

Institution: Queen Mary University of London		
Unit of Assessment: 1		
Title of case study: Influencing Policy Change and Informing UK Government Decisions to Combat Air Pollution and Its Health Risks		
Period when the underpinning research was undertaken: 2008 - present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
1) Jonathan Grigg	1) Professor of Paediatric Respiratory & Environmental Medicine	1) 08/1996 - present
2) Chris Griffiths	2) Professor of Primary Care	2) 1992 - present
Period when the claimed impact occurred: 2014 - present		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
<p>Queen Mary's Profs. Grigg and Griffiths are prominent advocates of the adverse effects of air pollution on paediatric health. They have contributed significantly to numerous leading reports in this area, including 'Every Breath We Take', a report on outdoor pollution from the Royal College of Physicians working group and used as fundamental evidence by London Mayor Sadiq Khan in introducing London's Ultra-Low Emission Zone (ULEZ). The introduction of the ULEZ caused roadside nitrogen dioxide levels to drop by nearly one-third between July and September 2019. In 2017, Grigg and Griffiths founded the advocacy group 'Doctors Against Diesel', which prompted the UK Government to commit to diesel discouragement policies and led to the adoption of the Department for Environment, Food and Rural Affairs' 2019 Clean Air Strategy, which has ambitious pollution reduction targets exceeding those of the EU. More recently, Grigg has shown that exposure to air pollution increases vulnerability to COVID-19 infection, work that the All Party Parliamentary Group for Air Pollution used to produce an Air Quality Strategy to reduce susceptibility to the virus.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>In her 2018 annual report, Chief Medical Officer, Dame Sally Davies, concluded that air pollution is a public health issue and that we need to regain a focus on pollution as a serious threat to public health. Every year air pollution kills an estimated 7,000,000 people worldwide, with the UK suffering from 40,000 deaths and an estimated cost of GBP20,000,000,000 to society, business and the NHS per year. Queen Mary's Profs. Grigg and Griffiths, through their expertise and medical research on the health effects of pollution in children, helped promote this required and renewed focus on pollution as a threat to public health, using their research as a foundation for successful advocacy work and contributions to national reports and policy.</p>		
Examining pollution exposure in children		
<p>Grigg was the first to show that ultrafine fossil-fuel-derived particles can penetrate the smallest airways and his research at Queen Mary has shown that carbon loading in airway macrophages is associated with reduced lung function in both healthy children and children with severe asthma [3.1]. More recently, Grigg's group found that inhaled particulate matter can move to and be taken up by resident white blood cells (phagocytes) in the human placenta, thus posing a potential threat to a developing fetus [3.2].</p>		
Evaluating the effectiveness of the London Low Emission Zone		
<p>From 2008, Griffiths and Grigg led a collaborative study with Kings College London to evaluate the impact of the London Low Emission Zone (LEZ) on the lung function of young children. They showed that increased exposure to nitrogen oxides and particulate matter in London is associated with reduced lung function, and that decreasing levels of air pollution due to the LEZ were insufficient to reverse this major adverse effect. They therefore called for interventions that would deliver larger reductions in emissions to protect and improve children's health [3.3].</p>		

Establishing a connection between pollution and vulnerability to COVID-19

To infect healthy cells, the COVID-19 virus interacts with the angiotensin-converting enzyme 2 (ACE2) receptor found on cells in human airways. Since the start of the COVID-19 pandemic, Grigg has been studying the association between exposure to particulate matter and expression of the ACE2 receptor and has found that airway cells exposed to traffic-derived particulate matter show increased ACE2 expression. Therefore, exposure to air pollution increases vulnerability to infection by COVID-19 [3.4].

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

[3.1] Kulkarni, N., Pierse, N., Rushton, L. & Grigg, J. (2006). Carbon in airway macrophages and lung function in children. *New England Journal of Medicine*, 355, 21-30.

<https://doi.org/10.1056/NEJMoa052972>

[3.2] Liu, N. M., Miyashita, L., Maher, B. A., McPhail, G., Jones, C. J. P., Barratt, B., Thangaratnam, S., Karloukovski, V., Ahmed, I. A., Aslam, Z. & Grigg, J. (2021). Evidence for the presence of air pollution nanoparticles in placental tissue cells. *Science of The Total Environment*, 751, 142235. <https://doi.org/10.1016/j.scitotenv.2020.142235>. Available online 12 September 2020.

[3.3] Mudway, I. S., Dundas, I., Wood, H. E., Marlin, N., Jamaludin, J. B., Bremner, S. A., Cross, L., Grieve, A., Nanzer, A., Barratt, B. M., Beevers, S., Dajnak, D., Fuller, G. W., Font, A., Colligan, G., Sheikh, A., Walton, R., Grigg, J., Kelly, F. J., Lee, T. H. & Griffiths C. J. (2018). Impact of London's low emission zone on air quality and children's respiratory health: a sequential annual cross-sectional study. *The Lancet Public Health*, e28-e40.

[https://doi.org/10.1016/S2468-2667\(18\)30202-0](https://doi.org/10.1016/S2468-2667(18)30202-0)

[3.4] Miyashita, L., Foley, G., Semple, S. & Grigg, J. (2020) Traffic-derived particulate matter and angiotensin-converting enzyme 2 expression in human airway epithelial cells. *BioRxiv preprint*.

<https://doi.org/10.1101/2020.05.15.097501>

Evidence of the quality of the research

[EQR.1] Griffiths, C. [PI]. (2008-2013). EXHALE Programme – evaluating the effect of London's Low Emission Zone on children's respiratory health [16/139/01]. *NIHR*. Kings Biomedical Research Centre. GBP250,000.

[EQR.2] Griffiths, C. [PI]. Grigg, J. Lee, T. Sheikh, A. [Co-Investigators]. (2008). Low Emission Zone: evaluation of effect on children's respiratory health [PMO 34c]. *City & Hackney Primary Care Trusts*. GBP115,000.

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

Building on their research and expertise in assessing the health effects of air pollution in children, Profs. Grigg and Griffiths have informed, influenced and provoked significant policy change in air pollution, both on a national and international scale. Grigg provided medical evidence to the Inquest into the death of 9-year-old Ella Kissi-Debrah, which made history by ruling in December 2020 that air pollution exposure was a medical cause of death on the coroner's report, the first time such a ruling has ever been made in the UK [5.1].

Informing the Royal Colleges and shaping the keystone report 'Every Breath We Take'

In 2015–2016, Grigg was Vice Chair and Griffiths was a member of a Royal College of Physicians working party on outdoor air pollution. In the resulting report, 'Every Breath We Take', Grigg wrote the chapter 'Health Effects of air pollution over our lifetime', which referenced his carbon loading data [3.1, 5.2]. This report, the first from the Royal College since the 1970s, is the major source material on the adverse health effects of air pollution, used as evidence for work by Mayor Sadiq Khan and the Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP). Grigg was also co-chair of the Royal College of Paediatrics and Child Health working party on indoor air pollution, which published its report 'The inside story: Health effects of indoor air quality on children and young people' in January 2020 — the first report from the Royal Colleges to document indoor air pollution [5.3], recommending fundamental change to building design and construction as well as increasing Local Authority oversight and powers.

Influencing the UK Government’s diesel discouragement policy

With the support of the charity Medact in 2016, Grigg and Griffiths founded the advocacy group ‘[Doctors Against Diesel](#)’, an evidence-based campaign comprising of over 300 doctors and health professionals. In 2017, the group published an open letter to then-Prime Minister Theresa May in *The Times* stating its concern over diesel’s contribution to poor air pollution in the UK. In her response, May accepted the major role of diesel in the air quality challenge, and the government subsequently committed to significant diesel discouragement policies that same year, including, “a further £290 million...invested to support electric vehicles, low emission buses and taxis, and alternative fuels” [5.4].

Grigg also provided evidence to the UK Government as the member of COMEAP representing paediatrics and as a member of the UK Health Alliance on Climate Change working party in order to influence further change in government policy. Grigg co-authored the 2016 report ‘A Breath of Fresh Air’ [5.5] with the latter group, a report that builds on the Royal College of Physicians’ ‘Every Breath We Take’ and made the recommendations found in Figure 1. These recommendations are set out in order to achieve substantial benefits to both health and the environment by combining the strategies for air pollution and climate change for the first time, using cross-departmental collaboration.

From the evidence and pressure exerted by these recommendations and reports, the Department for Environment, Food and Rural Affairs released its Clear Air Strategy in 2019 [5.6]. The strategy sets out ambitious, legally binding international targets for reducing emissions of five highly damaging air pollutants (fine particulate matter, ammonia, nitrogen oxides, sulphur dioxide, and non-methane volatile organic compounds) – by 30% by 2020 and 46% by 2030. These targets

are even more ambitious than EU requirements and are underpinned and clearly enforced by new England-wide powers, supporting the creation of Clean Air Zones in cities beyond London, such as the planned launches of Birmingham and Bath in 2021, to control major sources of air pollution. The strategy also set the target of banning the sale of new diesel cars and vans by 2040.

Enabling the creation of London’s Ultra-Low Emission Zone (ULEZ)

In August 2016, London Mayor Sadiq Khan wrote a letter in response to Grigg stating: “I will draw on the advice in the report [‘Every Breath We Take’] as I develop my proposals for tackling both indoor and outdoor air pollution” [5.7], and a year later, this plan turned into action. The Mayor introduced the Emissions Surcharge in October 2017, the first step in rolling out the world’s first Ultra-Low Emission Zone (ULEZ) scheme in London from 8 April 2019. Under ULEZ, most vehicles, including cars and vans, must either meet tighter exhaust emission standards or pay a daily charge. The Mayor used the ‘Every Breath We Take’ report as fundamental supporting evidence to justify such major policy change, and its effects were seen within the year. From July to September 2019, nitrogen dioxide concentrations at roadside locations in central London were an average of 24µg/m³ lower, equating to a reduction of 29% compared to a scenario with no ULEZ. In September 2019, the average compliance rate with the ULEZ standards was 77% over a 24-hour period (and 74% in congestion charging hours) — far higher than in February 2017



Phase out coal



Clean air zones



Retain standards from EU regulations



Better monitoring

Figure 1: Recommendations made in ‘A Breath of Fresh Air’. Adapted from *A Breath of Fresh Air: Addressing Climate Change and Air Pollution Together for Health* by UK Health Alliance on Climate Change, 2016. Copyright [2016] by UK Health Alliance on Climate Change.

(39%) and March 2019 (61%) [5.8]. The annual mean of particulate matter at monitoring sites in London from 2016-2020 dropped by 11% across the network and 14% at roadside sites [5.9].

Developing an Air Quality Strategy to reduce COVID-19 infection

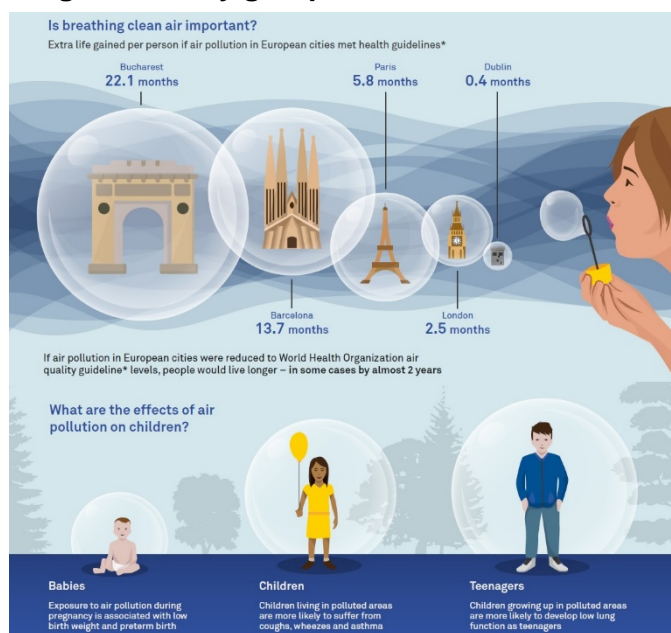
In May 2020, Grigg presented evidence to the All Party Parliamentary Group for Air Pollution, showing that exposure of airway cells to particulate matter increases vulnerability to COVID-19 infection. The following month the Group subsequently produced an Air Quality Strategy [5.10] to reduce COVID-19 infection, citing Griggs' work [3.4] and stating that it is "essential that the government ensures pollution remains low to ensure that a second peak does not overwhelm the NHS after lockdown." As a result, the strategy promises to "deliver cleaner air over subsequent years to help to ensure better public health, less strain on the NHS and greater resilience against future pandemics."

Influencing international policy-makers to improve air quality at schools

In 2018, Grigg worked with UNICEF to produce the highly publicised policy briefing document 'The Toxic School Run' [5.11], which is based on unpublished data from his group showing that children are being disproportionately exposed to pollution while on the school run and at school. In the report, Grigg and UNICEF call on policy-makers in government to put effective mitigations in place that address children's vulnerability during these peak periods, including "a ring-fenced funding pot to pay for measures that protects children from toxic air where they learn and play." Based on analysis by Grigg, a coalition headed by the Philips Foundation and Global Action Plan has formed to invoke action from government and local authorities to improve the air quality at schools [5.12].

Developing patient education resources through advocacy groups

Grigg has acted as the Science Media Centre's expert on air pollution since 2015. In 2016, he was appointed as the British Lung Foundation's advisor on air pollution, and advised on and reviewed their advice on mitigating the health effects of air pollution [5.13]. In 2016, Grigg led a European Lung Foundation (ELF) workshop on 'Communicating Risk of Air Pollution to Patients,' which was attended by >20 healthcare professionals [5.14]. One of the outcomes of the workshop was an infographic (Figure 2) to be used as a tool for healthcare professionals when explaining the risk of poor air quality to their patients [5.15]. This has been downloaded more than 600 times and was distributed at the European Respiratory Society Congress to more than 3,000 recipients.



Based on the success of the workshop, the ELF coordinated a call from 65 medical societies and patient organisations for combined action on air quality [5.14], requested for by the World Health Organization (WHO). As a result, ELF and WHO are working together to create WHO's international air pollution guidelines.

Figure 2: Infographic used by healthcare professionals to explain the risk of poor air quality to their patients. Adapted from *Air quality and lung health-the risks* by European Respiratory Society (ERS) and European Lung Foundation (ELF), 2016. Copyright [2016] by ERS and ELF.

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

[5.1] Dyer, C. (2020, 17 December). Air pollution from road traffic contributed to girl's death from asthma, coroner concludes. *The BMJ*, 371, m4092.

<https://www.bmj.com/content/371/bmj.m4092>. Accessed 26 February 2021.

- [5.2] Royal College of Physicians. (2016). *Every breath we take: the lifelong impact of air pollution*. (Chapter 4, pp. 52). <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>.
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- [5.4] T. May. Prime Minister. *UK Government* (testimonial letter, 9 March 2017).
- [5.5] UK Health Alliance on Climate Change (2016). *A Breath of Fresh Air: Addressing Climate Change and Air Pollution Together for Health*. <http://www.ukhealthalliance.org/wp-content/uploads/2016/10/UK-Health-Alliance-A-Breath-of-Fresh-Air-Final-Report.pdf>
- [5.6] Department for Environment Food & Rural Affairs. (2019). *Clean Air Strategy*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf
- [5.7] S. Khan. Mayor of London. *Greater London Authority* (testimonial letter, 17 August 2018).
- [5.8] Mayor of London. (2019). *Central London Ultra Low Emission Zone – Six Month Report*. https://www.london.gov.uk/sites/default/files/ulez_six_month_evaluation_report_oct19.pdf
- [5.9] Major of London. (2020). *Air pollution monitoring data in London: 2016 to 2020*. https://www.london.gov.uk/sites/default/files/air_pollution_monitoring_data_in_london_2016_to_2020_feb2020.pdf
- [5.10] All Party Parliamentary Group Air Pollution. (2020). *Air Quality Strategy to Reduce Coronavirus Infection*. <https://appgairpollution.org/2020/05/29/air-quality-strategy-to-reduce-coronavirus-infection/>
- [5.11] UNICEF, UK. (2018). *The Toxic School Run*. <https://www.unicef.org.uk/publications/the-toxic-school-run/>
- [5.12] Philips. (2020, 16 September). *Philips, the Philips Foundation and Global Action Plan team up to improve the air quality at schools*. <https://www.philips.com/a-w/about/news/archive/standard/news/press/2020/20200916-philips-the-philips-foundation-and-global-action-plan-team-up-to-improve-the-air-quality-at-schools.html>. Accessed 26 February 2020.
- [5.13] British Lung Foundation. (2016). *Air pollution*. <https://www.blf.org.uk/support-for-you/air-pollution/tips>. Accessed 7 December 2020.
- [5.14] P. Powell. Director. *European Lung Foundation* (testimonial letter, 26 February 2019). [Corroborator 1]
- [5.15] European Respiratory Society and European Lung Foundation. (2016). *Air quality and lung health-the risks* [Infographic]. <https://www.europeanlung.org/assets/files/factsheets/air-pollution-risks-web.pdf>