

**THE SCOTTISH MANAGEMENT OF ANTIMICROBIAL
RESISTANCE ACTION PLAN [ScotMARAP] 2008**

HEALTHCARE ASSOCIATED INFECTION TASK FORCE

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The Scottish Management of Antimicrobial Resistance Action Plan 2008 (ScotMARAP)

1. Summary

Resistance to antibiotics and other antimicrobials is recognised nationally and internationally as a major threat to public health and patient safety which requires rapid and effective intervention. Prudent prescribing of antibiotics also has a major role to play in prevention and control of *Clostridium difficile* associated disease, though the organism itself is not regarded as antibiotic-resistant.

The recommendations set out in the *Antimicrobial Resistance Strategy and Scottish Action Plan* (SEHD 2002)¹ have now largely been implemented, or overtaken by subsequent developments. A Ministerial Healthcare Associated Infection (HAI) Task Force working group was commissioned to review the progress in delivery of these recommendations, and to produce the *Scottish Management of Antimicrobial Resistance Action Plan* (ScotMARAP). ScotMARAP expands on the issues raised in the guidance document *Antimicrobial Prescribing Policy and Practice in Scotland* (2005)², produced by the Scottish Medicines Consortium on behalf of the HAI Task Force, and outlines the national programme for Scotland over the next five years.

The major elements of ScotMARAP include:

- Establishing a communications network for NHSScotland which brings together microbiologists, infection control professionals, pharmacists, prescribers and national expert bodies (e.g. Health Protection Scotland, Information Services Division of National Services Scotland, NES Education for Scotland) within a new national forum
- Ensuring robust and quality controlled systems for data gathering both for surveillance of resistant organisms and use of antimicrobial agents
- Collation, analysis and interpretation of these data at local and national level
- Implementation and monitoring of antimicrobial prescribing policies at local and national level
- Education and training in prudent antimicrobial prescribing.

Key issues for action within ScotMARAP include:

- Utilising existing pharmacy and prescriber networks by tasking the Scottish Medicines Consortium to convene a new national antimicrobial Prescribing Group, membership to include Health Protection Scotland, NHS Education for Scotland, the Information Services Division of

National Services Scotland, and other expert sources of information and advice

- Implementing standardised automated sensitivity testing across Scotland, linked to national surveillance programmes
- Driving forward the collection of prescribing information - using standardised definitions - within the hospital and 'out of hospital' sectors, with clear links to antimicrobial resistance data and clinical information
- Ensuring the establishment and effective working of Antimicrobial Management Teams within every NHS Board in Scotland
- Further development of education and training frameworks, programmes and competencies, including promotion of prudent prescribing as part of the mandatory Continuing Professional Development element as stated in the HAI Task Force *Code of Practice for the Local Management of Hygiene and HAI* (SEHD 2004)³.

ScotMARAP is intended as a five-year strategic plan which will undergo continual review within its implementation. A formal review will be conducted in 2013, or earlier if appropriate.

The Action Plan outlines these roles and responsibilities as they apply to the various national and local agencies.

2. Background

The worldwide threat from antimicrobial resistant organisms is increasing. The consequences of this for society as a whole are potentially very serious. Various threats to health are posed by antimicrobial resistance:

- Some infections may become untreatable
- Empirical antimicrobial treatment may become increasingly ineffective, and thus time may be lost in treating critically ill patients
- Length of hospital stay, antimicrobial use, morbidity, mortality and overall costs to all involved may be increased
- Less effective, more toxic, and/or more expensive alternative medications may be required⁴
- Other interventions e.g. organ transplantation, cytotoxic therapy for cancer, hip replacements, may prove increasingly ineffective should prophylactic and empirical antimicrobial therapy fail
- The reduced ability to control bacterial infection will impede progress in the development of innovative medical procedures.

The development of antimicrobial resistance is a complex evolutionary process. The major factor is exposure to antimicrobial agents but there are, however, other drivers for resistance including other drugs and environmental factors. Certain prescribing practices are likely to exacerbate the development of antimicrobial resistance⁵. The association between antimicrobial prescribing and the emergence of resistance is not straightforward; once resistance has developed, removal of the agent selecting for resistance will not necessarily result in the disappearance of resistant strains. However, prudent prescribing using agents less likely to select for resistance can delay the emergence of resistant strains⁶. It is hard to prove that changing practice, including prudent antimicrobial prescribing, reduces the emergence of resistance, but it is certain that failure to change will worsen the current situation.

It is known that a significant proportion of current antimicrobial usage in hospitals is not 'prudent'⁷; this is mainly an issue of excessive use (use of an antimicrobial where not necessary or prolonged courses), or inappropriate choice of (or incorrect dosing of) antimicrobial agent for treatment or prevention of the relevant infection. Prudent prescribing of antimicrobials may prevent, or at least slow the rate of, the development of drug resistant strains^{8,9} – for example, the Scottish Intercollegiate Guidelines Network SIGN 88 document, *Management of Suspected Bacterial Urinary Tract Infection in Adults*, has defined criteria where it is inappropriate to use antimicrobials for this condition¹⁰. Promoting good prescribing practice is an ongoing process requiring continuing vigilance. It will be greatly enhanced by developing better information systems about resistance patterns, and improved and more consistent dissemination of current and future information to those who need it most urgently, namely prescribers at the point of writing prescriptions.

In addition to the selection of resistant bacteria by antimicrobial treatment, spread of infection in hospital is encouraged by other factors such as poor hygiene, crowded environments, transfers of potentially or actually infected patients between wards in hospitals, and the fact that hospitals, care homes and other healthcare settings can act as a significant reservoir of resistant bacteria. It is imperative that NHS Boards institute, audit and regularly review policies and procedures that promote prudent antimicrobial prescribing and minimise the incidence of antimicrobial resistance (and the attendant patient morbidity and mortality). This will also reduce the increasing risks of litigation when patients acquire resistant infections during healthcare.

There is significant public, political and professional concern about the emerging and apparently increasing problem of *Clostridium difficile* associated disease. This is not an issue of antimicrobial resistance, but its emergence and the precipitation of illness in patients may well be directly related to all the prudent prescribing factors cited as contributing to the overall resistance problem. It is clear to the Group that the interventions proposed to alleviate antimicrobial resistance could also contribute significantly to the prevention and control of *C. difficile* associated disease.

There is clearly an issue for use of antimicrobials in 'out of hospital' care as well as within hospitals; infection with resistant organisms in the community is most likely to arise in those recently treated with antimicrobial medications¹¹⁻¹⁵, and it is increasingly recognised that many cases of *Clostridium difficile* are generated in community settings.

The Ministerial Action Plan *Preventing Infections Acquired While Receiving Healthcare*¹⁶ published in 2002 included actions relating to antimicrobial resistance; these were included in the overarching work programme of the Ministerial Healthcare Associated Infection (HAI) Task Force¹⁷ formed as a result of the Action Plan. The HAI Task Force has produced a raft of policies and supporting documents complementary to the antimicrobial resistance issues, including the *Code of Practice for the Local Management of Hygiene and HAI*³, hand hygiene initiatives, extensive education and training resources in infection prevention and control, a National Cleaning Services Specification¹⁸, and changes to organisational structures. It is the primary aim of these strategies that they will lead to a reduction in the magnitude of this important public health problem.

The Scottish strategic approach to antimicrobial resistance

In 2002, the Scottish Executive (now the Scottish Executive) produced the *Antimicrobial Resistance Strategy and Scottish Action Plan*¹. The three key elements of this strategy were:

- Surveillance: to monitor and provide data on resistant organisms, associated morbidity, and antimicrobial usage
- Prudent antimicrobial use: to reduce unnecessary and inappropriate exposure of micro-organisms to antimicrobials in clinical practice

- Infection prevention and control: both in general and with a specific focus on antimicrobial resistant organisms.

In response, one strand of the HAI Task Force work programme was the publication *Antimicrobial Prescribing Policy and Practice in Scotland: recommendations for good antimicrobial practice in acute hospitals (APP&P)* in 2005². This document detailed the practical steps to be taken by acute hospitals to improve the quality of antimicrobial prescribing and thus reduce the risk of resistance. These are presented under six key areas:

- Establishing lines of responsibility and accountability in NHS Boards;
- Defining structures and responsibility for multidisciplinary and generic undergraduate and postgraduate training relating to antimicrobial prescribing;
- Defining the minimum dataset requirements and standard procedures for collecting information related to antimicrobial resistance patterns;
- Defining the minimum dataset requirements and procedures for collecting information related to antimicrobial consumption and quality of prescribing;
- Defining the key areas for acute hospital policy and recommendations for audit; and
- Defining and developing performance indicators.

There has been some progress since publication of APP&P in implementing these recommendations; however it is clear that to sustain and enhance this progress, further work is necessary. Specifically, there is an urgent need in the short term to contain and then reduce the spread of antimicrobial resistant organisms as part of the broad agenda for the HAI Task Force and for NHSScotland.

There are specific and significant public concerns about the risk of acquiring antimicrobial resistant organisms - the so-called 'super bugs' – and *C. difficile* while in hospital, either as a patient or as a visitor. Whatever the evidence from surveillance, this risk is popularly perceived as being on the increase. Public involvement is already well embedded within the HAI Task Force strategy to reduce the prevalence of HAIs. To help allay these fears, further work is required to educate the public in order to promote their knowledge of (and involvement with) hospital and 'out of hospital' care, infection control and prevention, and antimicrobial management. Much is being done by the HAI Task Force Public Involvement Communications Team¹⁷. The Chief Medical and Nursing Officers have jointly issued 'Five Top Tips' to help engage patients and visitors in preventing infections¹⁹.

Also in 2005, the Care Commission published *A Review of Cleanliness, Hygiene and Infection Control in Care Homes for Older People*²⁰ which confirms that, in order to prevent and reduce infections, older people in care homes must have a clean and safe environment, where staff receive regular infection control and prevention training.

International Examples of Good Practice

In 1998 the European Union made recommendations in response to the threat of antimicrobial resistance²¹. These recommendations emphasised that:

- Antimicrobial resistance is a major European and global problem
- Prudent use of antimicrobials should be promoted
- Member states should set up surveillance systems for antimicrobial resistance
- Member states should collect data on the supply and consumption of antimicrobial agents.

In relation to this, certain European countries (Denmark, Sweden, Netherlands and others), now have national agencies which produce annual reports detailing the incidence of antimicrobial resistance, trends in antimicrobial usage for humans and animals, and studies examining the links between antimicrobial use and antimicrobial resistance²²⁻²⁴. These reports are disseminated widely and help ensure that appropriate action is taken where indicated. For example, in Sweden, colonisation and carriage as well as actual infection with Meticillin Resistant *Staphylococcus aureus* (MRSA) is now reported (mandatory by legislation) and areas of high or increasing incidence are identified, investigated and appropriate action taken²³. Sweden, Denmark and the Netherlands tend to have a lower incidence of antimicrobial resistance; however, it is not proven that these measures alone are responsible for the observed lower prevalence, as each of these countries have implemented additional policies to control the spread of resistance. It is also important to note that these countries introduced measures when the incidence and prevalence of resistance (particularly in the case of MRSA) was low. Implementation of similar measures in Scotland may not necessarily have the same magnitude of beneficial effect, as we already experience a comparatively high level of antimicrobial resistance²⁵.

In May 2005 the European Centre for Disease Prevention and Control (ECDC) was established under the direction of the European Parliament and Council²⁶. With respect to antimicrobial resistance, this organisation aims to:

- Identify and maintain networks of microbiological reference laboratories
- Develop epidemiological surveillance to identify and assess emerging threats to human health from communicable diseases
- Communicate objective, reliable and easily accessible information to the public and decision makers on communicable diseases relevant to health.

The ECDC has stated in its annual epidemiological report for 2007 that *“The most important disease threat in Europe is posed by micro-organisms that have become resistant to antibiotics... Each year approximately three million people in the European Union catch a healthcare-associated infection, of whom approximately 50 000 die”*.²⁷

3. The Scottish Management of Antimicrobial Resistance Action Plan (ScotMARAP)

The Healthcare Associated Infection (HAI) Task Force set up a Steering Group on the Antimicrobial Resistance Strategy and Scottish Action Plan in 2006, with the remit of:

- assessing progress with the implementation of the 2002 *Antimicrobial Resistance Strategy and Scottish Action Plan*¹ and producing a successor document
- assessing progress with the implementation of the 2005 Scottish Medicines Consortium/HAI Task Force document *Antimicrobial Prescribing Policy and Practice*² (APP&P) and identifying outstanding actions required to achieve the goals of:
 - Reducing antimicrobial resistance
 - Promoting prudent antimicrobial prescribing
 - Developing a strategic approach to the systematic identification and containment of future resistant organisms.

The Steering Group fully endorses the conclusions of the *Antimicrobial Prescribing Policy and Practice* document² and notes that NHS Boards are moving towards implementing at least some of the major recommendations. The Steering Group notes however that progress in this area has been slow and patchy. In addition, this report focused solely on the acute, hospital setting and did not address the 'out of hospital' care environment. The present report includes all situations whether 'in hospital' or 'out of hospital' care.

The Steering Group believes that progress towards full implementation should be accelerated despite the many competing demands on NHS Board resources. The issue is of great concern to clinical, public health and other healthcare professionals, and to patients and their carers. Moreover, there is increasing public concern surrounding the perceived increase in frequency of healthcare associated infection associated with resistant organisms ('superbugs'), particularly in the hospital environment. This concern also now extends to *Clostridium difficile* infection, which is related to antibiotic use though not strictly a 'resistant' organism: the principles expressed in the current document apply in large part to prevention and control of *C. difficile* infection.

The Group believes that it is now time to bring together several strands of information relevant to antimicrobial resistance. These include data on current and past levels of resistance in various sites within NHS Scotland, and data on antimicrobial prescribing patterns within the same environments. Such information should be collected, collated and analysed in a standardised manner, and thereafter communicated at appropriate regular intervals directly both to NHS Boards, their Area Drugs and Therapeutics Committees and Antimicrobial Management Teams and, through them, to prescribers.

This current document will detail a strategy for Scotland to take forward key recommendations from the *Antimicrobial Prescribing Policy and Practice* document² and meet National and European recommendations in:

- promoting prudent prescribing of antimicrobials through improved diagnostics, feedback of surveillance data to prescribers, and education of staff
- collating, analysing and reporting, in a standardised manner, local and national trends in antimicrobial resistance to allow early identification of serious antimicrobial resistance within hospitals and the community
- collating, analysing and reporting, in a standardised manner, local and national trends in antimicrobial utilisation in primary and secondary care to monitor and improve antimicrobial use
- linking data on antimicrobial utilisation and antimicrobial resistance
- monitoring the success of interventions to reduce the level of resistance.

Education of the public is also important and should be considered, albeit with due caution around possible unintended consequences²⁸. Further research to provide sound evidence on the safety and effectiveness of public media campaigns and other approaches in this area is clearly required.

The Steering Group recommendations follow. These incorporate the six original key areas identified in the *Antimicrobial Prescribing Policy and Practice*¹⁵ publication, but are broadened, and where appropriate, cover both hospital and 'out of hospital' care settings. The recommendations cover antimicrobial resistance, antimicrobial utilisation, and education of NHS staff (and of the general public as appropriate) on use of antimicrobials. These recommendations are specifically detailed for each responsible organisation, team and individual. In order, the action points are listed for the following agencies:

- Scottish Government Health Directorates (previously the Scottish Executive Health Department)
- Scottish Medicines Consortium (SMC)
- NHS Quality Improvement Scotland (QIS)
- Health Protection Scotland (HPS)
- National Medicines Utilisation Unit (NMUU)
- NHS Education for Scotland (NES)
- NHS Boards
- NHS Board Antimicrobial Management Teams (BAMT)
- Diagnostic services
- Individual prescribers, including supplementary and independent prescribers.

The Steering Group recognises that, in order for all national groups to fulfil these recommendations, there will be resource implications.

4. Action plan: Scottish Government Health Directorates (SGHD)

The primary role for SGHD is to encourage and facilitate the detection and reporting of local and national trends in antimicrobial resistance and antimicrobial utilisation by allocating tasks and ensuring consistency and coherence with related health policy developments. The principal task in the context of the current document is to ensure the establishment of a national framework for the generation, collation, interpretation and dissemination of data from national agencies to NHSScotland, and to provide systems for the effective communication of relevant information and policies.

Antimicrobial resistance

It is noted and welcomed that, in order to provide better-validated and consistent information concerning antimicrobial resistance to prescribers, microbiologists, antimicrobial management teams (AMT) and also for national surveillance programmes, the Scottish Government is funding purchase of standardised automated antimicrobial sensitivity testing equipment across all NHS Boards. This has been implemented as part of the HAI Task Force programme, and that body will continue to oversee and further develop the national strategic context for antimicrobial resistance.

Health Protection Scotland is tasked with collating, analysing and interpreting these surveillance data in order to help minimise the spread of antimicrobial resistance.

Antimicrobial Utilisation

The National Medicines Utilisation Unit (NMUU) can currently collate data on antimicrobial usage for NHS 'out of hospital' care. There is at present no equivalent standardised information available for hospital services or private prescribers and suppliers (e.g. dentists); systems should be put in place as soon as possible to facilitate provision of this information. *A Scottish prescription: Managing the use of medicines in hospitals*, a report prepared by Audit Scotland²⁹, highlighted that data linking antimicrobial usage to diagnosis are also not available; again, new systems will be required to facilitate the provision of this information. It is appreciated that such systems may not be operational for some years, but work to provide them is urgently required if we are to address the problem of resistant infections in hospitals, and indeed many other issues surrounding prescribing habits in Scotland.

The Steering Group recommends that there is a need for SGHD to identify a national body to work closely with Health Protection Scotland and the National Medicines Utilisation Unit to collate and disseminate scientifically rigorous information on antimicrobial resistance trends and antimicrobial use on an ongoing regular basis to NHS Boards, their Antimicrobial Management

Teams, national stakeholder organisations, and the Scottish Government. This should also encourage and promote investigation into variations in antimicrobial prescribing and microbial resistance patterns and thereby encourage the adoption of best practise across the country. The Steering Group has considered the possible bodies that could fulfil this function and recommends that the Scottish Medicines Consortium be tasked to undertake this additional function. Agreement in principle from Scottish Medicines Consortium has been obtained.

Education

Education of prescribers should be co-ordinated through NHS Education for Scotland as part of the ongoing suite of initiatives developed by them on behalf of the HAI Task Force. Consideration should also be given to, if or how appropriate methods of public education on antimicrobials can be facilitated.

5. Action Plan: Scottish Medicines Consortium (SMC)

The proposed primary role for SMC is to convene and service a group to fulfil the aspirations for a ‘national clinical forum’ as expressed in APP&P recommendations¹². This group would include national stakeholder organisations and would collate and disseminate scientifically rigorous information on antimicrobial resistance trends and antimicrobial use on an ongoing regular basis to NHS.

This body, formed as a Consortium of NHS Boards, has an established record of providing regular monthly advice on all newly licensed medicines to NHS Boards on a clearly defined cycle and has participation from all relevant prescriber groups (currently with the sole exception of dentists). To achieve the additional task of convening a ‘national clinical forum’ will require the Scottish Medicines Consortium to set up a new subgroup, (the Antimicrobial Prescribing Group) within its existing structure. The subgroup will include input from clinicians, dentists, microbiologists and pharmacists in addition to the major stakeholder organisations. It would be appropriate for the Chairperson and deputy to be represented on the Scottish Medicines Consortium itself. As all NHS Boards currently have structures to deal with Scottish Medicines Consortium monthly advice, it seems appropriate for them to deal with additional material regarding antimicrobial prescribing information and antimicrobial resistance patterns, aligned with information on infection surveillance as required. The high standing of the Scottish Medicines Consortium amongst prescribers, NHS Boards and the general public, together with its previous interest in this area in producing APP&P identifies it as the ideal body to fulfil this crucial new function with maximal use of, and minimal disruption to, existing structures.

The Scottish Medicines Consortium, recognising the extensive work already done by Health Protection Scotland and the National Medicines Utilisation Unit in the area of antimicrobial resistance and antimicrobial usage, should task its Antimicrobial Prescribing Group to:

- collate and disseminate standardised local and national surveillance data on antimicrobial resistance and antimicrobial usage provided by HPS, NMUU and other agencies, ensuring compatibility wherever possible with the rest of the UK and other European countries
- relate information on patterns of antimicrobial resistance to antimicrobial prescribing in Scotland and UK, as part of national and international efforts to improve knowledge on how use of antimicrobials may contribute to the development of, and control of, antimicrobial resistance. The Scottish Government may wish to encourage submission of the resulting information to the European Centre of Disease Prevention and Control (ECDC) and the European Surveillance of Antimicrobial Consumption (ESAC) programme
- produce an annual national report which systematically details:

- analysis and interpretation of data, including long term trends in antimicrobial resistance, for clinically important organisms
- local and national antimicrobial usage
- variations in practice and the reasons for them
- co-ordinate work undertaken by research units, HPS, the Scottish Microbiology Forum, and Antimicrobial Management Teams to explore and determine new risk factors and drivers for resistance patterns over time
- feed back to each NHS Board Antimicrobial Management Team their use of antimicrobials and incidence of antimicrobial resistance relative to other hospitals /NHS Boards
- collate national data on performance indicators as and when defined and agreed with key stakeholders (e.g. Scottish Government Health Directorates, NHS Quality Improvement Scotland, Health Protection Scotland, Scottish Microbiology Forum) and feed back the results to NHS Boards and Antimicrobial Management Teams.
- report at appropriate intervals on the usage patterns of agreed key antimicrobials in target infection groups across NHS Boards and encourage investigation of any apparently regional significant differences. Variations in the use of key antimicrobials could be a pointer to better clinical management and containment of spread of antimicrobial resistance
- provide a forum from which antimicrobial prescribing policies across Scotland can be co-ordinated and publicised in conjunction with NHS Board Antimicrobial Management Teams.

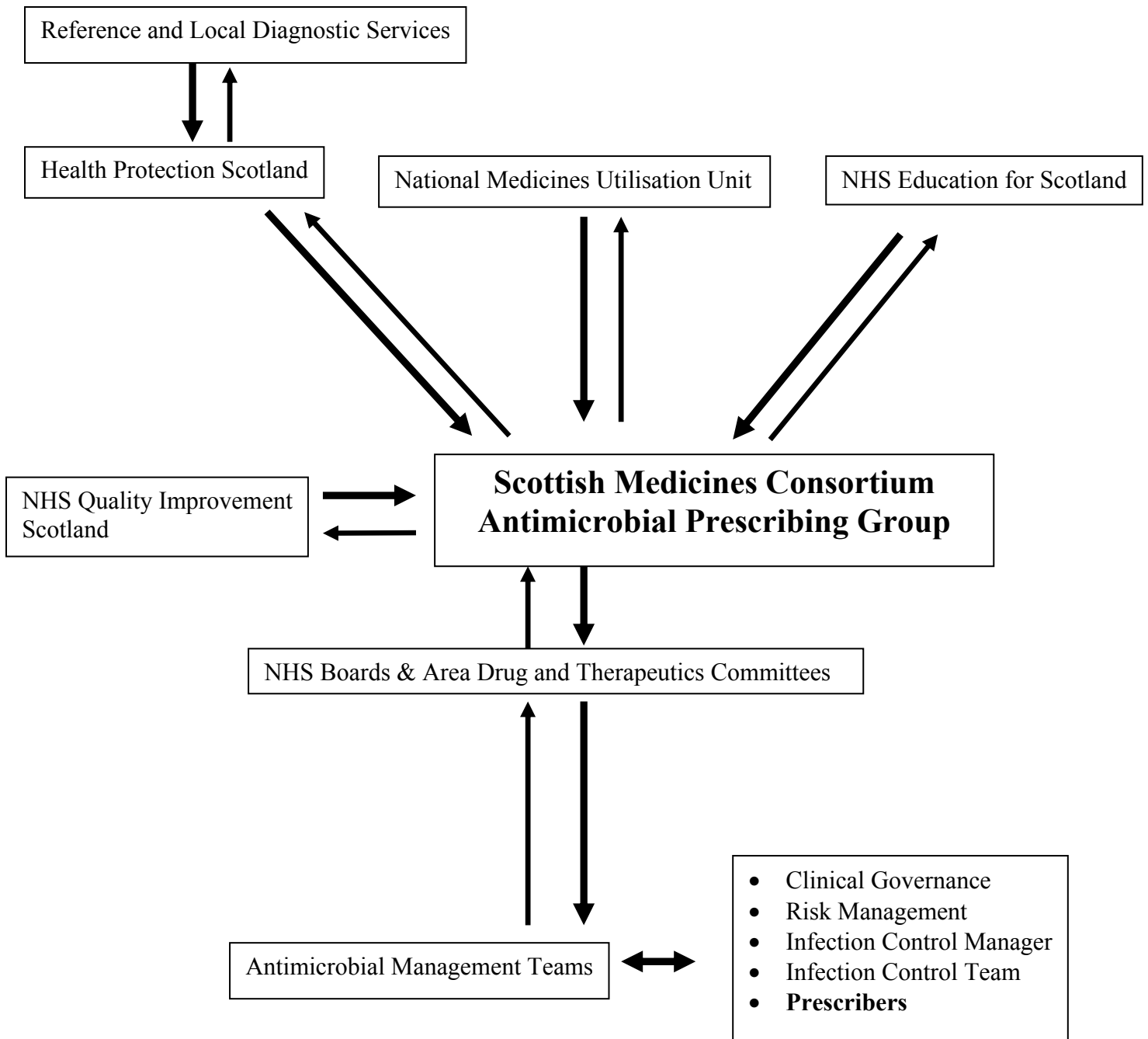
The importance of collating and reporting Scottish antimicrobial utilisation trends across Scotland is emphasised in the recommendations to the Scottish Executive (*now the Scottish Executive*) within the 2005 Audit Scotland report²⁹.

Where unusual levels of antimicrobial resistance and/or antimicrobial utilisation are identified, further follow-up may be required by the appropriate body – e.g. HPS, NMUU and NHS Board Antimicrobial Management Teams - in conjunction with the Scottish Medicines Consortium where appropriate.

The Steering Group recognises that there will be resource implications to support these recommendations. These could be met, at least in part, by re-allocation of existing resources.

The location of the Antimicrobial Prescribing Group within the existing and proposed structures is shown in Figure 1.

Figure 1: Communication Structure



6. Action Plan: NHS Quality Improvement Scotland (NHS QIS)

The key role for NHS Quality Improvement Scotland reflects its specific responsibility for patient safety and better integration and co-ordination of national organisations with an interest in quality of care.

The Scottish Medicines Consortium is administratively a part of NHS QIS, and NHS QIS will therefore play a key role in facilitating and supporting the developments proposed for SMC.

NHS Quality Improvement Scotland, linking with other relevant bodies should also help develop performance indicators (and possibly Standards) for prudent antimicrobial prescribing, in order to generate data which would enable measurement to track improvement in quality of care and patient safety.

There may be some synergy with existing proposals for improving quality of prescribing within NHS QIS's involvement with the Scottish Patient Safety Alliance programme.

7. Action Plan: Health Protection Scotland (HPS)

The primary role for HPS relates to national surveillance, a complex process which involves establishing national data definitions and data collection systems; collation, analysis and interpretation of quality controlled data; and dissemination of information in a timely manner to those who need to know.

Health Protection Scotland collates, analyses and interprets data from the current voluntary national antimicrobial resistance surveillance programmes, including offering professional advice. HPS is also a key player in the development and implementation of many of the HAI Task Force initiatives. HPS should work closely with the Scottish Medicines Consortium as described above to achieve the ScotMARAP objectives.

The Steering Group fully supports the work of Health Protection Scotland and recommends that it should:

- continue to build on the existing work on surveillance of antimicrobial resistance, work with the Scottish Microbiology Forum to improve and standardise diagnostic and antimicrobial susceptibility testing methods and develop consistent reporting of key resistance markers for alert organisms and for specific sites (e.g. blood cultures), in line where possible with other UK and European countries. Also, to systematically monitor long term trends in antibiotic resistance.
- conduct and co-ordinate detailed quantitative epidemiology of selected antimicrobial resistant organisms to establish the true magnitude of resistance in the community.
- work closely with the National Medicines Utilisation Unit and Scottish Medicines Consortium to produce linked regular reports on antimicrobial consumption and antimicrobial resistance
- continue to develop the national surveillance programme to provide information which informs guidance on prudent antimicrobial prescribing, such as the *Clostridium difficile* and the surgical site infection surveillance programmes
- develop surveillance programmes at local and national levels as appropriate when new resistance mechanisms are identified through research and/or enhanced surveillance, in order to monitor spread and develop interventions in association with local teams and other national bodies
- apply standardised epidemiological methods to clarify whether the dissemination of any resistant infection is due to the spread of a previously recognised resistant strain or the acquisition of a new resistant clone.

8. Action Plan: National Medicines Utilisation Unit (NMUU)

A key role for NMUU is the development of systems to collect and collate information on antimicrobial prescribing, particularly within hospitals. The UK lags behind much of Europe in being able to access these hospital data, and in Scotland this represents the major outstanding task within the 2002 *Antimicrobial Resistance Strategy and Scottish Action Plan*¹.

The National Medicines Utilisation Unit (National Services Scotland) supports the collection and dissemination of information on the use of medicines across NHS Scotland, including support for the development of a national hospital medicines utilisation database. The Steering Group fully supports this initiative and believes that NMUU should work closely with the Scottish Medicines Consortium and Health Protection Scotland to:

- report the usage of agreed key antimicrobials in target groups across NHS Boards
- evaluate the current information gaps (including antimicrobials prescribed privately, in prisons and supplied directly by dentists) and review the systems and resources necessary to enable appropriate capture of prescribing activity
- establish agreed standardised national units of measurement and performance indicators for antimicrobial utilisation in conjunction with NHS Quality Improvement Scotland and HPS
- inform the future development of electronic prescribing and how this will ensure provision of data on antimicrobial use, including linking of antimicrobial usage data to infection diagnoses
- work with HPS and SMC in linking data on antimicrobial resistance to antimicrobial prescribing.

It is appreciated that the NMUU may require additional resources to undertake this work.

9. Action Plan: NHS Education for Scotland (NES)

The primary role for NES is to continue to develop and deliver multidisciplinary education initiatives which promote prudent antimicrobial use and awareness of prevention and control of infection

*Antimicrobial Prescribing Policy and Practice*² states that structures for multidisciplinary and generic undergraduate and postgraduate training related to antimicrobial prescribing should be defined. That document applied only to hospital care, and the Steering Group recommends that these issues now be extended to include 'out of hospital' practice.

The *NHSScotland Code of Practice for the Local Management of Hygiene and Healthcare Associated Infection*³ states that healthcare workers, i.e. clinicians and support staff, must identify specific HAI objectives for continuing professional development (CPD) within their annual personal development plan.

NHS Education for Scotland should continue to develop and co-ordinate a national infrastructure, with the involvement of key stakeholders (Higher Education Sector, Health Protection Scotland, Medical Royal Colleges, Nursing and Midwifery Council, General Dental Council, and Royal Pharmaceutical Society), to allow all prescribers to have access to programmes on antimicrobial prescribing and resistance and the impact of both on Healthcare Associated Infection.

NES has already produced a short programme on antimicrobial prescribing, (now mandatory) for Foundation Year doctors, and this will be further developed for non-medical prescribers. A series of tutorials and vignettes are under development relating to MRSA, MSSA and *C.difficile* which, together with an educational package on bacterial resistance, should be available in 2008.

NES will continue to progress work in the following areas in conjunction with other key stakeholders;

- agree national core competencies for all multidisciplinary prescribers of antimicrobials and specific competencies for each profession, as appropriate.
- adapting, and making available nationally, the Scottish Government funded project on prudent prescribing for trainee doctors, for doctors in practice and other health professionals involved in prescribing (www.dundee.ac.uk/facmedden/APT).
- ensure education programmes identify the difference between colonisation and infection with resistant organisms, e.g. MRSA
- progress multidisciplinary HAI education, ensuring accurate and good quality information relating to antimicrobial resistance
- consider, within 3-5 years, the commissioning of formal post graduate education modules in infection management, suitable for

multidisciplinary education and with a focus on prescribing and the development of resistance to antimicrobials. For those who wish, MSc degrees or specific modules therein could become a feature of CPD in this area.

10. Action Plan: NHS Boards and their Area Drug and Therapeutics Committees

All NHS Boards should immediately set up, as a sub group of their Area Drug and Therapeutics Committee (ADTC), Antimicrobial Management Teams (AMT), where these are not already in place.

To ensure effective communication with SMC and linkage with other appropriate systems the AMT should be a sub group of the NHS Boards Area Drug and Therapeutics Committee.

To maximise implementation and monitoring of the impact of any actions required or taken, the Antimicrobial Management Team in liaison with the Area Drug and Therapeutics Committee should also link closely with:

- clinical governance and risk management teams within NHS Boards and other appropriate bodies
- NHS Board Infection Control Committee
- the Infection Control Manager
- appropriate 'out of hospital' agencies.

In collaboration with their Area Drug and Therapeutics Committees, Antimicrobial Management Teams would receive, disseminate and ensure implementation of advice from the Scottish Medicines Consortium at NHS Board level regarding antimicrobial resistance and antimicrobial utilisation, and co-ordinate work across hospital and 'out of hospital' care areas.

All ADTCs should ensure that Antimicrobial Management Teams involve and engage with members of the public in a meaningful way. These persons would link into existing formal Patient Focus and Public Involvement (PFPI) structures.

NHS Boards should also ensure that the antimicrobial Automated Sensitivity Testing equipment, recently funded by the Scottish Government via a new national contract, is adequately supported in terms of purchase of consumables and participation in the national surveillance arrangements as specified by Health Protection Scotland.

11. Action Plan: Antimicrobial Management Teams (AMT)

The role of the Antimicrobial Management Team in improving standards of antimicrobial use includes supporting staff education and clinical governance, promoting application of hospital antimicrobial policies, and enabling audit and feed back of these policies. In the context of single system working, hospital and 'out of hospital' care are both included in the remit of the Antimicrobial Management Team.

The *Antimicrobial Prescribing Policy and Practice* document² highlighted concern about insufficient liaison between microbiologists, clinicians and pharmacists. The Infection Control Manager, lead physician, microbiologist and pharmacist for antimicrobial prescribing should take responsibility to ensure the Antimicrobial Management Team(s) are set up and fully functional as soon as practical. The Antimicrobial Management Team including lead antimicrobial physician, lead microbiologist, lead antimicrobial pharmacist and other appropriate professionals should work supportively and collaboratively to promote prudent antimicrobial use through the actions outlined in this section.

Larger NHS Boards may wish to establish local hospital antimicrobial management teams, to facilitate the implementation of the recommendations.

Reporting Local and National Trends on Antimicrobial Resistance and Antimicrobial Utilisation

All Antimicrobial Management Teams should ensure that the relevant recommendations are adopted from *Antimicrobial Prescribing Policy and Practice*². These are:

- For the purpose of appropriate patient management and antimicrobial resistance surveillance, blood cultures should be submitted before antimicrobial administration in all patients with possible bacteraemia
- MIC or zone sizes must be measured for all clinically relevant bacterial isolates
- Susceptibility to non formulary or restricted agents should not routinely be reported by microbiology departments
- Standard systems should be in place for bringing antimicrobial resistance alerts to the notice of the infection control team and clinicians/prescribers
- The institution laboratory susceptibility data should be published annually. Duplicate isolates should be removed from the analysis. Local susceptibility data should be used to inform prescribers, policies and formularies.
- All acute hospitals should analyse and report antimicrobial use using the World Health Organization Defined Daily Doses numerator and total occupied bed days as the denominator

- The use of key antimicrobials should be analysed and evaluated on a monthly to 3 monthly basis for each hospital, group of hospitals, directorates and specific wards
- The Antimicrobial Management Team should liaise and co-ordinate with the Area Drug and Therapeutics Committee on controlling the introduction and the use of new antimicrobial medication.

In addition, all Antimicrobial Management Teams:

- should receive, and ensure implementation of, advice from the Scottish Medicines Consortium at local level about antimicrobial resistance patterns and antimicrobial utilisation in a timely manner
- should ensure that information sent from Scottish Medicines Consortium is disseminated in a timely manner to all relevant parties
- should co-ordinate the work across hospital and 'out of hospital' care areas
- link with the Scottish Medicines Consortium in determining new risk factors and drivers for resistance. Where risks are identified, Antimicrobial Management Teams should work with local infection control teams and area drug and therapeutics committees, clinical governance and risk committees to minimise emergence of resistance.
- monitor the burden of disease caused by antimicrobial resistant strains and antibiotic-related infections (initially targeted at key organisms e.g. MRSA bacteraemias, pneumococcal bacteraemia and *Clostridium difficile* infection).

Education of staff

To ensure quality and safety objectives are achieved, Antimicrobial Management Teams should help ensure the implementation of multi-professional educational programmes developed by NHS Education for Scotland for contracted and employed staff, including staff in the independent sector. These will relate to healthcare associated infection, antimicrobial resistance and prudent antimicrobial prescribing, working in collaboration with infection control committees and Infection Control Managers.

Clinical Governance in Antimicrobial Utilisation and Measures for Improvement

Appropriate use of antimicrobials is an important clinical governance issue. The Antimicrobial Management Team should ensure compliance with evidence based infection related Scottish Intercollegiate Guideline Network (SIGN) guidelines and audit recommendations within these guidelines, which should be used to monitor quality of prescribing practice in hospitals and community.

Antimicrobial management teams should also feed back to Scottish Medicines Consortium information on effective actions and good practice which promote prudent antimicrobial prescribing and reduction in antimicrobial resistance.

Infection Control Managers, working with the Antimicrobial Management Team, will have managerial responsibility for ensuring implementation of, compliance with, and review of, prudent antimicrobial prescribing policies. Together they will implement, deliver and supervise:

- specific competencies and capabilities for each healthcare professional group based on national core competencies as defined by NHS Education for Scotland;
- identification of an education facilitator or education subgroup within their institution. This person or group should oversee the achievement and maintenance of specific competencies and capabilities for antimicrobial prescribing for individual prescribers and groups of prescribers.

In terms of clinical governance for antimicrobial utilisation and measures for improvement, data relating to antimicrobial performance indicators should be fed back to risk management and clinical governance bodies to help ensure best standards of good quality and safe care.

In relation to hospital policies and audit, the Antimicrobial Management Team should ensure that:

- where appropriate, all new staff are aware of antimicrobial policies at induction
- all microbiologists, pharmacists and prescribers are aware of hospital policies relating to antimicrobial use and antimicrobial resistance
- antimicrobial policies are regularly updated, with stated review dates, to reflect local antimicrobial resistance patterns and inform appropriate treatment
- compliance with antimicrobial policies is audited regularly and results fed back to local users
- information on unexplained departures from prescribing policies is fed back to prescribers and to the risk management and clinical governance groups in order to optimise patient care
- working with the infection control manager they are active in ensuring that national and local policies are followed in the boarding-out of potentially or actually infected patients. Generally such patients should not be boarded to other wards except for clinical reasons and in major emergencies.

All Antimicrobial Management Teams should ensure that they have adequate public representation as fully engaged and involved members.

12. Action Plan: Diagnostic Services

As a matter of clinical governance and patient safety, diagnostic services should be adequately resourced to support rapid clinical diagnosis and to maximise appropriate antimicrobial prescribing.

In particular:

- microbiology laboratories should implement the antimicrobial sensitivity testing methods and implementation of automated sensitivity testing as recommended by the Scottish Microbiology Forum Antimicrobial Sensitivity Testing subgroup
- at a local level, turnaround times for antibiotic sensitivity tests should be as short as possible, and the advice made available timeously to the clinician at the point of delivery of care to the patient
- routine reporting of sensitivity to antimicrobial agents which are not included in the local antimicrobial policy should be avoided
- laboratories should implement rapid diagnostic methods such as Polymerase Chain Reaction, antigen testing or other markers of infection, where consensus exists around methodology, and normally in conjunction with advice from the Scottish Microbiology Forum
- Reference laboratories have a role to play in the monitoring of resistance and emergence of new resistance mechanisms. Service level agreements between Reference Services and HPS should be reviewed to ensure this is included within their remit
- Turnaround times for disseminating results from reference laboratories need to be rapid to be clinically meaningful and thereby facilitate control of spread of target organisms and to disseminate reports at a local and national level.

13. Action Plan: Prescribers' Individual Responsibilities

Patient safety and quality of care is the personal responsibility of each prescriber.

The prevalence of antimicrobial resistant bacteria is partly governed by antimicrobial usage and the ability of bacteria to spread through the environment. Healthcare environments are particularly prone to bacterial spread. Antimicrobials are used more often here than in other environments and individual patients are cared for by staff working in this enclosed environment.

Infection prevention and control is an essential part of preventing the spread of antimicrobial resistance and guidelines developed by the Healthcare Associated Infection Task Force should always be followed^{17, 19, 20}. A plan of action for combating the development of antimicrobial resistance must include measures that deter the spread of bacteria in general - and antimicrobial resistant strains in particular - both in hospitals and in care homes.

Prudent prescribing following local and national guidelines in line with local formularies should be encouraged and actively managed as a matter of good clinical governance. All antimicrobial prescribers, including supplementary and independent prescribers, should have specific continuing professional development (CPD) objectives related to antimicrobial prescribing, antimicrobial resistance patterns and healthcare associated infections, which is mandatory in the *NHSScotland Code of Practice for the Management of Hygiene and Healthcare Associated Infection*³. Each prescriber should update their knowledge in this area on a regular basis, usually annually in the case of trainee prescribers.

Reorganisations in the health service aimed at staff efficiencies and higher patient throughputs have led to greater mobility of patients between different wards during single episodes of hospitalisation. While there may be operational reasons for this, patient movements inevitably carry a risk of spreading infection with antimicrobial resistant organisms. This risk must be weighed against the clinical requirements for moving patients within a hospital.

14. Appendix: Membership of the Steering Group and subgroups

Members of the Steering Group

Professor David H Lawson CBE (Chairman), Hon Professor of Medicine & Therapeutics, Glasgow University (ret),
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Dr Ian Bashford, Senior Medical Officer, Scottish Government Health Directorates
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Mr Robin Creelman, Public involvement representative
Ms Evonne Curran, Consultant Nurse Infection Control, Health Protection Scotland
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15. References

- 1) Scottish Executive Health Department. Antimicrobial Resistance and Scottish Action Plan. SEHD, Edinburgh, UK 2002.
<http://www.scotland.gov.uk/Publications/2002/06/14962/7799>
- 2) Scottish Executive Health Department. Antimicrobial Prescribing Policy and Practice in Scotland, Edinburgh, UK, 2005. <http://www.scotland.gov.uk/Publications/2005/09/02132609/26099>
- 3) Scottish Executive Health Department. The NHSScotland Code of Practice for the Management of Hygiene and Healthcare Associated Infection, May 2004.
<http://www.scotland.gov.uk/Publications/2004/05/19315/36624>
- 4) Department of Health. The Path of Least Resistance. Department of Health, London, UK, 2002. <http://www.advisorybodies.doh.gov.uk/smac1.htm>
- 5) Weinstein RA, Controlling Antimicrobial Resistance in Hospitals: Infection Control and Use of Antibiotics. *Em Infec Dis* 2001;7(2):188-191
- 6) Livermore DM, Minimising Antibiotic Resistance. *Lancet Infec Dis* 2005;5(7):450-459
- 7) Davey P, Brown E, Fenelon L, Finch R, Woffen P et al, Interventions to improve antibiotic prescribing practices for hospital inpatients. *The Cochrane Database of Systematic Reviews* 2005, Issue 4. Art No.:CD003543
- 8) Goldman DA, Weinstein RA, Wenzel RP, Tablan OC, Duma RJ, Gaynes RP et al. Strategies to prevent and control the emergence and spread of antimicrobial-resistant microorganisms in hospitals. A challenge to hospital leadership. *JAMA* 1996;275:234-40
- 9) Shlaes DM, Gerding DN, John JF, Craig WM, Bornstein DL, Duncan RA et al. Society for Healthcare Epidemiology of America and Infectious Diseases Society of America Joint Committee on the Prevention of antimicrobial resistance in hospitals *Clin Infec Dis* 1997;25:584-99
- 10) Management of Suspected bacterial urinary tract infection in adults. Scottish Intercollegiate Guidelines Network, number 88, July 2006
- 11) Donnan PT, Wei L, Steinke DT, Phillips G, Clarke R, Noone A et al. Presence of bacteriuria caused by trimethoprim resistant bacteria in patients prescribed antibiotics: multilevel model with practice and individual patient data. *Br Med J* 2004; 328(7451):1297.
- 12) Guillemot D, Carbon C, Balkau B, Geslin P, Lecoer H, Vauzelle-Kervroedan F et al. Low dosage and long treatment duration of beta-lactam: risk factors for carriage of penicillin-resistant *Streptococcus pneumoniae*. *JAMA* 1998; 279:365-370.
- 13) Mason BW, Howard AJ, Magee JT. Fusidic acid resistance in community isolates of methicillin-susceptible *Staphylococcus aureus* and fusidic acid prescribing. *J Antimicrob Chemother* 2003;51:1033-36.
- 14) Metlay JP, Strom BL, Asch DA. Prior antimicrobial drug exposure: a risk factor for trimethoprim-sulfamethoxazole-resistant urinary tract infections. *J Antimicrob Chemother* 2003; 51(4):963-970.
- 15) Seppala H, Klaukka T, Vuopio-Varkila J, Muotiala A, Helenius H, Lager K et al. The effect of changes in the consumption of macrolide antibiotics on erythromycin resistance in group A Streptococci in Finland. *N Engl J Med* 1997; 337:441-446.
- 16) Preventing healthcare infections acquired while receiving healthcare
<http://www.scotland.gov.uk/Publications/2002/10/15677/12344>
- 17) The Scottish Ministerial Healthcare Associated Infection Task Force
<http://www.scotland.gov.uk/Topics/Health/NHS-Scotland/19529/2005>
- 18) National Cleaning Services Specification
<http://www.scotland.gov.uk/Publications/2004/05/19319/36643>

- 19) Scottish Executive Health Department. Chief Medical and Nursing Officers: Five Top Tips for Patients and Visitors <http://www.scotland.gov.uk/Topics/Health/NHS-Scotland/19529/cnotpis>
- 20) Scottish Commission for the Regulation of Care 2005. A Review of Cleanliness, Hygiene and Infection Control in Care Homes for Older People 2005. http://www.carecommission.com/images/stories/documents/publications/reviewsofqualitycare/complete_infection_control_doc.pdf
- 21) European Union Conference. The Copenhagen Recommendations. Report from the invitational EU conference on the microbial threat. Ministry of Health, Ministry of Food Agriculture and Fisheries, Denmark 1998 [cited 2007 August 21]. Available from <http://www.im.dk/publikationer/micro98/index.htm>
- 22) Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, foods and humans in Denmark [DANMAP 2005] [cited 2007 August 21] http://www.danmap.org/pdfFiles/Danmap_2005.pdf
- 23) A Report on Swedish Antibiotic Utilisation and Resistance in Human Medicine [SWEDRES 2005]. [cited 2007 August 21] <http://en.strama.se/dyn//,109,.html>
- 24) Consumption of antimicrobial agents and antimicrobial resistance among medically important bacteria in the Netherlands [NETHMAP 2007] [cited 2007 August 21] [http://www.swab.nl/swab/swabcms.nsf/\(WebFiles\)/D552D3B6190D0461C12572FF0024F246/\\$FILE/NETHMAP_2007.pdf](http://www.swab.nl/swab/swabcms.nsf/(WebFiles)/D552D3B6190D0461C12572FF0024F246/$FILE/NETHMAP_2007.pdf).
- 25) European Antimicrobial Resistance Surveillance System [EARRS] Annual Report 2005 [cited 2007 August 21] http://www.rivm.nl/earss/Images/EARSS%202005_tcm61-34899.pdf
- 26) Disease Projects for the European Centre for Disease Prevention and Control. http://www.ecdc.europa.eu/About_us/Disease_projects.html
- 27) The First European Communicable Disease epidemiological Report. European Centre for Disease Prevention and Control, 2007. <http://www.ecdc.europa.eu/Publications/Technicalreports.htm>
- 28) McNulty CAM, Boyle P, Nichols T, Clappison DP, Davey P. Antimicrobial drugs in the home, United Kingdom. *Emerg Infect Dis* [serial on the Internet]. 2006 October. Available from <http://www.cdc.gov/ncidod/EID/vol12no10/05-1471.htm>
- 29) Audit Scotland. A Scottish prescription: Managing the use of medicines in hospitals. July 2005 <http://www.audit-scotland.gov.uk/docs/health/2005>



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