$2,634.72	\$1,129.18

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php

** 99302 Nursing Facility Services code, used in original 2002 study, was deleted and replaced by 99305 in 2006. http://www.ritecode.com/2006_cpt/cpt_6.htm

Table 7
Medical Costs for Six Scenarios

SCENARIO III						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Foley, AL	36535	99203	Outpatient Services (4 times)	(\$123.06x4)= \$492.24	(\$86.14x4)= \$344.56	(\$36.92x4)= \$147.68
		99244	Office consultation	\$267.96	\$187.57	\$80.39
		99354	Prolonged physician service with direct patient contact	\$220.00	\$154.00	\$66.00
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$10.01	\$7.01	\$3.00
			TOTAL COST	\$1,300.25	\$910.17	\$390.08
Stilwell, OK	74960	99203	Outpatient Services (4 times)	(\$182.98x4)= \$731.92	(\$128.09x4)= \$512.36	(\$54.89x4)= \$219.56
		99244	Office consultation	\$372.12	\$260.48	\$111.64
		99354	Prolonged physician service with direct patient contact	\$160.00	\$112.00	\$48.00
		99455	Work related or medical disability evaluation services	\$399.88	\$279.92	\$119.96
		95004	Percutaneous test	\$12.00	\$8.40	\$3.60
		95044	Patch or application test	\$21.44	\$15.01	\$6.43
			TOTAL COST	\$1,697.36	\$1,188.17	\$509.19
Seattle, WA	98144	99203	Outpatient Services (4 times)	(\$267.26x4)= \$1,069.04	(\$187.08x4)= \$748.32	(\$80.18x4)= \$320.72
		99244	Office consultation	\$505.12	\$353.58	\$151.54
		99354	Prolonged physician service with direct patient contact	\$230.00	\$161.00	\$69.00
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49
		95004	Percutaneous test	\$19.00	\$13.30	\$5.70
		95044	Patch or application test	\$19.01	\$13.31	\$5.70
			TOTAL COST	\$2,257.13	\$1,579.98	\$677.15

Table 7
Medical Costs for Six Scenarios

SCENARIO III						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement#	Out-of-Pocket Costs
Milwaukee, WI	53222	99203	Outpatient Services (4 times)	(\$286.02x4)= \$1,144.08	(\$200.21x4)= \$800.84	(\$85.81x4)= \$343.24
		99244	Office consultation	\$521.08	\$364.76	\$156.32
		99354	Prolonged physician service with direct patient contact	\$400.00	\$280.00	\$120.00
		99455	Work related or medical disability evaluation services	\$391.04	\$273.73	\$117.31
		95004	Percutaneous test	\$22.00	\$15.40	\$6.60
		95044	Patch or application test	\$42.00	\$29.40	\$12.60
		TOTAL COST		\$2,520.20	\$1,764.13	\$756.07
Brookline, MA	02446	99203	Outpatient Services (4 times)	(\$305.06x4)= \$1,220.24	(\$213.54x4)= \$854.16	(\$91.52x4)= \$366.08
		99244	Office consultation	\$654.92	\$458.44	\$196.48
		99354	Prolonged physician service with direct patient contact	\$350.00	\$245.00	\$105.00
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03
		95004	Percutaneous test	\$23.00	\$16.10	\$6.90
		95044	Patch or application test	\$20.00	\$14.00	\$6.00
		TOTAL COST		\$2,831.58	\$1,982.09	\$849.49
Los Angeles, CA	90034	99203	Outpatient Services (4 times)	(\$300.02x4)= \$1,200.08	(\$210.01x4)= \$840.04	(\$90.01x4)= \$360.04
		99244	Office consultation	\$565.04	\$395.53	\$169.51
		99354	Prolonged physician service with direct patient contact	\$256.80	\$179.76	\$77.04
		99455	Work related or medical disability evaluation services	\$491.92	\$344.34	\$147.58
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$25.01	\$17.51	\$7.50
		TOTAL COST		\$2,548.85	\$1,784.18	\$764.67

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php

Table 7
Medical Costs for Six Scenarios

SCENARIO IV						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Foley, AL	36535	16025	Burns, local treatment	\$144.12	\$100.88	\$43.24
		01952	Anesthesia for treatmt. of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area	\$409.75	\$286.83	\$122.93
		99203	Outpatient Services	\$123.06	\$86.14	\$36.92
		99242	Office consultation	\$147.22	\$103.05	\$44.17
		99305	Initial nursing facility, 35 minutes per day**	\$132.96	\$93.07	\$39.89
		99284	Emergency department visit	\$348.00	\$243.60	\$104.40
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$10.01	\$7.01	\$3.00
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01
			<i>If skin grafting is performed:</i>			
		01951	Anesthesia for burn excisions or debridement	\$245.85	\$172.10	\$73.76
		20926	Tissue grafts	\$563.06	\$394.14	\$168.92
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$639.99	\$447.99	\$192.00
		15120	Free skin graft	\$1,830.32	\$1,281.22	\$549.10
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$639.99	\$447.99	\$192.00
			TOTAL COST	\$5,544.37	\$3,881.05	\$1,663.34
Stilwell, OK	74960	16025	Burns, local treatment	\$166.67	\$116.67	\$50.00
		01952	Anesthesia for treatmt. of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area	\$560.20	\$392.14	\$168.06
		99203	Outpatient Services	\$182.98	\$128.09	\$54.89
		99242	Office consultation	\$199.92	\$139.94	\$59.98
		99305	Initial nursing facility, 35 minutes per day	\$164.96	\$115.47	\$49.49
		99284	Emergency department visit	\$773.00	\$541.10	\$231.90
		95004	Percutaneous test	\$12.00	\$8.40	\$3.60
		95044	Patch or application test	\$21.44	\$15.01	\$6.43
		99455	Work related or medical disability evaluation services	\$399.88	\$279.92	\$119.96
			<i>If skin grafting is performed:</i>			
		01951	Anesthesia for burn excisions or debridement	\$336.12	\$235.28	\$100.84
		20926	Tissue grafts	\$686.40	\$480.48	\$205.92
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$813.99	\$569.79	\$244.20
		15120	Free skin graft	\$2,116.71	\$1,481.70	\$635.01
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$813.99	\$569.79	\$244.20
			TOTAL COST	7,248.26	\$5,073.78	\$2,174.48

**Table 7
Medical Costs for Six Scenarios**

SCENARIO IV						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge *	Estimated Reimbursement #	Out-of-Pocket Costs
Seattle, WA	98144	16025	Burns, local treatment	\$265.00	\$185.50	\$79.50
		01952	Anesthesia for treatmt of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area	\$540.55	\$378.39	\$162.17
		99203	Outpatient Services	\$267.26	\$187.08	\$80.18
		99242	Office consultation	\$249.05	\$174.34	\$74.72
		99305	Initial nursing facility, 35 minutes per day	\$276.00	\$193.20	\$82.80
		99284	Emergency department visit	\$582.00	\$407.40	\$174.60
		95004	Percutaneous test	\$19.00	\$13.30	\$5.70
		95044	Patch or application test	\$19.01	\$13.31	\$5.70
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49
			<i>If skin grafting is performed:</i>			
		01951	Anesthesia for burn excisions or debridement	\$324.33	\$227.03	\$97.30
		20926	Tissue grafts	\$1,344.10	\$940.87	\$403.23
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$990.00	\$693.00	\$297.00
		15120	Free skin graft	\$2,234.95	\$1,564.47	\$670.49
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$990.00	\$693.00	\$297.00
			TOTAL COST	\$8,516.24	\$5961.36	\$2,554.88
Milwaukee, WI	53222	16025	Burns, local treatment	\$340.00	\$238.00	\$102.00
		01952	Anesthesia for treatmt of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area	\$2,100.00	\$1,470.00	\$630.00
		99203	Outpatient Services	\$286.02	\$200.21	\$85.81
		99242	Office consultation	\$308.04	\$215.63	\$92.41
		99305	Initial nursing facility, 35 minutes per day	\$310.08	\$217.06	\$93.02
		99284	Emergency department visit	\$488.00	\$341.60	\$146.40
		95004	Percutaneous test	\$22.00	\$15.40	\$6.60
		95044	Patch or application test	\$42.00	\$29.40	\$12.60
		99455	Work related or medical disability evaluation services	\$391.04	\$273.73	\$117.31
			<i>If skin grafting is performed:</i>			
		01951	Anesthesia for burn excisions or debridement	\$512.91	\$359.04	\$153.87
		20926	Tissue grafts	\$2,001.01	\$1,400.71	\$600.30
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$1,449.99	\$1,014.99	\$435.00
		15120	Free skin graft	\$4,218.05	\$2,952.64	\$1,265.41
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$1,449.99	\$1,014.99	\$435.00
			TOTAL COST	\$13,919.13	\$9,743.40	\$4,175.73

**Table 7
Medical Costs for Six Scenarios**

SCENARIO IV								
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014				
				Estimated Charge *	Estimated Reimbursement #	Out-of-Pocket Costs		
Brookline, MA	02446	16025	Burns, local treatment	\$275.00	\$192.50	\$82.50		
		01952	Anesthesia for treatmt of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area	\$650.00	\$455.00	\$195.00		
		99203	Outpatient Services	\$305.06	\$213.54	\$91.52		
		99242	Office consultation	\$308.04	\$215.63	\$92.41		
		99305	Initial nursing facility, 35 minutes per day	\$300.00	\$210.00	\$90.00		
		99284	Emergency department visit	\$327.00	\$228.90	\$98.10		
		95004	Percutaneous test	\$23.00	\$16.10	\$6.90		
		95044	Patch or application test	\$20.00	\$14.00	\$6.00		
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03		
			<i>If skin grafting is performed:</i>					
		01951	Anesthesia for burn excisions or debridement	\$390.00	\$273.00	\$117.00		
		20926	Tissue grafts	\$2,019.99	\$1,413.99	\$606.00		
		00400	Anesthesia for procedure on skin of arms, legs or trunk.	\$1,040.01	\$728.01	\$312.00		
		15120	Free skin graft	\$2,424.94	\$1,697.46	\$727.48		
		00400	Anesthesia for procedure on skin of arms, legs or trunk	\$1,040.01	\$728.01	\$312.00		
		TOTAL COST				\$9,686.47	\$6,780.53	\$2,905.94
		Los Angeles, CA	90034	16025	Burns, local treatment	\$250.00	\$175.00	\$75.00
01952	Anesthesia for treatmt of 2 nd & 3 rd degree burn, between 4% and 9% total body surface area			\$558.05	\$390.64	\$167.42		
99203	Outpatient Services			\$300.02	\$210.01	\$90.01		
99242	Office consultation			\$290.02	\$203.01	\$87.01		
99305	Initial nursing facility, 35 minutes per day			\$250.08	\$175.06	\$75.02		
99284	Emergency department visit			\$493.00	\$345.10	\$147.90		
95004	Percutaneous test			\$10.00	\$7.00	\$3.00		
95044	Patch or application test			\$25.01	\$17.51	\$7.50		
99455	Work related or medical disability evaluation services			\$491.92	\$344.34	\$147.58		
	<i>If skin grafting is performed:</i>							
01951	Anesthesia for burn excisions or debridement			\$334.83	\$234.38	\$100.45		
20926	Tissue grafts			\$1,391.00	\$973.70	\$417.30		
00400	Anesthesia for procedure on skin of arms, legs or trunk.			\$1,050.00	\$735.00	\$315.00		
15120	Free skin graft			\$3,175.00	\$2,222.50	\$952.50		
00400	Anesthesia for procedure on skin of arms, legs or trunk			\$1,040.01	\$728.01	\$312.00		
TOTAL COST				\$9,658.94	\$6,761.25	\$2,897.69		

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php.

** 99302 Nursing Facility Services, code was deleted and replaced by 99305 in 2006. http://www.ritecode.com/2006_cpt/cpt_6.htm

Table 7
Medical Costs for Six Scenarios

SCENARIO V						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Foley, AL	36535	99203	Outpatient Services (3 times)	(\$123.06x3)= \$369.18	(\$86.14x3)= \$258.42	(\$36.92x3)= \$110.76
		99242	Office consultation	\$147.22	\$103.05	\$44.17
		99354	Prolonged physician service with direct patient contact	\$220.00	\$154.00	\$66.00
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$10.01	\$7.01	\$3.00
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01
		TOTAL COST				\$1,056.45
Stilwell, OK	74960	99203	Outpatient Services (3 times)	(\$182.98x3)= \$548.94	(\$128.09x3)= \$384.27	(\$54.89x3)= \$164.67
		99242	Office consultation	\$199.92	\$139.94	\$59.98
		99354	Prolonged physician service with direct patient contact	\$160.00	\$112.00	\$48.00
		95004	Percutaneous test	\$12.00	\$8.40	\$3.60
		95044	Patch or application test	\$21.44	\$15.01	\$6.43
		99455	Work related or medical disability evaluation services	\$399.88	\$279.92	\$119.96
		TOTAL COST				\$1,342.18
Seattle, WA	98144	99203	Outpatient Services (3 times)	(\$267.26x3)= \$801.78	(\$187.08x3)= \$561.24	(\$80.18x3)= \$240.54
		99242	Office consultation	\$249.05	\$174.34	\$74.72
		99354	Prolonged physician service with direct patient contact	\$230.00	\$161.00	\$69.00
		95004	Percutaneous test	\$19.00	\$13.30	\$5.70
		95044	Patch or application test	\$19.01	\$13.31	\$5.70
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49
		TOTAL COST				\$1,733.80
Milwaukee, WI	53222	99203	Outpatient Services (3 times)	(\$286.02x3)= \$858.06	(\$200.21x3)= \$600.63	(\$85.81x3)= \$257.43
		99242	Office consultation	\$308.04	\$215.63	\$92.41
		99354	Prolonged physician service with direct patient contact	\$400.00	\$280.00	\$120.00
		95004	Percutaneous test	\$22.00	\$15.40	\$6.60
		95044	Patch or application test	\$42.00	\$29.40	\$12.60
		99455	Work related or medical disability evaluation services	\$391.04	\$273.73	\$117.31
		TOTAL COST				\$2,021.14

**Table 7
Medical Costs for Six Scenarios**

SCENARIO V						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Brookline, MA	02446	99203	Outpatient Services (3 times)	(\$305.06x3)= \$915.18	(\$213.54x3)= \$640.62	(\$91.52x3)= \$274.56
		99242	Office consultation	\$308.04	\$215.63	\$92.41
		99354	Prolonged physician service with direct patient contact	\$350.00	\$245.00	\$105.00
		95004	Percutaneous test	\$23.00	\$16.10	\$6.90
		95044	Patch or application test	\$20.00	\$14.00	\$6.00
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03
		TOTAL COST				\$2,179.64
Los Angeles, CA	90034	99203	Outpatient Services (3 times)	(\$300.02x3)= \$900.06	(\$210.01x3)= \$630.03	(\$90.01x3)= \$270.03
		99242	Office consultation	\$290.02	\$203.01	\$87.01
		99354	Prolonged physician service with direct patient contact	\$256.80	\$179.76	\$77.04
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$25.01	\$17.51	\$7.50
		99455	Work related or medical disability evaluation services	\$491.92	\$344.34	\$147.58
		TOTAL COST				\$1,973.81

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php

Table 7
Medical Costs for Six Scenarios

SCENARIO VI							
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014			
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs	
Foley, AL	36535	99203	Outpatient Services (4 times)	(\$123.06x4)= \$492.24	(\$86.14x4)= \$344.56	(\$36.92x4)= \$147.68	
		99242	Office consultation	\$147.22	\$103.05	\$44.17	
		99354	Prolonged physician service with direct patient contact	\$220.00	\$154.00	\$66.00	
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00	
		95044	Patch or application test	\$10.01	\$7.01	\$3.00	
		99455	Work related or medical disability evaluation services	\$300.04	\$210.03	\$90.01	
		TOTAL COST			\$1,179.51	\$825.65	\$353.86
		Stilwell, OK	74960	99203	Outpatient Services (4 times)	(\$182.98x4)= \$731.92	(\$128.09x4)= \$512.36
99242	Office consultation			\$199.92	\$139.94	\$59.98	
99354	Prolonged physician service with direct patient contact			\$160.00	\$112.00	\$48.00	
95004	Percutaneous test			\$12.00	\$8.40	\$3.60	
95044	Patch or application test			\$21.44	\$15.01	\$6.43	
99455	Work related or medical disability evaluation services			\$399.88	\$279.92	\$119.96	
TOTAL COST				\$1,525.16	\$1,067.63	\$457.53	
Seattle, WA	98144			99203	Outpatient Services (4 times)	(\$267.26x4)= \$1,069.04	(\$187.08x4)= \$748.32
		99242	Office consultation	\$249.05	\$174.34	\$74.72	
		99354	Prolonged physician service with direct patient contact	\$230.00	\$161.00	\$69.00	
		95004	Percutaneous test	\$19.00	\$13.30	\$5.70	
		95044	Patch or application test	\$19.01	\$13.31	\$5.70	
		99455	Work related or medical disability evaluation services	\$414.96	\$290.47	\$124.49	
		TOTAL COST			\$2,001.06	\$1,400.74	\$600.33
		Milwaukee, WI	53222	99203	Outpatient Services (4 times)	(\$286.02x4)= \$1,144.08	(\$200.21x4)= \$800.84
99242	Office consultation			\$308.04	\$215.63	\$92.41	
99354	Prolonged physician service with direct patient contact			\$400.00	\$280.00	\$120.00	
95004	Percutaneous test			\$22.00	\$15.40	\$6.60	
95044	Patch or application test			\$42.00	\$29.40	\$12.60	
99455	Work related or medical disability evaluation services			\$391.04	\$273.73	\$117.31	
TOTAL COST				\$2,307.16	\$1,615.00	\$692.16	

Table 7
Medical Costs for Six Scenarios

SCENARIO VI						
City and State	Zip Code	Code for Medical Treatment	Type of Medical Treatment/Service	Cost of Medical Service, 2014		
				Estimated Charge*	Estimated Reimbursement [#]	Out-of-Pocket Costs
Brookline, MA	02446	99203	Outpatient Services (4 times)	(\$305.06x4)= \$1,220.24	(\$213.54x4)= \$854.16	(\$91.52x4)= \$366.08
		99242	Office consultation	\$308.04	\$215.63	\$92.41
		99354	Prolonged physician service with direct patient contact	\$350.00	\$245.00	\$105.00
		95004	Percutaneous test	\$23.00	\$16.10	\$6.90
		95044	Patch or application test	\$20.00	\$14.00	\$6.00
		99455	Work related or medical disability evaluation services	\$563.42	\$394.39	\$169.03
		TOTAL COST				\$2,484.70
Los Angeles, CA	90034	99203	Outpatient Services (4 times)	(\$300.02x4)= \$1,200.08	(\$210.01x4)= \$840.04	(\$90.01x4)= \$360.04
		99242	Office consultation	\$290.02	\$203.01	\$87.01
		99354	Prolonged physician service with direct patient contact	\$256.80	\$179.76	\$77.04
		95004	Percutaneous test	\$10.00	\$7.00	\$3.00
		95044	Patch or application test	\$25.01	\$17.51	\$7.50
		99455	Work related or medical disability evaluation services	\$491.92	\$344.34	\$147.58
		TOTAL COST				\$2,273.83

Source: FAIR Health, http://fairhealthconsumer.org/medical_cost.php

Table 8
Quantifiable Costs Associated With Six Scenarios
Scenario I

SCENARIO I							
State	Cost of Medical Services	Cost to Insurance	Cost to Worker	Other Out-of-Pocket*	4 Weeks Lost Earnings	Total Cost of Worker Illness	Cost to Worker
Alabama	\$423	<u>\$296</u>	\$127	\$67	\$3,053	\$3,543	\$3,247
California	\$792	<u>\$554</u>	\$238	\$67	\$4,466	\$5,325	\$4,771
Massachusetts	\$868	<u>\$608</u>	\$261	\$67	\$4,073	\$5,008	\$4,401
Oklahoma	\$583	<u>\$408</u>	\$175	\$67	\$2,763	\$3,413	\$3,005
Washington	\$682	<u>\$478</u>	\$205	\$67	\$4,086	\$4,835	\$4,358
Wisconsin	\$677	<u>\$474</u>	\$203	\$67	\$3,765	\$4,509	\$4,035

Key: bold: costs to worker

single underline: cost to government, such as job training. This does not include 3rd party reimbursements.

double underline: third party payments by government, such as food stamps and TANF/Workers' Compensation/health insurance

* Based on initial 2001 calculations and corrected for inflation

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014.

Table 8

**Quantifiable Costs Associated With Six Scenarios
Scenario II**

SCENARIO II											
State	Cost of Medical Services (Medicaid)	Other Out-of-Pocket*	Workers Comp as % of Wages	1 Year Temporary Total Disability WC Max	16 Months Food Stamps for Family of 3	Job Training	Lost Earnings for 16 Months	Total Cost of Worker Illness	Total 3rd Party Reimb	Govt Cost	Cost to Worker
Alabama	<u>\$2,005</u>	\$806	66.7%	<u>\$23,445</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$52,912	\$69,302	\$30,897	\$8,132	\$30,273
California	<u>\$3,764</u>	\$806	66.7%	<u>\$34,304</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$77,419	\$95,568	\$41,756	\$9,891	\$43,921
Massachusetts	<u>\$3,982</u>	\$806	60.0%	<u>\$28,140</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$70,600	\$88,967	\$35,592	\$10,109	\$43,266
Oklahoma	<u>\$2,558</u>	\$806	70.0%	<u>\$22,267</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$47,884	\$64,827	\$29,719	\$8,685	\$26,423
Washington	<u>\$3,366</u>	\$806	75.0%**	<u>\$35,288</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$70,825	\$88,576	\$42,740	\$9,493	\$36,343
Wisconsin	<u>\$4,126</u>	\$806	66.7%	<u>\$28,914</u>	<u>\$7,452</u>	<u>\$6,127</u>	\$65,256	\$83,767	\$36,366	\$10,253	\$37,148

Key: bold: costs to worker

single underline: cost to government, such as job training. This does not include 3rd party reimbursements.

double underline: third party payments by government, such as food stamps and TANF/Workers' Compensation/health insurance

* Based on initial 2001 calculations and corrected

** Maximum is used here (75%) State uses a range of 60%-75%

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014.

Table 8**Quantifiable Costs Associated With Six Scenarios
Scenario III**

SCENARIO III						
State	Cost of Medical Services	Medical Cost to Insurance	Medical Cost. to Worker	Other Out-of-Pocket*	Total Cost of Worker Illness	Cost to Worker
Alabama	\$1,300	\$910	\$390	\$806	\$2,106	\$1,196
California	\$2,549	\$1,784	\$765	\$806	\$3,355	\$1,571
Massachusetts	\$2,832	\$1,982	\$849	\$806	\$3,638	\$1,655
Oklahoma	\$1,697	\$1,188	\$509	\$806	\$2,503	\$1,315
Washington	\$2,257	\$1,580	\$677	\$806	\$3,063	\$1,483
Wisconsin	\$2,520	\$1,764	\$756	\$806	\$3,326	\$1,562

Key: bold: costs to worker
single underline: cost to government, such as job training. This does not include 3rd party reimbursements
double underline: third party payments by government, such as food stamps and TANF/Workers' Compensation/health insurance

* Based on initial 2001 calculations and corrected for inflation

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014

Table 8

**Quantifiable Costs Associated With Six Scenarios
Scenario IV**

SCENARIO IV									
State	Cost of Medical Services (Medicaid)	Other Out-of-Pocket*	Food Stamps for 1 for 12 months	Job Training	1 Year Lost Earnings	Total Cost of Worker Illness	Total 3rd Party Reimb	Govt Cost	Cost to Worker
Alabama	<u>\$5,544</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$39,684	\$56,847	<u>\$2,268</u>	<u>\$11,671</u>	\$42,908
California	<u>\$9,659</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$58,064	\$79,342	<u>\$2,268</u>	<u>\$15,786</u>	\$61,288
Massachusetts	<u>\$9,686</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$52,950	\$74,255	<u>\$2,268</u>	<u>\$15,813</u>	\$56,174
Oklahoma	<u>\$7,248</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$35,913	\$54,780	<u>\$2,268</u>	<u>\$13,375</u>	\$39,137
Washington	<u>\$8,516</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$53,119	\$73,254	<u>\$2,268</u>	<u>\$14,643</u>	\$56,343
Wisconsin	<u>\$13,919</u>	\$3,224	<u>\$2,268</u>	<u>\$6,127</u>	\$48,942	\$74,480	<u>\$2,268</u>	<u>\$20,046</u>	\$52,166

Key: bold: costs to worker
 single underline: cost to government, such as job training. This does not include 3rd party reimbursements.
 double underline: third party payments by government/Workers' Compensation

* Based on initial 2001 calculations and corrected for inflation.

Note: Had the worker collected workers compensation or unemployment insurance, the burden to the worker would have been lower and the burden to third party payments and government would have been more.

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014.

Table 8
Quantifiable Costs Associated With Six Scenarios
Scenario V

SCENARIO V										
State	Cost of Medical Service	Cost to Insurers	Cost to Worker	Other Out-of-Pocket	Six Months UI*	Six Months Lost Earnings	Six Months Lost Wages in Lower Paid Job**	Total Cost of Worker Illness	Total 3rd Party Reimb	Cost to Worker
Alabama	\$1,056	<u>\$ 740</u>	\$ 317	\$762	<u>\$ 6,890</u>	\$19,842	\$9,360	\$31,020	<u>\$ 7,630</u>	\$30,281
California	\$1,974	<u>\$1,382</u>	\$ 592	\$762	<u>\$11,700</u>	\$29,032	\$9,360	\$41,128	<u>\$13,082</u>	\$39,746
Massachusetts	\$2,180	<u>\$1,526</u>	\$ 654	\$762	<u>\$16,978</u>	\$26,475	\$9,360	\$38,777	<u>\$18,504</u>	\$37,251
Oklahoma	\$1,342	<u>\$ 940</u>	\$ 403	\$762	<u>\$16,692</u>	\$17,957	\$9,360	\$29,421	<u>\$17,632</u>	\$28,482
Washington	\$1,734	<u>\$1,214</u>	\$ 520	\$762	<u>\$15,158</u>	\$26,560	\$9,360	\$38,416	<u>\$16,372</u>	\$37,202
Wisconsin	\$2,021	<u>\$1,415</u>	\$606	\$762	\$9,438	\$24,471	\$9,360	\$36,614	<u>\$10,853</u>	\$35,199

Key: bold: costs to worker
single underline: cost to government, such as job training. This does not include 3rd party reimbursements.
double underline: third party payments by government, such as food stamps and TANF/Workers' Compensation

Note: Wages for brick masons are 24.8% higher than for cement mason, nationally. (See Table 1.) This table assumes that that percentage is the same across the country. Assumed in this scenario is that the brick mason later found a job at \$9/hour less than his brick mason job.

* This conservatively assumes the highest possible payment, which in most cases is unlikely; or up to full compensation for wage loss, which is also unlikely.

** This loss only represents the second half of the first year after he loses his job.

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014

Table 8

**Quantifiable Costs Associated With Six Scenarios
Scenario VI**

SCENARIO VI											
State	Cost of Medical Service (Medicaid)	Other Out-of-Pocket[^]	Food Stamps for Family of 8 for 26 weeks*	TANF 26 weeks^{^^}	Minimum Wage for 26 weeks**	26 Weeks Lost Earning for 1st 26 Weeks	Lost Wages Due to Reduced Wages for 2nd 26 Weeks	Total Cost of Worker Illness	Total 3rd Party Reimbursement	Govt Cost	Cost to Worker
Alabama	<u>\$1,180</u>	\$3,224	<u>\$6,822</u>	<u>\$1,290</u>	\$7,540	\$19,842	\$12,302	\$44,660	<u>\$ 8,112</u>	<u>\$1,180</u>	\$33,368
California	<u>\$2,274</u>	\$3,224	<u>\$6,822</u>	<u>\$3,072</u>	\$9,360	\$29,032	\$19,672	\$64,096	<u>\$ 9,894</u>	<u>\$2,274</u>	\$51,928
Massachusetts	<u>\$2,485</u>	\$3,224	<u>\$6,822</u>	<u>\$3,708</u>	\$8,320	\$26,475	\$18,155	\$60,869	<u>\$10,530</u>	<u>\$2,485</u>	\$47,854
Oklahoma	<u>\$1,525</u>	\$3,224	<u>\$6,822</u>	<u>\$1,752</u>	\$7,540	\$17,957	\$10,417	\$41,697	<u>\$ 8,574</u>	<u>\$1,525</u>	\$31,598
Washington	<u>\$2,001</u>	\$3,224	<u>\$6,822</u>	<u>\$2,868</u>	\$9,693	\$26,560	\$16,867	\$58,342	<u>\$ 9,690</u>	<u>\$2,001</u>	\$46,651
Wisconsin	<u>\$2,307</u>	\$3,224	<u>\$6,822</u>	<u>\$4,038</u>	\$7,540	\$24,471	\$16,931	\$57,793	<u>\$10,860</u>	<u>\$2,307</u>	\$44,626

Key: bold: costs to worker
 single underline: cost to government, such as job training. This does not include 3rd party reimbursements.
 double underline: third party payments by government, such as food stamps and TANF/Workers' Compensation

Note: Laborer wages are 86.3% that of cement mason wages, nationally. (See Table 1.) Assumed here is that this ratio is the same across the country.

- [^] Based on initial 2001 calculations and corrected for inflation
- * <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014.
- ^{^^} These numbers are low as they are based on a family of 3 for the last year available.
- ** The national minimum wage is \$7.25. In California, it is \$9 per hour; in Massachusetts, it is \$8 per hour; and in Washington State, \$9.32.

Sources: Tables 9 and 10 of this report; <http://www.fns.usda.gov/snap/how-much-could-i-receive>, retrieved July 25, 2014

Table 9

**Average Annual Wages and Earnings, by State,
for Cement Masons and Concrete Finishers,
2013**

	Average Annual Wage (May 2013)	Average Annual Earnings* (August 2013)
Alabama	\$35,150	\$39,684
California	\$51,430	\$58,064
Massachusetts	\$46,900	\$52,950
Oklahoma	\$31,810	\$35,913
Washington	\$47,050	\$53,119
Wisconsin	\$43,350	\$48,942
National Average	\$44,510	\$50,252

*Average hourly earnings for cement masons and concrete finishers are assumed, in this table, to have the same relationship to mean hourly wage, as for construction employment generally. It is also assumed that that ratio is the same across the six states studied. Hence, earnings are calculated to have the same ratio as \$24.17 for average hourly earnings and \$21.40 for mean hourly wage; i.e. 1.129. "Occupational Employment Statistics" of the Bureau of Labor Statistics calculates annual mean wages as 2080 hours of hourly mean wage.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, May 2013 State Occupational Employment and Wage Estimates, <http://www.bls.gov/oes/current/oesrcst.htm>, retrieved September 2014; U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, <http://www.bls.gov/news.release/empsit.t24.htm>; http://www.bls.gov/oes/2013/may/oes_nat.htm#47-0000, retrieved September 2014.

Table 10

Workers' Compensation Payments for Lost Wages

**Percent of Weekly Wage &
Likely Annual Workers' Compensation Payment
for Cement Masons and Concrete Finishers
Temporary Total Disability***

State	% of Weekly Wage	Average Annual Wage	Likely Annual Workers Compensation Payment
Alabama	66.7%	\$35,150	\$23,445
California	66.7%	\$51,430	\$34,304
Massachusetts	60.0%	\$46,900	\$28,140
Oklahoma	70.0%	\$31,810	\$22,267
Washington	60.0% - 75.0%	\$47,050	\$28,230 - \$35,288
Wisconsin	66.7%	\$43,350	\$28,914

Source: U.S. Bureau of the Census, "Construction & Housing: Construction Industry, Table 961," for 2007, 2008, Internet release date September 30, 2011, September 30, 2011, *2012 Statistical Abstract*.

Note: Numbers based on 2007 Economic Census, as reported in *2012 Statistical Abstract* (so numbers differ somewhat from 2007 Economic Census numbers as reported in earlier versions of this study).

*Most recent data available

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Table 11

Unemployment Compensation Benefits in Six States

State	Weekly Benefit Amount	
	Minimum	Maximum
Alabama	\$45	\$265
California	\$40	\$450
Massachusetts	Approx. 50 percent of average weekly wage	\$674
Oklahoma	\$16	\$440
Washington	\$151	\$637
Wisconsin	\$54	\$370

Note: Most recent data available on line. Therefore, not all amounts are for the same calendar year

Sources:

Alabama: Alabama Department of Labor, "Claims and Benefits FAQ," <http://labor.alabama.gov/uc/claims.aspx#q6>, retrieved July 21, 2014.

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Table 12

**Approximate Temporary Assistance to Needy Families Payments (TANF)
for Six Selected States**

State	Approximate Monthly Payment
Alabama	\$215
California	\$512
Massachusetts	\$618
Oklahoma	\$292
Washington	\$478
Wisconsin	\$673

Note: These amounts are for a family of 3. Data for a family of 8 were not available for all states (but for Alabama, a family of 8 would receive \$365 per month rather than \$215), so the numbers provided here are likely to be lower than actual for Scenario VI.

Sources:

Alabama: Alabama State Department of Human Resources, "Temporary Assistance for Needy Families (TANF) State Plan Renewal October 1, 2011 - September 30, 2013," http://dhr.alabama.gov/services/FamilyAssistance/Documents/StatePlan_2013.pdf, and National Center for Children in Poverty (NCCP), State Profiles, "Temporary Assistance for Needy Families (TANF) Cash Assistance," http://www.nccp.org/profiles/AL_profile_36.html, retrieved July 21, 2014.

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Washington State: Washington State, "TANF and Support Services," http://www.dshs.wa.gov/onlinecso/TANF_Support_Services.shtml, retrieved August 2014.

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Appendix 1

Methodology

The initial research paper, completed in 2002, supported the overall work of a NIOSH-supported study by The Center to Protect Workers' Rights (now CPWR – The Center for Construction Research and Training). In testing an intervention to reduce occupational dermatitis and cement burns in construction workers who are exposed to wet portland cement, CPWR also assessed the costs of the intervention and the comparative costs of non-prevention; i.e., disease and burns. This paper is an update of the original study.

The challenges of this paper, methodologically, are:

1. To estimate the number of construction workers exposed to wet portland cement
2. To estimate the number of exposed construction workers who experience cement burns and contact dermatitis
3. To estimate the number of exposed construction workers who develop allergic dermatitis
4. To estimate the number of lost work days associated with cement related skin disease
5. To estimate the average wage and earnings for the affected crafts
6. To estimate the medical costs associated with cement-related skin problems
7. To estimate non-medical costs, such as lost wages, disability insurance, unemployment insurance, and Workers' Compensation
8. To estimate lost productivity to employers
9. To determine the best gloves to use and their cost
10. To estimate the costs of pH neutralizing soaps and solutions.
11. To update all aspects of the paper from data initially collected and analyzed in 2000, 2002, and 2012.

For numbers 1 through 3 above, the authors of this report relied on data from the Bureau of Labor Statistics, the Census, and other published literature. Estimation of medical and non-medical costs and of costs for gloves on the job, involved several steps:

- Six scenarios were created to outline possible sequential events leading to development of irritant or contact dermatitis or burns in workers exposed to wet cement at work. Cement masons, bricklayers, and laborers are most often exposed to wet cement, and workers from these trades are in the scenarios. The scenarios acknowledge that different workers exposed to wet cement will exhibit differences in the severity and type of dermatitis they develop due to variations in individual susceptibilities, duration of exposure, use of PPE, and the stage at which successful medical diagnosis of their condition and the appropriate medical intervention occurs.
- Acknowledging a range of costs for the same treatment, based on geographic location of treatment, each scenario has six associated costs. These costs are based on zip codes across the country which range in level of expense. The six locations are in Foley, Alabama; Los Angeles, California; Brookline, Massachusetts; Stilwell, Oklahoma; Seattle, Washington; and Milwaukee, Wisconsin. (There is no importance in the specific choice of zip codes. The

objective was simply to display the wide variation in medical costs and insurance reimbursement across the country.)

- To determine medical costs associated with cement dermatitis, the Current Procedural Terminology (CPT),¹⁶⁸ was used to identify codes used in the medical insurance industry for services and procedures associated with diagnosis and treatment of dermatitis. Medical utilization software was used to determine, to the extent possible, the 80th. percentile of cost (most commonly used by insurance companies) for the appropriate medical treatment and service codes in the six zip codes previously identified.
- Costs to worker and family can be significant; e.g., lost wages, out-of-pocket medical expenses, inability to do other activities. Lost wages may be for lost work time; they may be for lower wages if a person must leave their trade and seek another job, often requiring lower skill levels, at least until such time as retraining and/or additional education can be obtained. (Out-of-pocket medical expenses are likely to be higher for many workers, as the reimbursement model assumes the worker has insurance.)
- Compensation costs for workers afflicted with cement-related skin disease were estimated. A worker with unresolved dermatitis may be unable to continue work, and become eligible for Workers' Compensation, unemployment benefits, Medicaid, food stamps, SSI disability, or a job retraining program. If the worker has severe dermatitis and is unable to acquire skills to change his trade in order to avoid exposure to cement, he/she may have to go on total disability. An affected worker may need the help of a public sector job retraining program. These costs were estimated for each scenario in each geographic location.
- Data on lost time away from work and federal earnings statistics were used to estimate lost wages. Lost productivity is based on time away from a job, when the affected worker is expected to return to the job site.
- The costs of pH neutralizing products is from information from suppliers and their literature and web site information.
- Finally, because costs may be borne by the affected workers, employers, insurers, and the public sector, the burden on each major group is estimated.

Note: All tables are subject to rounding errors.

¹⁶⁸ The CPT is published by the American Medical Association. It is a listing of descriptive terms and identifying codes for reporting medical services and procedures performed by physicians. CPT is the most widely accepted nomenclature for the reporting of physician procedures and services under government and private health insurance programs. CPT is also useful for administrative management purposes such as claims processing and for development of guidelines for medical care review.

Appendix 2

Job Descriptions of Selected Occupations Of Those Working with Wet Portland Cement

A. Cement Masons

The job of cement masons is to pour, smooth, and finish concrete floors, sidewalks, roads, and curbs.¹⁶⁹ They may also color concrete surfaces, expose aggregate in walls and sidewalks, or fabricate concrete beams, columns, and panels. In preparing a site for placing concrete, cement masons first set the forms for holding the concrete to the desired pitch and depth and properly align them. Masons then guide a straightedge back and forth across the top of the forms to “screed,” or level, the freshly placed concrete. Immediately after leveling the concrete, masons smooth the concrete surface with a “bull float,” a long-handled tool about 8 by 48 inches that covers the coarser materials in the concrete. Sometimes masons perform all steps of laying concrete, including the finishing.

B. Concrete Finishers

Concrete finishers continue after cement masons have leveled and floated the concrete. They press an edger between the forms and the concrete and guide it along the edge and the surface to create a smooth finish. On concrete surfaces that will remain exposed after forms are stripped, cement masons fill any large indentations with a portland cement paste and smooth the surface with a rubbing carborundum stone. Finally, they coat the exposed area with a rich portland cement mixture using either a special tool or a coarse cloth to rub the concrete to a uniform finish.

C. Terrazzo Workers

Terrazzo workers, using a cement mixture, create durable and decorative surfaces for floors and stairways.¹⁷⁰ Terrazzo workers create attractive walkways, floors, patios, and panels by exposing marble chips and other fine aggregates on the surface of finished concrete. Much of the preliminary work of terrazzo workers is similar to that of cement masons. Most terrazzo requires three layers of materials. First cement masons or terrazzo workers build a solid, level concrete foundation that is 3 to 4 inches deep. After the forms are removed from the foundation, workers add a 1-inch layer of sandy concrete. Before this layer sets, terrazzo workers partially embed metal divider strips into the concrete wherever there is to be a joint or change of color in the terrazzo. For the final layer, terrazzo workers blend and place into each of the panels a fine marble chip mixture. They then hand trowel each panel until it is level with the tops of the

¹⁶⁹ U.S. Department of Labor, Occupational Handbook: Cement Masons and Terrazzo Workers, <http://www.bls.gov/ooh/construction-and-extraction/cement-mason-and-terrazzo-workers.htm>, April 26, 2012, retrieved June 17, 2012.

¹⁷⁰ Ibid.

ferrule strips. While the mixture is still wet, workers toss additional marble chips of various colors into each panel and roll a lightweight roller over the entire surface. Finally, they grind, buff, and polish the terrazzo.

D. Brickmasons, Blockmasons and Stonemasons

Brickmasons, blockmasons, and stonemasons work with bricks, concrete blocks, and natural stones to build fences, walkways, walls, and other structures.¹⁷¹ Their work varies, from laying a simple masonry walkway to installing an ornate exterior of a high-rise building. Bricklayers build walls, floors, partitions, fireplaces, chimneys, and other structures with brick, precast masonry panels, concrete block, and other masonry materials. When building a structure, bricklayers begin by constructing a pyramid of bricks—called a lead—at each corner of a wall, around which the rest of the bricks are laid. After the corner leads are complete, less experienced bricklayers fill in the wall between the corners, using a line from corner to corner to guide each course, or layer, of brick. Bricklayers spread a bed of mortar (a cement, sand, and water mixture) with a trowel (a flat, bladed metal tool with a handle), place the brick on the mortar bed, and then press and tap the brick into place. Depending on blueprint specifications, bricklayers either cut bricks with a hammer and chisel or saw them to fit around windows, doors, and other openings. Then, mortar joints are finished with jointing tools for a sealed, neat, uniform appearance.

Stonemasons build stone walls, as well as set stone exteriors and floors. Stonemasons usually work on nonresidential structures, such as houses of worship, hotels, and office buildings. When building a stone wall, masons set the first course of stones into a shallow bed of mortar. They then align the stones with wedges, plumb lines, and levels, and adjust them into position with a hard rubber mallet. Masons continue to build the wall by alternating layers of mortar and courses of stone. As the work progresses, masons remove the wedges, fill the joints between stones, and use a pointed metal tool called a tuck pointer, to smooth the mortar to an attractive finish. To hold large stones in place, stonemasons attach brackets to the stone and weld or bolt these brackets to anchors in the wall. Finally, masons wash the stone with a cleansing solution to remove stains and dry mortar.

E. Laborers

Construction craft laborers are skilled workers who provide much of the physically demanding labor at construction projects, tunnel and shaft excavations, hazardous waste removal projects, and demolition sites. They clean and prepare sites, dig trenches, mix and place concrete, and set braces to support the sides of excavations. Construction craft laborers may also assist other craft workers. Construction craft laborers operate a variety of equipment including concrete mixers.

¹⁷¹ U.S. Department of Labor, Occupational Handbook: Brickmasons, Blockmasons, and Stonemasons, <http://www.bls.gov/ooh/construction-and-extraction/brickmasons-blockmasons-and-stonemasons.htm>, March 29, 2012, retrieved June 17, 2012.

Many of these workers belong to the Laborers' International Union of North America, International Union of Bricklayers and Allied Craftsmen, Operative Plasterers' and Cement Masons' International Association, or the United Brotherhood of Carpenters and Joiners.

F. Workers in Construction Generally

Many construction workers – whether residential, commercial, heavy highway, or other – work with wet portland cement at some time. Clearly there are more workers exposed to wet portland cement than those who specialize in the trade.

