Institution: University of Worcester

Unit of Assessment: 5 – Biological Sciences

Title of case study: Improving Quality of Life for Hay Fever Sufferers

1. Summary of the impact

In the UK, 20-25% of the population (around 15 million people) sufferer from allergic rhinitis (hay fever) resulting in about 4 million 'sick days' per year. Research undertaken by the National Pollen and Aerobiology Research Unit (NPARU) over a period of 20 years has resulted in the development of a national pollen forecasting system for the UK which has had direct benefits on the health and wellbeing of hay fever sufferers. This research has also raised awareness of the importance of pollen information for sufferers, fed into policy on allergy services (and subsequently practice of these services), underpinned training of health professionals, and informed clinical trials of anti-allergy products and devices.

2. Underpinning research

Over a period of 20 years, the National Pollen and Aerobiology Research Unit (NPARU) has engaged in research into pollen and the effects of pollen on those suffering from a range of allergies, first under the leadership of Professor Jean Emberlin (Director, 1993-2010) and subsequently Professor Roy Kennedy (Director, 2010-present) with particular support from Dr Matthew Smith (Researcher, 2004-2011).

This research can be divided into three areas:

- ***Research into pollen assay methods***

  Research has led to the development and testing of different types of air sampling equipment including volumetric traps for pollen (and technology for the assay of inorganic particles) (**Reference 3, Grant a**). Expertise in preparation of air sampled material and in pollen identification using microscopy has been developed to a very high level. Methods for the immunochemical measurement of specific pollen types have been developed using antibodies to some of the most allergenic proteins present on pollen grain coats (e.g. Betv1 on *Betula*: the birch genus) (**Reference 6; Grants b and e**). Building on the published research, current work involving a specialist in monoclonal antibody production, cross-over with recent developmental work on immunochemical methods on fungal spore, dust mite and cat dust assays, and ongoing collaboration with an engineer skilled in Micro-Electro-Mechanical Systems (MEMS) technology, are resulting in significant innovation in this area.

- ***Research into the variation of airborne pollen loads with time***

  Phenological research has examined the possible effects of climate change on the profile of the 'pollen season' (during which pollen is released into the air). There has been a focus on the timing of flowering of *Betula* and other trees across Europe - the first sources of allergenic pollen in the atmosphere in spring (**References 4 and 6**). Critically, the combination of expertise in airborne pollen monitoring has been combined with mathematical modelling using geographical and meteorological parameters to develop protocols for the forecast of pollen abundance in the air (**References 2 and 5**). The accuracy of these predictions has been assessed by using 'back trajectory' analysis. A key outcome has been the development of the national pollen forecast for the UK.

- ***Collaborative work with clinicians***

  This has included a range of funded joint research activities with clinicians (**Grants a, b, c, d, and e**). There has been specific work on allergic rhinitis (hay fever) and other chronic inflammatory disorders, such as asthma (**Reference 1**). Work has included research into the effects of local environmental conditions, such as thunderstorms, pollution and 'urban canyons' on the allergic reaction of hay fever sufferers to pollen. It has included research into variation in the 'potency' of pollen grains of a single species (**Reference 6**).

3. References to the research

1. Anderson, H.R., de Leon, A.P., Bland J.M., Bower J.S., **Emberlin, J.** & Strachan D.P. (1998) Air pollution, pollens, and daily admissions for Asthma in London 1987-92. *Thorax*, 53: 842-848. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1745078/pdf/v053p00842.pdf.
2. **Emberlin, J.**, Mullins, J., Corden, J., Jones, S., Millington, W., Brooke, M. & Savage, M. (1999) Regional variations in grass pollen seasons in the UK, long-term trends and forecast models. *Clinical and Experimental Allergy*, 29: 347-356. DOI:10.1046/j.1365-2222.1999.00369.x.
3. Carinanos, P, **Emberlin, J,** Galan, C, Dominguez-Vilches, E. (2000) Comparison of two pollen counting methods of slides from a Hirst type volumetric trap. *Aerobiologia*, 16: 339-346. DOI: 10.1023/A:1026577406912 .
4. **Emberlin, J.**, Detandt, M., Gehrig, R., Jaeger, S., Nolard, N., & Rantio-Lehtimaeki, A. (2002) Responses in the start of Betula (birch) pollen seasons to recent changes in spring temperatures across Europe. *International Journal of Biometeorology*, 46: 159-170. DOI:10.1007/s00484-002-0139-x.
5. **Smith, M.** & **Emberlin, J.** (2005) Constructing a 7-day ahead forecast model for grass pollen at north London, United Kingdom. *Clinical and Experimental Allergy*, 35: 1400-1406. DOI:10.1111/J.1365-2222.2005.02349.x.
6. Buters, J.T.M. Thibaudon, M., Smith, M., **Kennedy, R.**, Rantio-Lehtimaki, A., Albertini, R., Reese, G., Weber, B., Galan, C., Brandao, R., Antunes, C., Jackowiak, B., Sauliene, I., Weichenmeier, I., Pusch, G., Sarioglu, H., Ueffing, M., Behrendt, H., Prank, M., Sofiev, M. & Cecchi, L. (2012) Release of *Betv1* from birch pollen from 5 European countries. Results of the HIALINE study. *Atmospheric Environment*, 55: 496-505. DOI:10.1016/j.atmosenv.2012.01.054.

Grants

a. Jean Emberlin (Co-I), **SPRING** (**S**ystem for **P**ollen **R**elated **In**formation **G**athering), eTEN (EU Programme), (01/2001-07/2002), €490,000.

b. Jean Emberlin (Co-I), **MONALISA** (***MO****nitoring* ***N****etwork of* ***Al****lergens by* ***I****mmuno-****Sa****mpling*)**,** Life (EU Programme), (01/2005-04/2008), €667,362.

c. Matthew Smith (Member), Assessment of production, release, distribution and health impact of allergenic pollen in Europe (EUPOL), COST Action (09/2007-09/2011).

d. Jean Emberlin (Co-I), **AIRPATH** – Working Group on Outdoor Environments, Pathogens in Air, and Human Health, NERC, (07/2007-12/2008), £12,594.

e. Roy Kennedy (Co-I), **HIALINE** (**H**ealth **I**mpacts of Airborne **Al**lergen **I**nformation **Ne**twork) Health (EU Programme), (01/2009-01/2012), €878,926.

The University is confident that the research meets the 2* quality threshold. Reference 2 was returned by Worcester to UoA14 in RAE2001. References 4 and 5 were returned to UoA12 in RAE2008. Reference 6 is returned to UoA5 in REF2014 as “KennedyR3”. Much of the research has been funded through the European grants outlined above which the University believes is indicative of its excellence.

4. Details of the impact

The impact of the research can be divided into four distinct areas, although the overarching benefits arising from the research are for those suffering from hay fever and other allergies.

i) Public Health

NPARU produces and supplies the daily pollen forecasts for the UK (2-, 3- and 5-day) using data produced by the National Pollen Monitoring Network. It provides training for those collecting these data with regard to air sampling and pollen assay and quality assures the data. It then collates the data with geographical and meteorological information and applies mathematical modelling protocols developed through the research to make predictions of the amount of pollen that will be in the air. NPARU was the sole provider of the pollen forecast until 2011 when a collaborative

contract was formed with the Met Office (**Source A**). NPARU continues to provide the forecasts directly to Met Eireann**,** Irish Health**,** GlaxoSmithKline and media outlets such as the Daily Telegraph and MBC Netweather Ltd.

The Met Office website is in the top 150 most visited websites in the UK according to the Alexa Web Information Company. The Daily Telegraph has a circulation of over 500,000. A less detailed forecast also forms part of, for example, BBC Weather forecasts which regularly get upwards of 5 million viewers. This gives a sense of the sheer number of individuals who have access to the pollen forecast on a daily basis.

The pollen forecast is a vital tool in the prevention and treatment of hay fever. The NHS provides clear advice through, for example, its NHS Choices site on checking the pollen forecast as part of the recommended strategy for managing hay fever (**Source B**). The 'user experience' improves lives as sufferers are better able to control their symptoms by adapting their medication and behaviour. An example of this in microcosm comes at the regional level. A team from the allergy clinics at Worcestershire Acute Hospitals NHS Trust and NPARU utilise Twitter (@Worcs_Allergy) to provide information about the pollen count to patients to enable them to use the appropriate medication.

NPARU has also been effective in engaging the public with its research and specifically raising awareness of the health implications for hay fever sufferers. For example, Emberlin was commissioned by Kleenex to produce *The Hay Fever Health Report 2010*, a public-facing review of how lifestyle choices affect hay fever sufferers (**Source C**). NPARU was also heavily involved in the development of a Low Allergy Show Garden which won a Silver Medal at Chelsea Flower Show in 2010 receiving extensive TV coverage. More generally, staff members in NPARU have made 229 media appearances (TV, radio and press) focused on its research during the period 2008-2013.

ii) Public Policy

NPARU's research has contributed to policy debate on allergy services and ultimately informed the development of quality control measures for these services. Emberlin sat on the Royal College of Physicians Working Party that produced the report, *Allergy: the unmet need. A blueprint for better patient care* in 2003 (**Source D**). This report informed a 2007 report of the House of Lords' Science & Technology Committee (**Source E**) which set out a series of recommendations for the enhancement of allergy services. It also underpinned the (similarly titled) 2010 report by a joint Royal College of Physicians and Royal College of Pathologists Working Party, *Allergy services. Still not meeting the unmet need* (**Source F**) which assessed progress against the Science & Technology Committee's recommendations and itself made further recommendations, one outcome of which was the establishment of the *Improving Quality in Allergy Services (IQAS) Registration Scheme* in 2011 (**Source G**). The IQAS registration scheme is a new project from the Royal College of Physicians (RCP) and Royal College of Pathologists (RCPath) Joint Committee on Immunology and Allergy (JCIA), which aims to improve the quality of NHS specialist allergy services.

iii) Practitioner services

NPARU's research has also underpinned training provided to health professionals. Feedback from these events states that this training has improved the quality of the services these professionals are able to provide. Examples of this training are: a general workshop on Ocular, Perennial and Seasonal Rhinitis April 2010 with attendees from 11 different businesses including pharmacies, surgeries and opticians; a Contact Lens seminar in February 2011 with 28 optometrists, dispensing opticians and contact lens specialists attending; one day workshop in March 2013 for optometrists, dispensing opticians and contact lens specialists from 77 different ophthalmology businesses exploring the impact of allergies on contact lens wearers. Feedback showed that 80% of the attendees found the day very useful with 15% of attendees having no prior knowledge and 74% having little knowledge of the subject before attending. The seminar also provided 11 points of Continuing Education and Training (CET) for the attendees. Optometrists, dispensing opticians and contact lens specialists have to earn 36 points over the CET cycle (Currently1 January 2013 to 31 December 2015) with 6 points in any one year (**Source H**).

iv) Commerce

NPARU has brought commercial benefits to a number of companies through undertaking product testing of devices, such as vacuum cleaners, floor washers, washing machines, air purifiers. This testing (the protocols for which were developed through research on the immunochemical assay of pollen) is undertaken under the agency of Allergy UK, which provides accreditation of the products through a seal of approval (**Source I**). NPARU also undertakes clinical trials of seven anti-allergy products, such as bedding and hay fever treatments. All seven products have been commercialised and are now in production. A good example is the product *Nasaleze*®. According to Paul Duxbury of that company, trial results from NPARU *"provided evidence that Nasaleze® reduces the need to take rescue medication for the symptoms of hay fever. The product now has the clear competitive advantage in that it is the only remedy with no adverse side effects (of particular benefit to children, pregnancies and the elderly). As a result of NPARU's work, Nasaleze® has accessed mainstream marketing channels in the UK, including Asda, Morrisons, Holland & Barrett. In the US, Nasaleze is in CVS and Walgreen. Nasaleze® is on sale in over 100 countries (which includes all EU countries, New Zealand, USA, Eastern Europe, and Russia and Ukraine)"* (**Source J**).

5. Sources to corroborate the impact

A. Letter of support from the Met Office.

B. NHS Choices website: http://www.nhs.uk/Conditions/Hay-fever/Pages/Symptoms.aspx

C. The Hay Fever Report 2010: https://www.kleenex.co.uk/Themes/Default/Images/UK/products/hayfever/HayfeverReport_2010%20amend%20FINAL.pdf

D. *Allergy: the unmet need. A blueprint for better patient care* - Report of the Royal College of Physicians Working Party on the provision of allergy services in the UK (2003): http://www.bsaci.org/pdf/allergy_the_unmet_need.pdf

E. *Allergy* - Report of the House of Lords' Science & Technology Committee (2007): http://www.publications.parliament.uk/pa/ld200607/ldselect/ldsctech/166/166i.pdf

F. *Allergy services. Still not meeting the unmet need* - Report of the Joint Royal College of Physicians and Royal College of Pathologists Working Party (2010): http://www.rcplondon.ac.uk/sites/default/files/documents/allergy-services-still-not-meeting-the-unmet-need.pdf

G. Improving Quality in Allergy Services (IQAS) Registration Scheme: http://www.rcplondon.ac.uk/projects/iqas

H. Feedback from training events.

I. Letter of Support from AllergyUK.

J. Letter of Support from Paul Duxbury at *Nasaleze*®.