

Unit of Assessment: UoA2 - Public Health, Health Services and Primary Care

Title of case study: Improving antibiotic prescribing to hospital inpatients

1. Summary of the impact

The need to measure and improve hospital antibiotic prescribing was identified as a priority in European and UK policy documents about antibiotic resistance in the late 1990s. Our research developed sustainable methods for evaluating interventions to improve hospital antibiotic prescribing, and led to **Davey** collaborating with the European Surveillance of Antimicrobial Consumption (ESAC) project and becoming the Scottish Antimicrobial Prescribing Group's Representative with Responsibility for International Liaison and Research. Implementation of ESAC quality indicators and measurement methods has been associated with progressive improvement in antibiotic policy compliance and reduction in *Clostridium difficile* infection in all 14 Health Boards in Scotland since 2008.

2. Underpinning research

Following the House of Lords reports on Antimicrobial Resistance in 1998 and 2001 and the European Union's Microbial Threat in 1998, which expressed extreme concern with the lack of progress in measurement of antibiotic use and compliance with policies in hospitals (<http://www.publications.parliament.uk/pa/ld199798/ldselect/ldsctech/081vii/st0701.htm>, <http://www.publications.parliament.uk/pa/ld200001/ldselect/ldsctech/56/5601.htm> and http://soaping.icecube.snowfall.se/strama/Kopenhamnsmotet_1998.pdf), **Davey** (Lead for Clinical Quality Improvement, Division of Population Health Sciences, Dundee) collaborated with Ramsay (University of Aberdeen) and the British Society for Antimicrobial Chemotherapy on a systematic review [i]. This confirmed significant gaps in the evidence base on interventions to improve hospital antibiotic prescribing. They tested a novel approach to measurement of effect size with segmented regression analysis of an intervention to change antibiotic policy in NHS Tayside [ii] and used the method in the systematic review to demonstrate a significant association between reduction in use of broad spectrum antibiotics and infections with drug resistant bacteria and with *C. difficile* [iii]. Collaboration with authors of another systematic review about infection control produced the ORION guidelines for good practice in reporting interventions [iv].

Most hospital data systems only record supply of antibiotics to hospital wards. This information can be used to analyse the impact of interventions on use of antibiotics targeted by policy change [ii]. However, hospitals also need a sustainable method for measurement of prescribing to individual patients in order to assess compliance with antibiotic policy for treatment of specific infections. **Davey** was the UK representative for the 2000-2003 ESAC project and from 2003-10 was funded by ESAC II and III to lead work on surveillance of hospital consumption. This led to the development and testing in 20 European hospitals of a method for point prevalence surveying of the treatment of individual patients. The participating hospitals conducted the point prevalence survey without any additional resources for data collection [v]. Analysis and comparison between hospitals was enabled by a web based reporting system. The output from this work included identification of three quality indicators:

1. Documentation of indication for antibiotics in the hospital case notes
2. Compliance with the hospital antibiotic policy
3. Duration of all antibiotic prophylaxis for surgery no greater than 24h

Following on from the ESAC project **Davey** collaborated with colleagues in Geneva on time series analysis of pharmacy data to identify targets for reduction in *C. difficile* infections. The model for hospital-acquired *C. difficile* infections suggested that variation in four antibiotics explained 61% of the variance in *C. difficile* infections in hospitals in NHS Tayside [vi] and led to an intervention to change antibiotic policy in hospitals in Scotland.

3. References to the research

- i. Ramsay C, Brown E, Hartman G and **Davey P** (2003) Room for improvement: a systematic review of the quality of evaluations of interventions to improve hospital antibiotic prescribing. *J. Antimicrob. Chemother.* **52**, 764-771 (DOI: 10.1093/jac/dkg460).
- ii. Ansari F, Gray K, Nathwani D, Phillips G, Ogston S, Ramsay C, and **Davey P** (2003) Outcomes of an intervention to improve hospital antibiotic prescribing: interrupted time series with segmented regression analysis. *J. Antimicrob. Chemother.* **52**, 842-848 (DOI: 10.1093/jac/dkg459).
- iii. **Davey P**, Brown E, Fenelon L, Finch R, Gould I, Hartman G, Holmes A, Ramsay C, Taylor E, Wilcox M and Wiffen P (2005) Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database of Systematic Reviews* 2013 Issue 4: CD003543 (DOI: 10.1002/14651858.CD003543.pub2).
- iv. Stone SP, Cooper BS, Kibbler CC, Cookson BD, Roberts JA, Medley GF, Duckworth G, Lai R, Ebrahim S, Brown EM, Wiffen PJ and **Davey, PG** (2007) The ORION statement: guidelines for transparent reporting of outbreak reports and intervention studies of nosocomial infection. *Lancet Infect. Dis.* **7**, 282-288 (DOI:10.1016/S1473-3099(07)70082-8).
- v. Ansari F, Erntell M, Goossens H and **Davey P** (2009) The European surveillance of antimicrobial consumption (ESAC) point-prevalence survey of antibacterial use in 20 European hospitals in 2006. *Clin. Infect. Dis.* **49**, 1496-1504 (DOI: 10.1086/644617).
- vi. Vernaz N, Hill K, Leggeat S, Nathwani D, Philips G, Bonnabry P and **Davey, P** (2009) Temporal effects of antibiotic use and *Clostridium difficile* infections. *J. Antimicrob. Chemother.* **63**, 1272-1275 (DOI: 10.1093/jac/dkp128).

Funding

- **Davey P** (lead for Hospital Prescribing Sub-project) with Goossens (University of Antwerp): European Surveillance of Antimicrobial Consumption; DG Sanco of the European Union (01/10/2005 to 01/10/2007) Value to University of Dundee £16,562 (Total grant €3.5M).
- **Davey P** (lead for Work Packages 4 and 5) with Frank, Schumacher (University of Freiburg), Grundman (RIVM, Netherlands), Suetens (Institute of Public Health, Brussels): Burden of Resistance and Disease in European Nations; DG Sanco of the European Union. (01/07/2007 to 31/07/2009). Value to University of Dundee £185,256 (Total grant €1.32M).
- **Davey P** (with **Donnan P**, University of Dundee): Monitoring consequences of changes in antibiotic regime for surgical prophylaxis; Healthcare Associated Infection Task Force, Scottish Government (01/10/ 2011 to 30/06/2013) £60,227.
- **Davey P**, (with **Marwick C**, University of Dundee, Charani E, Imperial College Gould I, Ramsay C, University of Aberdeen): Systematic review and meta-analysis of interventions to improve antibiotic prescribing practices for hospital inpatients; Chief Scientist Office, Scotland (01/06/2013 to 31/03/2015) £174,906.

4. Details of the impact

Our research has been central to the development of methods for evaluating the impact of antibiotic policy and the relationship between hospital prescribing and resistance in Europe; Davey has, for example, participated in Europe-wide reviews of the issue [1,2]. In Scotland our work on prescribing indicators and quality improvement has enabled sustainable evaluation of hospital antibiotic prescribing by hospitals in all 14 Health Boards; this was accompanied by a demonstrated 43% reduction in *C. difficile* infection in Scotland between 2008 and 2011 [3,p7 and 4]

In addition to multiple citations of the main report of the Cochrane review [iii], its impact is evidenced by the ORION guidelines [iv] arising from subsequent collaboration with researchers

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from University College London and the University of Bristol. These have been endorsed by professional societies in the UK, Europe and USA and disseminated at their meetings [4]. The Cochrane review was quoted in the Scottish Management of Antimicrobial Resistance Action Plan (<http://www.scotland.gov.uk/Publications/2008/03/12153030/0>) and influenced the recommendation for a national organisation to integrate improvement in antibiotic prescribing with control of healthcare associated infection. This resulted in establishment of the Scottish Antimicrobial Prescribing Group (SAPG) as part of the Scottish Medicines Consortium (2007) [5].

Research outputs [i-iv] led to Davey being invited to lead the Hospital Subproject of ESAC from 2003-2010. From 2006-2010 Davey led the development and testing in 20 European hospitals of a web based method for reporting on point prevalence studies of antibiotic use [v]. The ESAC project continued until 2010 and the ESAC website documents wide dissemination across Europe. The 2009 point prevalence survey included 172 hospitals from 25 European countries [6]. In Scotland, hospitals from all 14 Health Boards participated in the 2009 ESAC point prevalence survey, and this is specifically cited by NHS Boards when discussing the impact SAPG has had in their area, in the SAPG 2009 Annual Report [7].

As the Representative with Responsibility for International Liaison and Research for SAPG **Davey** recommended that the ESAC quality indicators should be adopted as national targets. This SAPG recommendation was included by Scottish Government in 2009 as part of their HEAT (Health, Efficiency and Access to Treatment) target to reduce the rate of *C. difficile* Associated Disease among patients aged 65 and over by at least 30% by 31 March 2011 [8]. SAPG adapted the ESAC Point Prevalence Survey method for continuous measurement of compliance with the national targets for hospital antibiotic use. A secure, web based system was created for all acute hospitals in Scotland to report their compliance with antibiotic policy with monthly prevalence surveys in acute medical and surgical admission units. The recommended restrictive antibiotic policy for reducing *C. difficile* Associated Disease was based on **Davey's** study to identify high risk antibiotics [vi] as well as the Cochrane review [iii]. The SAPG Report on Progress from 2008-11 cites the development and measurement of hospital prescribing indicators as being critical to SAPG's contribution to the 43% reduction in *C. difficile* infection seen throughout NHS Scotland by national restriction of antimicrobials associated with a high risk of *C. difficile* infection [3,p7]. SAPG continues to use the hospital antibiotic prescribing indicators for measurement of antibiotic use and compliance with policy and produces annual reports [9,10]. The *C. difficile* infection HEAT target for 2009-11 has been reviewed by the Healthcare Acquired Infection Task Force and a new *C. difficile* infection target from April 2011 has been set using a 'best in class' approach so that by March 2013 the rate of *C. difficile* infection in patients aged 65 and over is 0.39 cases or less per 1000 total occupied bed days in all NHS boards. As a result of the impact of this work the University of Dundee is being funded by Scottish Government's Healthcare Associated Infection Task Force to work with National Services Scotland on the development of further quality indicators of hospital antibiotic prescribing. Internationally, the Clinical Excellence Commission in Sydney, Australia invited **Davey** to be a consultant in February 2013, and has subsequently adapted the ESAC quality indicators for implementation across New South Wales [11].

5. Sources to corroborate the impact

1. Adriaenssens N and Coenen S, for European Surveillance of Antibiotic Prescribing Management Team (2010) Disease-specific antibiotic prescribing quality indicators report. http://ecdc.europa.eu/en/activities/surveillance/esac-net/publications/documents/report_disease_specific_antibiotic_prescribing_quality_indicators.pdf
2. Corroboration statement from the Co-ordinator, European Surveillance of Antibiotic Consumption, Belgium.
3. Scottish Antimicrobial Prescribing Group (2011) Scottish Antimicrobial Prescribing Group Progress Report for 2008-2011; available at http://www.scottishmedicines.org.uk/files/sapg/SAPG_Progress_Report_2008-11.pdf.
4. Infectious Diseases Research Network. ORION Statement Website. <http://www.idrn.org/orion.php>.

Impact case study (REF3b)

5. Corroboration statement from Project Lead, Scottish Antimicrobial Prescribing Group, Scottish Medicines Consortium, Scottish Medicines Consortium.
6. Zarb P, Amadeo B, Muller A, Drapier N, Vankerckhoven V, Davey P, Goossens H; ESAC-3 Hospital Care Subproject Group (2011) Identification of targets for quality improvement in antimicrobial prescribing: the web-based ESAC Point Prevalence Survey 2009. *J. Antimicrob. Chemother.* **66**, 443-49 (DOI: 10.1093/jac/dkq430).
7. Andrea Patton on behalf of Scottish Antimicrobial Prescribing Group (2010) CDI HEAT Target (CEL April 2009) Hospital-based Empirical Prescribing National Report May 2010. http://www.scottishmedicines.org.uk/files/SAPG_Antimicrobial_Supporting_Indicators_Report_Final_National_Report_May_2010.pdf
8. McGuire M, Keel A and Scott B (Chief Nursing Officer Directorate) (2009) A revised framework for national surveillance of Healthcare Associated Infection and the introduction of a new Health Efficiency and Access to Treatment (HEAT) target for *Clostridium difficile*-associated disease (CDAD) for NHS Scotland. Scottish Government, Edinburgh. http://www.sehd.scot.nhs.uk/mels/CEL2009_11.pdf
9. Scottish Antimicrobial Prescribing Group (2010) Scottish Antimicrobial Prescribing Group Annual Report 2008-2009. http://www.scottishmedicines.org.uk/files/sapg/SAPG_AR_Lo-Res.pdf.
10. Scottish Antimicrobial Prescribing Group (2012) Empirical Prescribing Indicator Report April 2011 – December 2011 http://www.scottishmedicines.org.uk/files/sapg/Empirical_Prescribing_Report_February_2012.pdf.
11. Corroboration statement from Acting Deputy Chief Executive Officer, Clinical Excellence Commission of New South Wales, Australia.