Welcome

Welcome to this week’s edition of BC Disease News.

In this issue, we examine the judgment of Goldscheider v the Royal Opera House Covent Garden Foundation [2018] EWHC 687 (QB), in which the claimant was successful in bringing a claim for occupationally-induced acoustic shock.

We also report on the High Court authority of Nash v Ministry of Defence [2018] EWHC B4 (Costs), in which the Costs Master considered whether ‘good reason’ to depart from budgeted costs was provided by revisions to the hourly rate of incurred costs.

Elsewhere, we highlight a new study which has associated smoking with an increased risk of hearing loss at 4 kHz.

This week’s feature is the final segment of our emerging risks in agriculture series, in which we consider research into occupational conditions associated with ‘fracking’, and highlight advances in technology which may improve workplace safety.

Any comments or feedback can be sent to Boris Cetnik or Charlotte Owen.

As always, warmest regards to all.

SUBJECTS

Acoustic Shock: 
Goldscheider v the Royal Opera House Covent Garden Foundation [2018] EWHC 687 (QB)

A musician has been successful at the High Court in claiming damages for acoustic shock, onset by occupational exposure to noise. Goldscheider v the Royal Opera House Covent Garden Foundation [2018] EWHC 687 (QB) is the first instance of success for a musician bringing a claim of this type. However, Nicola Davies J, in handing down judgment, said it is ‘not uncommon’ for musicians to complain about noise levels and employers have attempted to take precautionary measures to reduce claims associated with hearing loss.

The claimant, a professional orchestral viola player, suffered aural damage during a rehearsal of Wagner’s Ring Cycle at the Opera House, on 1 September 2012. During a rehearsal session, he was positioned in front of 18 to 20 brass instrument players. Although the claimant had played in orchestras throughout his professional life: ‘... the sensation from so many brass instruments playing directly behind him, in a confined area, at the same time at different frequencies and volumes, created a wall of sound which was completely different to anything he had previously experienced.

The lack of space and the proximity of the trumpets to the claimant’s ears meant that he was in the brass section’s ‘direct line of fire’. It was excruciatingly loud and painful. His right ear was particularly painful because the principal trumpet was ‘directed at that side of his head’.

The injury suffered ‘prevented his return to music’. Subsequently, the claimant brought a claim against his employer, the ROH, on the grounds that it had breached its obligations to protect its employees under common law, the Control of Noise at Work Regulations 2005 and other regulations. He claimed to have been exposed to a maximum daily dose of 87 dB(A) and/or a maximum peak sound pressure level of 140 dB(C).

WHAT IS ACOUSTIC SHOCK?

The judge described acoustic shock as ‘an index exposure to any sound or cluster of sounds of short duration but at a high intensity reflects and is consistent with the evidence of the claimant as to the playing of the principal trumpet at or close to his right ear. It is a relatively new and thus far primarily associated with reports emanating from call centres’. In edition 109 of BC Disease News [here], we examined whether acoustic shock could be directly caused by unexpected noise exposure.

As a result of the ‘newness’ of the condition, ‘Mr Jones, the defendant’s expert who retired from clinical practice some five and a half years ago, was dismissive of the concept’.

Irrespective of this, the judge did not ‘regard the absence of reported cases of acoustic shock amongst professional musicians as being determinative on this issue of causation. Medical learning and knowledge is an evolving concept.

The injury was consistent with the fact that ‘the sound or sounds would have been unexpected because the claimant had only his own musical part in front of him, the trumpet player had his own part’.

COULD THE DEFENDANT BE EXPECTED TO TAKE PREVENTATIVE ACTION FOR ACOUSTIC SHOCK?

Until Goldscheider, there had never been a case of acoustic shock brought by a music industry employee. As such, the ‘extensive available guidance’ did not recognise the risk of acoustic shock.

Davies J, at paragraph 170, explained the defendant’s position, namely that it ‘should reasonably have been governed by the risk of established conditions, namely noise-induced hearing loss, associated with long term exposure, or the risk of acoustic trauma, associated with a peak exposure in excess of 135 dB(C)’.

She went on to explain the position of the defendant, that:

‘Exposure at 90 dB(A) Leq on a daily basis would only be expected to cause a small amount of noise-induced hearing loss after a period of ten years. There was no foreseeable risk of injury posed by such a level of exposure in the context of a single day’s rehearsal, particularly when hearing protection was worn’.

In any event, the claimant had been fitted with ‘custom-moulded earplugs’, shortly after joining the ROH, in 2002. Additional foam earplugs, providing enhanced protection, were provided at the entrance to the orchestra pit.

However, finding in favour of the claimant, Davies J concluded, at paragraph 229:

‘I am satisfied that the noise levels at the afternoon rehearsal on 1 September 2012 were within the range identified as causing acoustic shock. The index exposure was the playing of the principal trumpet in the right ear of the claimant whether it was one sound or a cluster of sounds of short duration. It was that exposure which resulted in the claimant sustaining acoustic shock which led to the injury which he sustained and the symptoms which have developed, from which he continues to suffer’.

The full text judgment can be accessed [here].
Good Reason’ to Depart from a CMO Revisited: Nash v Ministry of Defence [2018] EWHC B4 (Costs)

In this article, we report on the case of Nash v Ministry of Defence [2018] EWHC B4 (Costs) on costs at detailed assessment. Previously, in edition 197 (here) of BC Disease News, we reported on the decision in RNB v London Borough of Newham [2017] EWHC B15 (Costs), which also ruled on ‘good reason’ to depart from a costs management order (CMO). The appeal decision of RNB had been expected, but the case since settled and has not been heard.

In summary, this line of case law questions ‘...whether a costs judge, who reduces the hourly rates for incurred costs, should then do the same to budgeted costs?’ In recent case law, there has been uncertainty over the extent to which costs judges may fetter the orders of judges at costs and case management. Are incurred costs to be treated in the same way as costs to be incurred?

In RNB, Deputy Master Campbell ruled that, ‘reducing the hourly rates for incurred costs meant there was a “good reason” to reduce the budgeted costs too.’

However, in Bains v Royal Wolverhampton NHS Trust (unreported), which we later discussed in edition 201 (here), District Judge Lumb ‘expressly disagreed’ with the judgement of Master Campbell.

The most recent case of Nash was heard by Master Nagalingam in the Senior Courts Costs Office a fortnight ago, at detailed assessment. A costs management order had been made, reflecting the parties’ position of agreement, with respect to budgets. The claimant had spent less than the CMO had allowed for in certain phases and spent more in others. However, it was acknowledged by the claimant that an agreed budget could only be departed downwards, absent of good reason.

Since April of 2017, the latest iteration of CPR 3.18 has provided judges at detailed assessment with the following powers:

<table>
<thead>
<tr>
<th>Assessing costs on the standard basis where a costs management order has been made</th>
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<td>3.18 In any case where a costs management order has been made, when assessing costs on the standard basis, the court will —</td>
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<td>(a) have regard to the receiving party’s last approved or agreed budgeted costs for each phase of the proceedings;</td>
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<tr>
<td>(b) not depart from such approved or agreed budgeted costs unless satisfied that there is good reason to do so; and</td>
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<td>(c) take into account any comments made pursuant to rule 3.15(4) or paragraph 7.4 of Practice Direction 3E and recorded on the face of the order.</td>
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Defendant counsel argued that, where Master Nagalingam had earlier reduced the hourly rates for incurred costs, there was ‘good reason to apply the same reduced rates to the ‘budgeted’, i.e. future costs’. Thus, it was submitted that the newly assessed hourly rate could be retrospectively applied to reduce the future costs, which were ‘merely recorded’ by the case managing judge unconscritised.

The result of this, if the defendant was successful, was that the claimant would be restricted to a recalculated total of budgeted costs, where the claimant had spent more than the agreed budget, and receive the lower figure, at a recalculated rate, where they had spent less than the agreed budget.

Counsel for the defendant also submitted that the parties agreed that the hourly rates, applied to the budgeted costs, were at the discretion of the costs judge at detailed assessment. Whereas, counsel for the claimant argued that its client, in agreeing aspects of future costs, did not seek to exclude hourly rates from that agreement.

Under the iteration of CPR 3.15, which was in force when the CMO was made, judges at case management were required to ‘record the extent to which the budgets are agreed between the parties’.

This was consistent with Practice Direction 3E, paragraph 7.4:

‘If the budgets or part of the budgets are agreed between all parties, the court will record the extent of such agreement’.

Correspondence with the CMC, prior to the conference before the case management judge, specified:

‘... the parties have been able to agree budgets’.

The simplicity of this direction, it was observed, signified a basic agreement, namely that there had been an agreement ‘in full’.
The judge found in favour of the claimant, in respect of the terms of agreement, but this did not prevent the costs judge from considering ‘good reason’ to depart from the budgeted costs, at detailed assessment, pursuant to discretionary powers conferred by CPR 3.18(b).

Firstly, when tackling the existence of ‘good reason’, the judge sought to clarify that ‘when the parties agreed budgets, they were agreeing to fix a budget for future costs whilst accepting that incurred costs could be the subject of detailed assessment’. In addition, ‘... a costs management order may only arise in circumstances where the approved budgeted (future) costs are deemed to be proportionate by the case managing judge’.

Under PD 3E paragraph 7.4 (2016):

As part of the costs management process the court may not approve costs incurred before the date of any budget. The court may, however, record its comments on those costs and will take those costs into account when considering the reasonableness and proportionality of all subsequent costs (2016).

As such, Master Nagalingam explained, at paragraphs 56 and 57:

'The effect of the practice direction ... is to provide the case managing judge with a discretion to record comments on the costs management order relating to incurred costs, but provides a mandatory requirement for the case managing judge to take into account the incurred costs before making a costs management order of what amounts are reasonable and proportionate in terms of the subsequent costs.

The case managing judge is aware that the incurred costs are subject to detailed assessment and therefore approves a budget for subsequent costs. The court thus has an opportunity to assess the costs management order. If the court finds that the costs are not proportionate, the order can be revised.

The judge went on to emphasise that the purpose of costs budgeting is to increase certainty and reduce the costs of dealing with future assessment of costs. Thus, certainty is eroded if hourly rates are given form status. That certainty is entirely eroded if hourly rates are then given a form of special status which requires rates to be assessed in the estimated phases of a bill of costs.

CPR 3.15(3) provides that:

If a costs management order has been made, the court will thereafter control the parties’ budgets.

That control is on the amount of money the parties spend, not how they spend it.

By way of example, if a party budgets for 10 hours at £500/hr plus £2,000 on Counsel for future costs in the disclosure phase, the total of £7,000 is exactly the same as if the same party had budgeted for 100 hours at £50/hr plus £2,000 on Counsel. If £7,000 is approved for the budgeted (future) costs total, then the court will not interfere with
how that money is spent without good reason.

A budget approved in these terms does not, for example, compel that party to spend £2,000 on Counsel for future costs relating to disclosure or use the fee earners anticipated when the budget was drawn. Similarly, it does not limit that party to spend £2,000 on Counsel for future costs relating to disclosure.

The budget is set following the making of a costs management order, and Solicitors must thereafter cut their cloth accordingly.

Taking the example above, where a rate of £500/hr is reduced to £100/hr in the incurred costs, it cannot be logical for a budget claiming 10 hours at £500/hr plus £2,000 for Counsel (total £7,000) to be reduced to £3,000 on assessment but where a budget claiming 100 hours at £50/hour plus £2,000 for Counsel (total £7,000) would suffer no reduction at all (where say £7,000 is claimed in that phase in the bill of costs).

This decision follows Bains, but has the same High Court status as RNB. A Court of Appeal decision is needed to clarify the position on whether the changing of hourly rates for incurred costs supplied ‘good reason’ to depart from the budgeted costs.

Despite this finding, the judge highlighted that the defendant could still argue ‘that the overall sum of assessed incurred costs plus budgeted costs is disproportionate such that the overall sum should be reduced’, pursuant to CPR 44.3(2)(a):

(2) Where the amount of costs is to be assessed on the standard basis, the court will –
(a) only allow costs which are proportionate to the matters in issue. Costs which are disproportionate in amount may be disallowed or reduced even if they were reasonably or necessarily incurred; and

The full text judgment can be found here.

Asbestos-Related Injury Settlements

In this article, we discuss news of claimant settlement success in two asbestos-related claims, both of which were disseminated last week³.

Firstly, it was reported that a claimant law firm had been successful in bringing an asbestosis/pleural thickening claim 20 or 30 years out of time, securing settlement of £57,000. The deceased began work as an apprentice, aged 14, in 1941. He remained an employee of the same employer for the rest of his career. His job involved the removal of asbestos lagging from pipework and repair work. The defendant employee had faced hundreds of similar claims, which were documented in the personnel file. In 2017, a post mortem of the deceased revealed that, although there was no evidence of mesothelioma, there was ‘clear evidence of asbestosis and a very high level of asbestos fibres’.

The eventual settlement of £57,000 was reduced from the overall likely value of claim (£98,000). The reasoning behind this reduction was to account for unpursued periods of exposure and the risk of failing to persuade the court to exercise its discretion, under s.33 of the Limitation Act 1980, and proceed with the claim out of time. The defendant could not established that it had been any more prejudiced than if the claim had been brought within the limitation period.

A partner of the claimant firm believes that larger businesses would not have pursued the claim:

‘Some of the huge asbestos law firms have very strict protocols about what they can and can’t accept and it’s unlikely that any of these firms would have been able to help Mr R [the Claimant] when he was diagnosed with suspected mesothelioma more than 30 years after he was first diagnosed with asbestosis, and more than 40 years since he was diagnosed with asbestos-related changes in his lungs’.

Elsewhere, in the same week, it was reported that another firm had reached a ‘ground-breaking’ settlement, with insurers to cover existing mesothelioma treatment and ‘future unidentified treatments’. The 2nd settlement involved a 63 year old claimant, who developed peritoneal mesothelioma during the course of his employment at the North Eastern Gas Board, between 1969 and 1980. The claimant’s work involved stripping asbestos lagging from pipework and boilers in offices, factories and mills. Was also required to sweep up the dust generated by asbestos lagging. A partner of the claimant firm instructed in this claim stated:

‘We had previously secured a deferred periodical payments order for another client which ensured his cancer treatment costs would be covered regardless of their amount or the length of support he needed. However, this settlement for James builds on this further, as it includes the extra element of covering future unidentified treatments even if they are not currently on the medical radar at present. The ultimate benefit of such an agreement is simply peace of mind, as it ensures that our client does not face uncertainty regarding his access to treatment. Furthermore, with new treatments constantly in development but costs also
‘This prosecution highlights the health risks from using vibratory tools and the importance of employers having a health surveillance programme in place. Where vibratory tools are used, employers should monitor the health of employees using them and ensure appropriate systems are in place to manage and control the risk from vibration.’

Smokers at Increased Risk of Hearing Loss at 4 kHz

A new study has found that smokers may be at an increased risk of hearing loss, particularly at 4 kHz. To the researchers’ knowledge, this is the largest study to date, which has investigated the association between smoking and incident hearing loss.

The participants in the study were 50,195 Japanese employees, who were free of hearing loss at the start of the study. Pure-tone audiometry was performed annually, for up to 8 years, to identify hearing loss at 1 kHz and 4 kHz.

In follow up investigations, 3,532 individuals were found to have developed high-frequency hearing loss, and 1,575 developed low-frequency hearing loss.

Current smokers were 1.6 times more likely than individuals who had never smoked to develop hearing loss at 4 kHz, and 1.2 times more likely to develop hearing loss at 1 kHz. Further, the risk of both high- and low-frequency hearing loss increased with the number of cigarettes smoked per day.

There was a small increase in the risk of high-frequency hearing loss, but not low-frequency hearing loss, among former smokers. The analysis of data from former smokers showed that the risk of hearing loss reduced after stopping smoking, even among those who stopped just 5 years prior to the start of the study.

Consequently, researchers concluded that smoking is associated with increased risk of hearing loss, especially at the higher frequency, in a dose-response manner, and that the excess risk of hearing loss associated with smoking disappears in a relatively short period after quitting. Further research is required to supplement these findings.

New Study Shows 4 in 10 Cancer Cases Could be Prevented

A new study, led by Cancer Research UK, has found that more than 135,000 cases of cancer could be prevented in the UK each year, largely through lifestyle changes. This corresponds to nearly 4 in 10 cases. Analyses like this have been done before, but the new research uses all the latest available data and evidence to give more accurate estimates.

There are many factors that may contribute to cancer development, and they can be broadly classified as those people can control, and those they cannot. Factors that cannot be controlled include inherited genes and random genetic changes (bad luck), and factors that can be controlled include exposures to agents known to be carcinogenic.

In the study, population attributable fractions (PAFs) were calculated for combinations of risk factor and cancer type where there is some evidence of causation, e.g. smoking and lung cancer, and obesity and bowel cancer. The increased risks of exposure were calculated by comparing the risk of exposed people developing the cancer to the risk of unexposed people, and the numbers of people affected were determined by considering the numbers of people exposed to each risk factor.

Tobacco smoking contributed by far the largest proportion of attributable cancers, followed by being overweight or obese. Other factors that contributed to the burden of cancer in the UK were diet, exposure to the sun, exposure to substances at work, infections and alcohol consumption.
Congenital Effects of Common Chemical Exposure

A new review covers recent findings on chemicals that disrupt thyroid hormone function and their effects on brain development. The review describes how numerous common chemicals can interfere with normal thyroid hormone actions in pregnant women, which are essential for normal brain development in foetuses and young children.

Thyroid hormone is essential for normal brain development, where it influences a number of processes that occur during early pregnancy, after birth, and throughout life. During the first 10 to 12 weeks of pregnancy, a foetus depends entirely on its mother for thyroid hormone. Hence, severe maternal thyroid hormone deficiency may affect the neurodevelopment of the foetus. In fact, recent epidemiological studies have shown that only moderate disruption of thyroid hormones in the mother is sufficient to increase the risk of neurodevelopmental disorders in the child. Endocrine disrupting chemicals (EDCs) can disrupt thyroid function, and the review aimed to discuss how different EDCs can affect brain development.

Chemicals discussed in the review include perchlorate, phenols, pesticides, polychlorinated-biphenyls (PCBs), polybrominated flame-retardants, perfluorinated compounds (PFCs), and phthalates. Many substances falling into these categories have been banned, but remain environmentally relevant, due to the high volumes that were produced and their long persistence in the environment.

For each chemical class considered, the reviewers discuss the thyroid hormone disrupting effects and the main mechanisms by which they could modify hormone signaling and lead to developmental effects.
The reviewers conclude that their report adds to the established knowledge on the importance of iodine and thyroid hormone in brain development in offspring. They propose that prenatal exposure to mixtures of thyroid hormone-disrupting chemicals provides a plausible biological mechanism contributing to current increases in incidence of neurodevelopmental conditions, including autism spectrum disorder and attention deficit hyperactivity disorders.

Feature: Emerging Risks in Agriculture – Part 4: Technology and Fracking

Over the course of the previous three feature articles on Emerging Risks in Agriculture, we considered the latest information on respiratory, cardiac and mental health conditions and disorders; the impact of workplace exposure to biological chemical and physical agents; and the effect of environmental and demographic factors on worker health.

In this, our final instalment of the series, we provide an overview of the research into occupational conditions onset by hydraulic fracturing, or ‘fracking’, and also highlight advances in technology which may help to enhance workplace safety.

TECHNOLOGY

During 2017, A HSE report on information communication technology identified an ageing workforce, skills deficits and labour shortages as challenges facing farming, and further reported that technological solutions are emerging to deal with these challenges.

ROBOTICS

Most new research into work with robots focuses on safety and accidents, rather than health and diseases.

In September of 2017, NIOSH created the Centre for Occupational Robotics Research (CORR). The objectives of the project are to evaluate the potential benefits and risks of robots in the workplace, conduct workplace interventions to prevent robot-related worker injuries, and develop guidance for safe interactions between humans and robots. In October of 2017, three NIOSH researchers presented information about the application of robotics in the workplace, at the National Robot Safety Conference (USA).

NIOSH have also considered whether wearable exoskeletons will reduce or create hazards. These devices, ranging from whole-body suits to gloves, can reduce some of the mechanical stresses attributed to manual labour. However, potential risks associated with the exoskeleton include:

- Increased pressure on the chest;
- Increased load on the spine due to the weight of the device;
- Pressure wounds or compressed nerves due to poor fit of the device; and
- Spread of contagious diseases if many people use the same device and hygiene is poor.

Nevertheless, potential uses of robotics in agriculture include:

- Static milking robots;
- Mobile dairy farm robots;
- Autosteer tractors (more than 300,000 tractors equipped with autosteer or tractor guidance were sold in 2016);
- Autonomous tractors;
- Unmanned spraying drones;
- Autonomous data mapping drones;
- Robotic implements for de-weeding;
- Autonomous de-weeding mobile robots;
- Robotic fresh fruit harvesting (such as a machine that picks oranges);
- Robotic strawberry harvesting; and
- Manned and unmanned robotic lettuce/vegetable thinning/harvesting.
It was reported, earlier in 2017, that researchers in Shropshire were able to sow and harvest a field of barley using only robots. Estimates, produced by the International Federation of Robotics, show that, by 2018, global sales of industrial robots will grow by 15% each year, with 70% of sales recorded in China, Japan, USA, South Korea and Germany.

3D PRINTING

In edition 224 of BC Disease News (here), we discussed that 3D printers had emitted potentially hazardous ultrafine particles and volatile organic compounds. Working more than 40 hours each week with 3D printers was significantly associated with diagnoses of asthma or allergic rhinitis.

Last year, the European Agency for Safety and Health at Work published an expert review that provided a brief introduction to 3D printing and examined its risks. Occupational health and safety challenges related to 3D printing include:

- Gas and material exposures;
- Material handling;
- Static electricity;
- Moving parts; and
- Pressures.

The European Agency report noted that most materials used in 3D printing are known, and so are their effects on health. It provided an overview of the uses of 3D printing. Not more than 1% of the population owns a 3D printer. The majority of 3D printed products are manufactured at home and distributed within the sharing economy. Industrial 3D printing occurs less than home production. As an example, the economic contribution of the entire 3D printing industry in the Netherlands in 2015 was estimated at around €45 million, making up 0.005% of the country’s total gross national product. However, 3D printing is currently being encouraged as a way for farmers to develop and repair their own tools, in an effort to save expense. In January of 2017, it was reported that rural workers in Myanmar, have been using 3D printing as a means to design new sprinkler systems and water pumps.

Another application of 3D printing is the bioprinting of organic and/or living tissue, whereby organic matter can be built up by printing thin layers of cells. There have been numerous successful experiments of printing ‘living’ materials containing fungus or algae. However, this technique poses risks to health and hygiene and raises ethical issues. Last year, the Brazilian organisation, Embrapa Genetic Resources and Biotechnology’s Laboratory of Nanobiotechnology (LNANO), has recently had an application approved to use bioprinting in agricultural research.

Overall, the European Agency report concluded that the everyday impact of the 3D printer on physical safety in the workplace is likely to be limited.

However, a recent NIOSH study, comparing the printer emissions from the most commonly used type of desktop 3D printer and two models of black and white laser printers, found that certain chemicals, known as volatile organic compounds, were significantly lower with laser printers compared to 3D printers. The 3D printers also emitted 14 chemicals that laser printers did not emit. In addition, 3D printer emissions...
likely combined to form other chemicals. Even after printing, 3D printed objects emitted styrene, indicating that exposure beyond the actual process of printing may be a concern in the work place.

*Figure: 3D printing*  

**ENERGY PRODUCTION**

Increasingly, farmers are turning to renewable energy sources as a means to generate as much electricity as possible and provide a long-term source of income.\(^{30}\) We now look at the risks associated with growing sources of energy.

**BIOFUELS**

Many farm machines are driven by fossil fuels. Although there was no mention of a ban affecting tractors, the Government recently announced that the sale of diesel and petrol cars would be banned from 2040 onwards.\(^{31}\) Biofuels are being developed as alternatives to petrol and diesel fuels with the objective of reducing carbon emissions from liquid fuels. Biofuels, however, are not without their health-related drawbacks.

*Figure: Biofuel pumps in the United States*  

EFSA consider transmissible spongiform encephalopathy (TSE) to be the most relevant hazard caused by animal fat-based biofuels\(^{32}\). Forms of TSE include bovine spongiform encephalopathy (BSE), in cattle, and variant Creutzfeldt-Jakob disease (vCJD), in humans. With the exception of BSE in cattle, which can cause vCJD in humans, there is no scientific evidence that other TSE’s can be transmitted to humans\(^{34}\). TSE diseases can affect the brain and nervous system, and are fatal.
Animal fat also contains other biologically hazardous molecules, such as heat-resistant bacterial spores and viruses. TSE-causing agents have high resistance to destruction and are known to be stable at high temperatures.

A report, commissioned by the Department of Transport and the Department of Energy and Climate Change (now the Department for Business, Energy and Industrial Strategy) to provide advice on the UK strategy for development of biofuels, was published in July of 2017. The report contained a small section on air quality and human health-related issues, which stated:

- Air quality studies show that emissions of some pollutants may be higher for biofuels when compared to fossil fuels, largely resulting from the emissions associated with feedstock production and bioterror processing (i.e. emissions from producing biofuels may be more significant than emissions from burning fossil fuels). For example, burning straw in sugar cane fields in Brazil causes substantial respiratory diseases, such as asthma and pneumonia, in sugar cane workers and local populations.
- Vehicular exhaust emissions of bioethanol blends vary with blend strength. In general, lower bioethanol blends have lower carbon monoxide (CO) and particulate matter (PM) emissions compared to petrol. Higher ethanol blends lead to comparable or slightly lower levels of CO, PM and oxides of nitrogen, but five to ten times higher emissions of acetaldehyde.
- It has been argued that, despite having lower PM emissions, biodiesel exhaust emissions could be potentially more harmful to human health because of higher proportions of ultra-fine particles. Smaller particles remain suspended in the air for longer, are more easily inhaled and are able to penetrate more deeply into the lungs.
- Other assessments on potential human health implications of biodiesel suggest that using biofuels compared to diesel fuels results in minimal health impacts.
- Routes of health effects in humans other than air pollution, such as water/soil pollution and occupational hazards are scarcely discussed in the literature, and should be explored further.

Macro-algae, or seaweed, is increasingly gaining attention as a potential feedstock for third generation biofuels, which may be commercially available by the year 2030. At present, however, greenhouse gas emissions are higher than those from fossil fuels, meaning that they are not a feasible option.

**SOLAR PANELS**

Use of solar panels in the UK has increased significantly in the last 5 years. On 25 March 2017, it was found that solar power had produced six times more electricity than the country’s coal-fired power stations on that day. However, the amount of solar forecast to be installed by 2022 is a fifth of the amount installed over the last five years.

![Solar panels](image)

In November of 2017, researchers at the Fraunhofer Institute for Solar Energy Systems published a press release on an experiment, involving 720 bi-facial solar panels situated over a third of a hectare of agricultural land. The solar panels were mounted on top of crops, near Lake Constance, with enough room to permit the operation of farm machinery beneath the panels. After a year of trials, the research showed that the dual-use system (agrophotovoltaics) increased the total productivity of the land by 60%.

Previously, in a document from 2010, the State Smart Transportation Initiative outlined the health risks associated with each stage of the solar panel life cycle.

**Risks Associated with the Installation and Use of Solar Panels:**

- Because solar panels are encased in heavy-duty glass or plastic, there is little risk that small amounts of semiconductor material can be released into the environment.
- In the event of a fire, it is theoretically possible for hazardous fumes to be released and inhalation of these fumes could pose a risk to human health. However, researchers do not generally believe these risks to be substantial given the short-duration of fires and the relatively high melting point of the materials present in the solar modules.
- A greater potential risk associated with photovoltaic systems is the potential for shock or electrocution if an emergency responder comes in contact with a high voltage conductor.
The strength of electromagnetic fields produced by photovoltaic systems do not approach levels considered harmful to human health established by the International Commission on Non-Ionizing Radiation Protection. Moreover, the small electromagnetic fields produced by photovoltaic systems rapidly diminish with distance and would be indistinguishable from normal background levels within several yards.

**Risks Associated with End-of-Life Management and Recycling of Solar Panels:**

- If not properly decommissioned, the greatest end of life health risk from crystalline solar modules arises from lead containing solders. Under the right conditions it is possible for the lead to leach into landfill soils and eventually into water bodies.

Further, an article, published in April of 2017, identified the toxic chemicals emitted by solar panels and outlined the potential health effects upon exposure. Chemical agents found in solar panels include:

- Cadmium telluride,
- Copper indium selenide,
- Cadmium gallium (dil)selenide,
- Copper indium gallium (dil)selenide,
- Hexafluoroethane,
- Lead,
- Polyvinyl fluoride, and
- Crystalline silicon.

It was noted that these materials pose a toxicity risk to lungs. In the case of cadmium telluride, the journal of *Progress in Photovoltaics* reported that exposure by inhalation caused lung inflammation and lung fibrosis. At moderate to high doses, death was observed. Similar observations were made in a *Toxicology and Applied Pharmacology* article, involving copper indium selenide, although death was not a feature of exposure. Elsewhere, in the *Journal of Occupational Health*, research into cadmium indium gallium (dil)selenide, injected into the trachea, resulted in excessive fluid spots in the lungs, progressively worsening with time. Moreover, silicon tetrachloride has been found to kill plants and animals.

**HYDRAULIC FRACTURING**

Hydraulic fracturing, or fracking, involves injecting a high-pressure mixture of water, sand and other chemicals into wells, in order to induce fissures in rocks that allow the release of gases. These gases are collected and used to provide power. In both the UK and USA, fracking has been promoted as a way to reduce dependence on foreign energy sources. Drilling companies suggest that trillions of cubic feet of shale gas may be recoverable from underneath parts of the UK.

However, in early 2017, NIOSH, identified hydraulic fracturing as an occupational health and safety area needing attention. In America, hydraulically fractured wells provided two-thirds of the USA’s natural gas in 2015.

In December of 2017, UK media outlets reported that, ‘*domestic fracking will finally begin in earnest in 2018*’. Public support for fracking in the UK is low, primarily due to environmental and health concerns. In addition, scientists have questioned whether the geology of the UK is actually suitable for fracking. At this stage, the amount of hydraulic fracturing that will occur in the UK in the future is uncertain.

The link between hydraulic fracturing and farming is that much of the targeted areas for drilling of shale gas is rural farmland. As such, the hazardous risks associated with fracking are likely to affect the health and safety of agricultural workers.

In 2012, NIOSH evaluated that the transportation of hundreds of thousands of pounds of sand, during operations, generated dust that includes respirable crystalline silica, the inhalation of which can cause silicosis and lung cancer.
EFFECTS OF FRACKING ON FARMING

In July of last year, it was reported that farmers had protested outside a fracking site in Lancashire.

Health concerns expressed by farmers about fracking include:
- Health and safety impacts on families and children nearby sites;
- Sickness and reproductive defects in livestock;
- Water, land and air contamination of crops;
- Frack fluid spillages and animal deaths;
- Hazardous exposure to vegetable crops, meat, eggs and dairy products entering the food chain;
- Chemical spills; and
- Water shortages.

Farmers are also concerned that fracking could reduce the value of their land, and that supermarkets may stop sourcing produce grown on drilling sites.

Families and Children

In edition 215 of BC Disease News, we reported on an American study, published in 2017, into 1.1 million births in Pennsylvania between 2004 and 2013. It showed that there were greater risks of ill-health among infants born to mothers living within 2 miles of a hydraulic fracturing, or ‘fracking’, site.

There was evidence in support of negative health effects in babies born within 3km of fracking sites and the largest health impacts were seen among those living within 1km of a fracking site.

Among mothers living within 1km of a site, there was a 25% increase in the probability of low birth weight, and significant declines in average birth weight and in the infant health index.

Low birth weight is a risk factor for numerous negative outcomes, including infant mortality, attention deficit hyperactivity disorder, asthma, lower test scores, lower schooling attainment, lower earnings and higher rates of social welfare program participation.

The finding of a 25% increase in the probability of low birth weight, within 1 km of a fracturing site, is not inconsistent with findings from other studies that have investigated the effects of air pollution on foetal health.

Childhood cancer incidence has also been observed in Pennsylvania counties, though the standard incidence ratio of child leukemia was unremarkable.

Irrespective of this observation, a recent review of the chemicals used in hydraulic fracturing and their potential to cause childhood blood cancers found that, of 1177 chemicals, more than 80% had not been evaluated by the IARC. Of the 111 potential water contaminants and 29 potential air pollutants, (119 compounds), 49 water and 20 air pollutants were known, probable, or possible human carcinogens. A total of 17 water and 11 air pollutants (20 compounds) had evidence of increased risk of leukaemia/lymphoma.

In another 2017 study, volatile organic benzene compounds were found close to fracking operations. Researchers monitored the urinary levels of a metabolite of benzene in pregnant women living near a Canadian fracking site. Results showed that these women were approximately 3.5 higher than those in the general Canadian population. Levels were particularly high in indigenous women, though the differences were not statistically significant. The effects of benzene on developmental health have been widely studied, and include reduced birth weight, increased risk of childhood leukaemia, and birth defects such as cleft palate and spina bifida. The lead researcher of the study, Marc-André Verner, said:

‘Although the levels of muconic acid found in the participants’ urine cannot prove
beyond reasonable doubt that they were exposed to high levels of benzene, these results do clearly demonstrate the importance of exploring human exposure to environmental contaminants in natural-gas (fracking) regions.59

The researchers concluded that more extensive research is required, and they will undertake further studies in the future.

Case Study

After opening more than 30 gas and oil wells in close proximity to her farm, North Dakota cattle farmer, Jacki Schilke, claimed that 5 of her cows had ‘dropped dead’, while she claimed to have suffered chronic lung pain, back pain, and rashes, over the course of the year. Ms Schilke attributed these events to fracking. Subsequent air testing confirmed the existence of higher than normal levels of chemical compounds in her vicinity, such as benzene, butane and chloroform.60

Shale Gas Syndrome

Numerous online articles have reported on a case series study on health hazards caused by fracking.61 The study was limited, in that it was not epidemiological and did not compare exposed and unexposed workers.

However, the authors found adverse effects of fracking, including respiratory, reproductive, and growth-related problems in animals, and a spectrum of symptoms in humans, which they termed ‘shale gas syndrome’.

Symptoms of so-called ‘shale gas syndrome’, include a combination of burning eyes, sore throat, headaches, nosebleeds, vomiting, diarrhoea, and skin rashes. It has been reported that whenever fracking victims are compensated for their losses, they often are forced to sign non-disclosure agreements.62

As there is no systematic testing of air, soil or water for chemical contaminants, and there is no systematic health monitoring of nearby residents, researchers do not know which chemicals are present in the fracking process and therefore do not know which type of health effects testing should be conducted.63 Ideally, comparisons between pre-fracking and post-fracking exposure could establish a route of human exposure, and confirm that health effects are caused by the claimed chemical exposure.

Future Steps

According to the American Public Health Association (APHA), in a 2012 report, it stated that evidence regarding health impacts of gas drilling is difficult to obtain, and that many uncertainties remain about the types of exposures and resulting health impacts.64

In the USA, fracking companies are allowed to protect the precise identity and contents of fracking fluid under ‘proprietary’ or ‘trade secret’ designations. From a public health perspective, this makes exposure monitoring difficult, and makes it difficult for health agencies to offer advice to operators. However, a national hydraulic fracturing chemical registry, known as FracFocus, which was created in response to concerns about effects on health and the environment, provides public access to list of chemicals used in individual wells. As of December 2012, the registry contained more than 33,000 voluntary disclosures.65

According to the House of Representatives’ Committee on Energy and Commerce, between 2005 and 2009, the 14 oil and gas service companies in the USA used more than 2,500 hydraulic fracturing products containing 750 chemicals and other components. The products ranged from unexpected items such as instant coffee and walnut hulls, to products known to cause adverse health effects, such as benzene, silica, lead, ethylene glycol and methanol. There is also the potential for exposure to diesel fumes, due to the use of diesel vehicles on site. Though the occupational safety issues are well understood and regulated, the occupational health issues are less well understood.

Figure: Hydraulic fracturing site in the Marcellus shale deposit, in the Northeastern USA67

The emerging epidemiological studies, such as those outlined above, convey concerning adverse birth outcomes.68 There are few studies, at this time, which have focused on either worker or resident populations, exposed to fracking. Consequently, there is a need for more research to be conducted on potentially affected populations, as fracking operator activity, over recent months, indicates that UK fracking operations may begin imminently. Fracking is widespread throughout the USA, and has increased considerably in recent years, so studies from the USA should continue to offer insight into the risks faced by workers and residents in the UK. Hopefully, more comprehensive research can be used to initiate preventative measures for curbing occupational health risks, especially those affecting the agriculture industry.
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The real cost of fracking: How America’s shale gas boom is threatening our families, pets and food.


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