NHS SCOTLAND

Annual Report of the Chief Medical Officer

Health in Scotland 2011

Transforming Scotland's Health

healthier scotland
SCOTTISH GOVERNMENT

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INTRODUCTION

By far the most significant issue which the Chief Medical Officer of Scotland has to face is the problem of health inequalities. Why should a child born today, and live in the poorest areas of Scotland, be faced with living 10 or 12 years less, and struggling with considerably more ill health than a child who will live in an affluent area? Such a situation outrages a sense of fairness. It is unjust and the task of public health professionals is to work with others to narrow the gap.

The causes of health inequalities are complex and poorly understood. This report describes some of the research that has been carried out over the past few years in some of the poorest areas of Scotland. The research emphasises the complex nature of the problem and underlines the fact that concentrating on conventional risk factors will not be effective. The solution to Scotland's most pressing problems will require concentrated effort across the whole of Scottish society. It will require new relationships and new ways of working together. We can make a difference but it will require courage to move in new directions.

CHAPTER 1

Transforming Scotland's health

Scotland's health is improving. However, the rate of improvement in the poorer areas of Scotland is significantly slower that in the more affluent areas. This differential growth in life expectancy has puzzled many who believe that there is something inherently unhealthy about Scotland or the Scots. We hear talk of the "Scottish effect" or, more specifically, the "Glasgow effect". However, the evidence from life expectancy figures and annual mortality rates suggests that Scotland has not always been an unhealthy society.

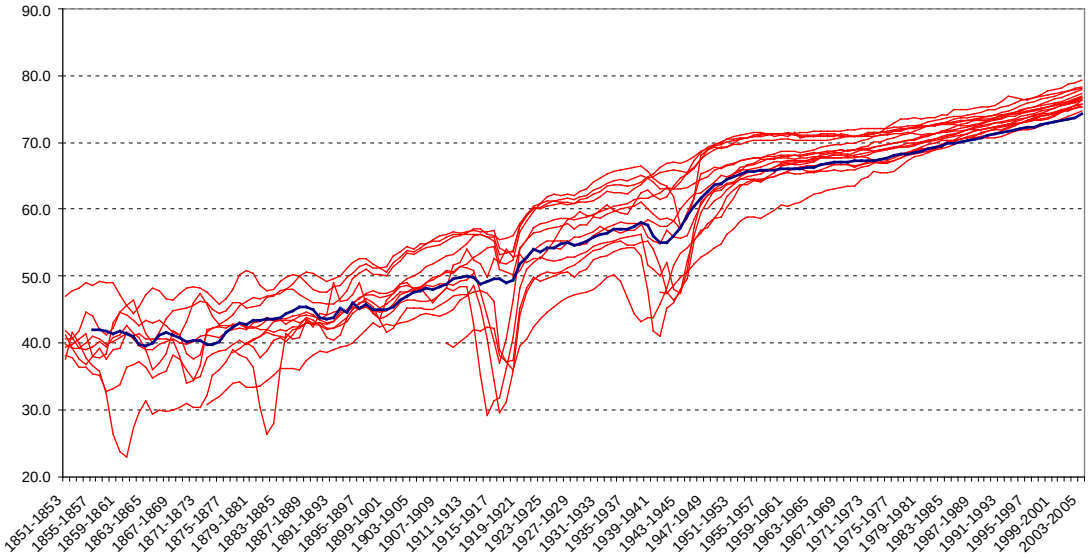


Figure 1 Male life expectancy in Scotland and 15 Western European countries since 1851.

Figure 1 shows that a relative slowing in the rate of improvement in life expectancy, compared to countries of Western Europe, took place in Scotland's health around 40-50 years ago. Scotland's life expectancy only began to fall behind our western European neighbours in the 1960s. Drug abuse began to emerge as a problem in the 1970s. Mortality from alcoholic liver disease in Scotland became the highest in Western Europe in the 1990s. At the same time as relative health indicators have been deteriorating, problems with crime and educational attainment have been growing. These problems are significantly commoner in poor neighbourhoods, and are the basis of growing inequalities in health and wellbeing.

The location of areas with the poorest health in present day Scotland points to the loss of jobs in the traditional industries of shipbuilding, steel making, heavy engineering, and mills as the catalyst for decline[1]. The loss of self esteem and lack of a sense of control which has followed decades of unemployment, led many to take refuge in alcohol and drugs. The chaotic environments and the disruption to families and their security produced many children ill fitted for education and life in general. Inevitably, many tragedies have occurred. These outcomes are entirely explainable in terms of our modern understanding of stress biology and neuroscience. Young people brought up in such circumstances have reduced capacity to learn, increased risk of offending behaviour and increased risk of diabetes, heart disease and cancer

in later life. The evidence for these associations is extensive and comes from many hundreds of studies carried out internationally as well as in Scotland.

The continuing problem of health inequalities

In previous reports, I have highlighted the continuing trends in inequality in health outcomes which continue to exist across our society. Last year, I reviewed trends in some of the indicators of inequality recommended by the Ministerial Task Force on Health Inequalities which was established in 2007. In summary, most of these indicators suggested that the gaps between affluent and poorer areas of Scotland in healthy life expectancy, risk of premature death, mental wellbeing of adults and deaths from heart disease had not materially changed for at least the previous decade.

There was some evidence of improvement in one or two of the indicators. For example, I pointed to a narrowing of the gap in low birth weight babies although low birth weight was still twice as common in poorer homes than in the more affluent. Another sign of the beginnings of an improvement in inequality was the observation that there had been a 40% reduction in first admission to hospital for heart attack between 1997 and 2009 in those under the age of 75. Not only had there been a significant fall in admission rate but there also had been a narrowing of the gap between rich and poor both in absolute and relative terms. Such a fall may eventually translate into a narrowing of health inequalities.

However, these trends are small and fragile. Examination of the trends in health inequalities over many years shows they have be on a stable and widening trajectory for many years. In fact, it is likely trends have been progressively widening since the 1950s

Many explanations have been offered for the gap in health between rich and poor in Scotland. This gap is wider than in most Western countries and the problem of inequality is most obvious in West Central Scotland. However, it would be wrong to believe that the origins of health inequalities are simply a reflection of unequal access to healthcare or that their remedies could be found solely in the National Health Service. What is also clear from the relentless widening of the gap between rich and poor is the fact the origins of health inequalities are complex and that they are to be found in the many interactions between social economic educational and environmental determinants.

What is very obvious is that conventional approaches to the problem that involve attempts to modify the health related behaviours of poorer people have failed. The past decades have seen a search for more effective ways of communicating health messages to people living in chaotic conditions. It is clear that such approaches are not effective. Sir Michael Marmot published in 2010 “Fair Society, Better Lives” [2], a report into health inequalities in England. Amongst his conclusions, he was clear that the evidence confirmed the strong relationship between social position and health – the lower a person’s social position, the worse his or her health. It was also emphasized that, if health inequalities result from social inequalities, action on health inequalities requires action across all the social determinants of health.

Continuing to do what we have always done while expecting different outcomes is one definition of insanity. Our approach to improving health across the whole

population requires a fundamental rethink and new strategies should be based on a more complete understanding of the basis of health inequalities if we are to devise effective strategies to improve health and wellbeing across society.

What is health?

We should begin consideration of a new paradigm with attempts to understand what health is.

The classical and most commonly used definition of health is that which was offered at the foundation of the World Health Organisation in 1948. *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."*

In the Ottawa Charter for Health Promotion which was published in 1986, the WHO said that health is: *"a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities."*

The WHO concept of health has been challenged more recently by the Lancet which stated in 2009 that "health is not a *state of complete physical, mental, and social well-being*. Neither is it *merely the absence of disease or infirmity*. " The article went on to say that the WHO definitions of health will not do in an era marked by new understandings of disease at molecular, individual, and societal levels. *(The Lancet, Volume 373, 9666: 781, 2009)*.More recent dictionary definitions widen the concept of health to include how the individual interacts with the external environment:

> " A state of dynamic balance in which an individual's or a group's capacity to cope with all the circumstances of living is at an optimal level."
>
> "A state characterized by anatomic, physiologic, and psychological integrity, ability to perform personally valued family, work, and community roles; ability to deal with physical, biologic, psychological, and social stress; a feeling of well-being, and freedom from the risk of disease and untimely death."

It is clear that the conventional definition takes no account of recent insights into the determinants of health and the close and complex interrelationships between an individual's societal and environmental circumstances and their sense of wellbeing.

A model of the determinants of health which is often referred to is that produced by the Canadian economists Bob Evans and Greg Stoddart. (Fig 2)

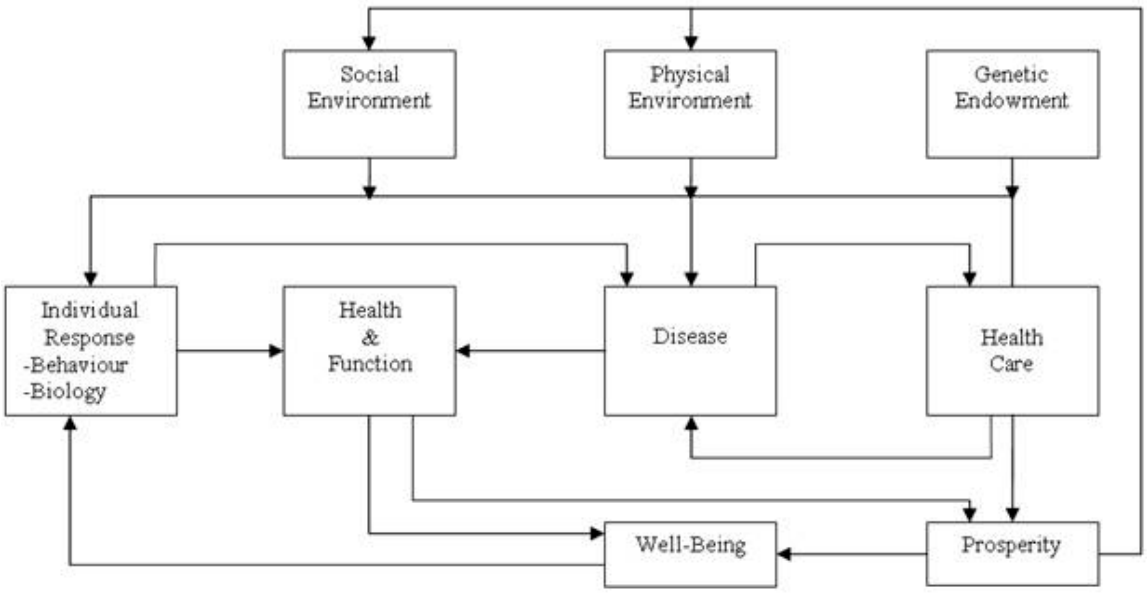


Figure 2 Feedback loop for human well-being and economic cost

They saw this model as a description of the interaction between determinants of health which would allow a better understanding of how the health of a population was created beyond the bounds of the health care system[3]. They sought to "construct an analytic framework within which such evidence can be fitted, and which will highlight the ways in which different types of factors and forces can interact to bear on different conceptualizations of health."

This model has been useful in demonstrating the complexity of the processes of health creation and it would be fair to say that, a decade after it was first described, the nature of the relationship described in the model remains far from clear. The process of health creation is complex and not completely understood. What is also very clear is that the interactions between an individual and the people and events which surround him are absolutely crucial to his health and wellbeing.

The challenge of creating health

Previous reports have referred to the concept of “salutogenesis”. This term originated almost 40 years ago[4] when the sociologist Aaron Antonovsky began to argue that doctors were primarily concerned with the causes of disease or “pathogenesis”. Instead, we should, he argued, concern ourselves more with the creation of health. He identified several problems with the pathogenic approach. One especially relevant criticism was his view that the pathogenic approach encourages belief in a “magic bullet” – one disease, one cure. A common problem with public health interventions over the past few decades has been the many attempts to improve health by tackling single risk factors. Smoking cessation, efforts to encourage healthy eating, encouraging physical activity are all examples of programmes which might be seen as public health “magic bullets”. All these programmes are vitally important and will significantly improve health in those who respond positively. But they are all likely to widen health inequalities. The more affluent, who are much more likely to be in control of their lives are much more likely to benefit from such programmes. Decades of research by the public health community has shown very clearly that campaigns which provide information and

rely on individuals to respond to that information by changing their behaviour are likely to be ineffective[5]. Interventions more likely to be effective, in MacIntyre's view, include fiscal policies, legislative controls, structural changes in the environment and effective social support. This observation raises the question as to the fundamental reasons that people living in deprived areas are more likely to respond to fiscal and legislative interventions rather than information and persuasion.

Antonovsky probably produced the most likely explanation in his book, "Health, Stress and Coping". In this book, he postulates that, in early life, we acquire a set of psychological and social resources which allow us to manage our way in the world. These resources, he suggests, include insight and intelligence, social networks, and cultural anchors such as belonging to a church or social organisations. Together, these resources allow an individual to feel that he has insight into the events of his life, that he feels he can influence them and that he can be optimistic that things will work out as well as can be expected[4]. He described this psychological outlook as having a "sense of coherence". Individuals who have a strong sense of coherence, he suggested, would be able to create and maintain a high level of health.

Antonovsky's social theories have been tested in a number of settings. He predicted that individuals who did not acquire a sense of coherence at an early age would experience a state of chronic stress and this state would reduce their chances of being healthy. The literature on the relationship between adverse social conditions and chronic elevation of markers of stress is extensive and shows a clear, strong relationship between socioeconomic status and a range of biochemical changes which are predictors of a range of problems.

To assess whether or not these processes are a feature of the inequality found in West Central Scotland, the Glasgow Centre for Population Health has, for the past few years been carrying out in depth studies of affluent and derived populations in Glasgow. The results of these studies support much of Antonovsky's hypothesis but they also offer important insights into the physical consequences of poor socioeconomic status.

CHAPTER 2

The psychological, social and biological determinants of health

Over the past few years, 700 volunteers from affluent and deprived areas of Glasgow have been studied[6]. In addition to a variety of blood tests, measurements of how affected arteries were by atherosclerosis were made. A small group agreed to have further examinations carried out to determine various aspects of cognitive function. A number of conclusions were drawn from this series of studies.

Socioeconomic status (SES) and vascular disease

The first study[7] used ultrasound to measure the thickness of arteries and also allowed the investigator to assess the number of cholesterol deposits in the carotid artery. It showed a strong relationship between a measure of area level socioeconomic deprivation and atherosclerosis. However, classic cardiovascular risk factors did not fully explain the difference in plaque presence between participants from the most deprived areas and those from the least deprived areas, confirming the view that current public health messages directed at classic risk factors (diet, blood pressure, smoking) would be unlikely to adequately address the continuing inequality in cardiovascular disease. Also, the difference in atherosclerosis rate could not be explained by low vitamin D levels. Individuals with low levels did not have a higher incidence of markers of arterial atherosclerosis[8].

This observation underlines the fact that health status is a reflection not only of features of the individual but also of wider social and economic influences, health and social services, early life experiences, and environmental factors.

The role of inflammatory processes

This study[9] found associations between social factors such as father's occupation, childhood home status (owner-occupier; overcrowding) and markers of chronic inflammation and stickiness of the cells lining arteries. Other markers of health and well being such as lung function and cognition were also related to early life conditions. Statistical models suggested that the early life conditions affected lung function and cognition through a pathway which involved inflammatory processes. The results suggest that early life conditions influence adult health by acting through a number of mechanisms but chronic inflammation appears to be a significant intermediate pathway.

The importance of personality traits

Personality traits appeared to have a significantly greater impact on mental wellbeing among those living in more deprived circumstances and personality and sense of wellbeing was associated with healthier behaviours in the lower SES group but not in the affluent[10]. Being an extrovert was more likely to be associated with healthy behaviour such as exercise.

Epigenetic factors

This series of studies confirms the complex interactions between early experiences, personality, stressful socioeconomic environments and the physiological responses to those experiences. However, it has been suggested that another set of factors

which influence health across generations may be involved in the progressive widening of inequalities. Epigenetics, is the study of how the environment influences our genetic code in our DNA and how those changes are expressed. The common belief is that we inherit a set of genes from our parents and the information contained in these genes determines our genetic future. In fact, it is now understood that the physical, and psychological environment in which we live can switch genes on or off, changing how they function. The prefix "*epi"* means "above" so this is a mechanism that sits "above genes" and allows us to respond more effectively to environmental challenges. The important point about epigenetic change is that the environmental modifications to parental genes can be passed on to future generations.

The importance of epigenetics was first appreciated in studies of the effects of famine in the 20th century. The "hunger winter" endured by the population of Holland in 1945 and the famine experienced by the population of China in the 1950s have been studied for the effect of malnutrition on children and grandchildren[11,12,13]. These studies have shown a variety of effects on physical and mental health. For example increased obesity rates have been observed in subsequent generations. The famine switched on genes that increased the ability to accumulate body fat in times of plenty, in order to improve survival in times of famine. In our present environment, with calorie rich foods more freely available than at any time in history, our current epidemic of obesity may be due to present generations inheriting the experiences of parents and grandparents.

The health impact of epigenetic change on subsequent generations has been quantified by a study carried out in the Swedish county of Nordbotten. Individuals born and raised in the small parish of Overkalix at the start of the 20th century were identified and the records of their children and grandchildren were obtained. Meticulously kept agricultural records from that period allowed researchers to estimate how much food had been available to the children in the early 1900s.

The researchers showed that boys who experienced overabundance of food winters, often going from normal eating to gluttony in a single year, had sons and grandsons who lived shorter lives[14]. The grandsons of boys who had overeaten lived an average of six years less than the grandsons of those who had lived with poor food supply. The researchers adjusted their results to exclude the impact of other socioeconomic factors and the difference in life expectancy increased dramatically.

The study showed that a single winter of overeating in childhood had biological consequences which greatly increased the likelihood of premature death of children and grandchildren decades in the future.

In the past decade there has been an accumulation of evidence pointing to the importance of epigenetic modification as the means of transmitting effects of the social environment to future generations[15]. Laboratory studies in experimental animals have shown that diet during pregnancy, nurturing behaviour by mothers and exposure to stress can alter the way an infant's genes are modified[16]. In adult laboratory animals, continuous exposure to stress, particularly defeat by other males, causes a depression like state which appears to be associated with epigenetic change in some areas in the brain[17].

Taken together, the emerging evidence on epigenetic change suggests it is an important pathway by which the socioeconomic environment becomes embedded at

a biological level. It is also transmissible between generations. It is not unreasonable to suggest that the persistence of health inequalities across the social spectrum, particularly in West Central Scotland, may be associated with such effects. If exposure to a glut of food over one winter in a Swedish village can lead to a 6 year difference in life expectancy in the grandsons of those boys experiencing the surfeit of food, it seems biologically plausible that an accumulation of similar nutritional, and other adverse experiences 50 years ago in West Central Scotland might contribute to the 12 year disparity in life expectancy currently observed.

Epigenetic modification in the West of Scotland.

The GCPH study[18] looked at modification of DNA by methylation. This process modifies the activity of genes by adding or removing from the genes methyl groups which consist of carbon and hydrogen. A comparison between affluent and deprived adults showed that the genes of deprived individuals had, on average 24% less methylation than was found in the more affluent. It is not possible to be specific about the precise significance of this finding. However, low levels of DNA methylation were associated with many of the socioeconomic predictors of poor health such as job status and it was also associated with many of the markers for cardiovascular risk. Such observations provide a potentially novel explanation for accelerated age-related disease onset in Glasgow.

Can epigenetic change be reversed?

This is a relatively new area of research in public health. However, there is little doubt that some changes can be reversed. There are a number of drugs with epigenetic effects already on the market and more are in development. Exercise has been shown, in obese patients to change the status of genes associated with fat burning, turning them on[19]. This change happens within minutes of beginning exercise. Diet can also affect gene expression so it is clear that this control mechanism for genetic expression is flexible.

CHAPTER 3

Can health inequalities be reversed?

The evidence from these studies of affluent and deprived Scots shows that a set of complexly interacting mechanisms are at work. Some may have been operative for at least two generations. There is no “magic bullet” available to us to solve this problem. In our present state of knowledge, it’s difficult to be sure if a risk factor is the cause of problems or if it is caused by problems. For example, it is clear that smoking causes significant ill health. What causes smoking? Is it the low sense of self esteem or the low sense of control we see in low SES populations? What then causes the low sense of control? Is it the absence of opportunities to work or does the worklessness come about because of the low sense of control? The complex interrelationships between all the different factors identified as being associated with inequality make planning strategies for change difficult. It is also difficult to predict the outcome of any intervention since, in a complex system, changing one bit of the system can have unintended and adverse consequences elsewhere in the system.

We must take action based on our best assessment of what is most likely to be effective. We should also take action based on a judgement as to what is the right and just thing to do. Values are as important as biology in this debate. Fortunately, there are actions we can take forward that are likely to be effective and, at the same time, enhanced protection for the most vulnerable members of society. Most of the risk factors described are closely related to events in early life. If we are to have the greatest chance of influencing the determinants of health and wellbeing, we should focus efforts on actions to improve the quality of care for children and families. We should start by making efforts to ensure a safe and healthy pregnancy, a nurturing childhood and support for families in providing such circumstances in which to bring up children. Although the epigenetic mechanisms described above are not confirmed as having an influence in shaping Scotland’s health, efforts to enrich early life represent our best hope of breaking the intergenerational cycle of disadvantage.

We should, in addition, look for ways of improving opportunities for improvement across the life course. Support for young people exposed to chaotic early lives will reduce offending and enhance educational attainment. Support for active labour market programmes (ALMPs) will help young people learn life skills as well as skill for the labour market. Efforts to encourage physical activity will improve life expectancy, reduce the incidence of chronic disease and reduce dependency in the elderly.

It is worth pointing out that these three areas are by no means the only potentially effective interventions and that there are other major initiatives which Scottish society might choose to undertake. An important aspect of improving wellbeing is to ensure communities have involvement in choosing and shaping the programmes in which they participate.

Improving early years

The link between adverse events in childhood and long term risks is incontrovertible. A large study[20] involving 14,000 subjects found a graded relationship between the number of categories of childhood exposure to adverse events such as abuse and neglect, and each of the adult health risk behaviours and diseases that were studied.

Adults who had experienced four or more categories of childhood exposure, compared to those who had experienced none, had 4- to 12-fold increased health risks for alcoholism, drug abuse, depression, and suicide attempt; a 2- to 4-fold increase in smoking, poor self-rated health, more than 50 sexual partners, and sexually transmitted disease; and a 1.4- to 1.6-fold increase in physical inactivity and severe obesity. The number of adverse childhood exposures showed a graded relationship to the presence of adult diseases including heart disease, cancer, chronic lung disease, skeletal fractures, and liver disease. The seven categories of adverse childhood experiences were strongly interrelated and persons with multiple categories of childhood exposure were likely to have multiple health risk factors later in life.

The interventions that have been shown in multiple studies to reduce this pattern of risk include action in pregnancy to reduce smoking and consumption of alcohol. Programmes to prevent domestic violence in pregnancy are enormously significant in protecting the developing baby. After birth, programmes to foster attachment between parents and children are successful in reducing risk in later life as well as improving educational attainment at school. The range of evidence based interventions which, applied over the first five years of a child's life will transform his future, are well researched and are being considered as part of the early years collaborative. In this programme of work, experts will work with staff from across health boards and local authorities to agree a range of interventions which can be delivered across Scotland.

The benefits of concerted efforts to transform the lives of children are, of course, to be seen in the wellbeing of future generations. However, the economic impact of such a programme is considerable. It has been calculated that, in Scotland, in the short term, investing in early years from pre-birth to aged five would realise potential net savings of up to £37k per annum per child in the most severe cases and of approximately £5k per annum for a child with moderate difficulties in the first five years of life[21]. In the longer term, savings are even more significant. American studies have involved follow up for longer periods and, typically, returns of 8-10 dollars for every dollar invested are realised by the mid teens. Benefits tend to accumulate over a life time[22] and recent work from New Zealand and the US suggests that children from difficult families who have access to appropriate support will, through reduced health costs and offending behaviour and increased educational attainment and employment rates produce a 30-40 fold return on investment.

Reducing offending and reoffending

Youth offending rates have been falling in Scotland over the last few years. The interventions that have contributed to this fall include early intervention to divert minor offenders towards positive activities, sharing intelligence on serious and persistent offenders across agencies to target interventions at those at highest risk of reoffending. There has also been greater use of community service to encourage offenders to develop skills.

There are other interventions that might be considered for a prevention programme. We know that consistent parenting, free from adverse events such as neglect or parental criminality reduces dramatically the risk of a young person committing an

offence and particularly a crime of violence. For young people who are already in a high risk category, there are a number of psychological interventions which can influence behaviour positively. For example, there are a number of techniques which help young people who react violently when stressed. There are others which can help young people identify and manage behaviours inappropriate to their present situation. The NHS should consider working with education colleagues to provide a coordinated programme of psychological support for young people identified in school as having easily defined behaviours which suggest they are at high risk of offending.

As well as interventions aimed at preventing offending by enhancing resilience, the National Offender Management Service in England identifies a number of factors which, if attended to, can substantially reduce the risk of reoffending. These factors include:

Accommodation and support

Many prisoners do not have settled accommodation prior to custody. Studies in England suggest that stable accommodation can reduce the likelihood of re-offending by more than a fifth.

Education, training and employment

Getting a job can reduce the risk of re-offending by between a third and a half. Poor literacy, language and numeracy skills are closely correlated with offending behaviour.

Drugs and alcohol

Intensive rehabilitation for substance misuse should be provided. Around two thirds of prisoners use illegal drugs in the year before imprisonment and intoxication by alcohol is linked to 30% of sexual offences, 33% of burglaries, 50% of street crime and more than half of all violent crimes.

Finance, benefits and debt

Ensuring that ex-offenders have sufficient lawfully obtained money to live on is vital to their rehabilitation. Around 48% of prisoners report a history of debt, which gets worse for about a third of them during custody and about 81% of offenders claim benefit on release. Continuing debt will often force them back into crime.

Children and families

Maintaining strong relationships with families and children can play a major role in helping prisoners to make and sustain changes that help them to avoid re-offending.

Attitudes, thinking and behaviour

Successfully addressing dysfunctional attitudes, thinking and behaviour using effective psychological interventions during custody may reduce re-offending by up to 14%.

There is good evidence that these interventions are economically beneficial. A London based study of mentoring of young offenders found that the project provided substantial positive net benefits to society, with a cost-benefit ratio of at least 10:1. Mentoring ex-offenders produced benefits ranging from £8,616 to £28,722 for each individual and resulted in a reduction in the rate of re-offending attributable to the project ranged from 10.66% to 17.71%. If Scotland were to agree a package of evidence based interventions to be applied at scale, the impact would be significantly greater and it is likely that the return on investment would be substantially greater than these figures suggest.

As part of a strategic approach to reducing antisocial behaviour and offending and building positive resilient communities Action for Children provide the Aberdeen Families Project. This person centred project cost £400,000 per annum and achieves annual savings in excess of £5,000,000 by reducing the number of police and housing officer call outs to families and reducing the number of children entering foster care. Staff work with families to help them develop their parenting and life skills, manage debts, provide housing and benefits advice and tackle substance (including alcohol) misuse, they also offer counselling.

An evaluation of the Persistent Offender Project in Glasgow by the Scottish Government in 2011 found that for every £1 spent on the project £14 of savings were generated, leading to £10million in savings over three years. The Persistent Offender Project is a joint project between Glasgow Addiction Services' and Strathclyde Police to challenge the high reoffending rates of addicts. The programme targets addicts and directs them towards intensive treatment. Since its inception in 2006, it is estimated the project has been responsible for a 39 per cent fall in crime among those on the programme.

Increasing physical activity across the life course - why focus on physical activity?

Inactivity accounts for at least 2,500 deaths each year in Scotland and accounts for almost 1 in 10 deaths worldwide. It is considered to be the second biggest risk factor for mortality, behind high blood pressure. Increased physical fitness would reduce premature death by 30% and can help prevent and treat more than 20 chronic diseases. Getting Scotland fit would increase life expectancy by almost a year. Furthermore, physical activity offsets much of the health problems of obesity - releasing cash and improving health outcomes at scale.

The benefits

Increasing physical activity is an evidence based way to:

a) increase life expectancy,

b) decrease health inequalities, and

c) achieve tangible cash savings not just for the NHS but also across a range of sectors.

For example, increasing levels of physical activity amongst the workforce can increase motivation, and reduce sick absences by 26% potentially saving over £500 million. Its positive impact is more extensive; regular physical activity improves

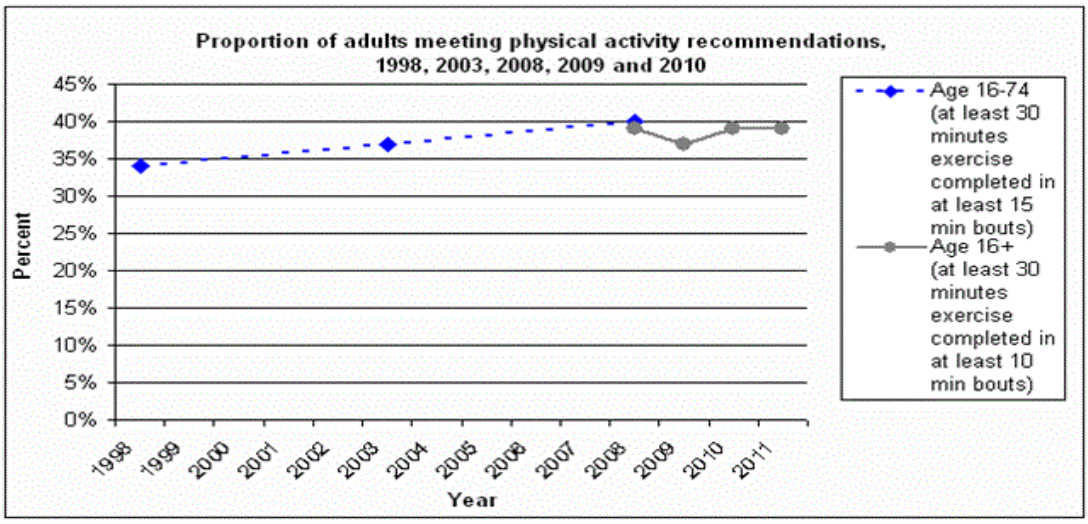
marks at school, as well as quality of life, and health outcomes for our children. It can reduce anti-social and criminal behaviour. Extensive evidence confirms that a reasonable level of cardio respiratory fitness – that achieved by 30 minutes brisk walking on 5 days each week – can reduce the risk of many illnesses. (Table 1)

Table 1

Chronic condition	**Risk reduction***
Premature Death	30% risk reduction
Heart Attacks, Stroke	20 – 35% reduction
Diabetes	30 – 40% reduction
Hip fractures	36 – 68% reduction
Bowel cancer	30% reduction
Breast cancer	20% reduction
Loss of function	30% reduction
Depression/dementia	20 – 30% reduction

Currently in Scotland, 39% of adults aged 16 and over meet the physical activity recommendations with men more likely to do so than women (45% compared with 33%). 73% of children (76% of boys and 70% of girls) meet the physical activity recommendations including school-based activity. Adult activity levels are related to income and area deprivation with those living in the highest income households more likely to meet the recommended activity levels and those in the most deprived areas least likely to meet the recommendations. Trends over the last decade are shown in Figure 3.

Figure 3 Scottish Health Survey - Trends in adult Physical Activity



Interventions

At present, a brief advice intervention from a health professional is the main way of encouraging physical activity. It is highly cost effective but is, in itself inadequate to deliver a step change in population uptake. Those with the greatest need are often the least likeliest to respond to such advice. The Toronto Charter on Physical Activity was a WHO sponsored effort to bring together all the evidence based interventions that have been shown to work across society. Recommendations include action in the following areas:

Education: Making Physical Activity in the early years, school age children, and students normal

Transport and the Environment: Transport policies and systems that prioritise walking, cycling and public transport

Urban design and infrastructure: Providing safe and equitable access for recreation and physical activity across the life course

The Workplace: Promoting policies and an environment that encourage regular physical activity and other health promoting behaviours

The NHS and Care: Embedding assessment and advice about physical activity as a routine part of the NHS and care

Training professionals: Integrating physical activity into undergraduate and postgraduate curriculums, CPD and workforce development

Sport and Recreation: Sport systems and programs that promote “sport for all” and encourage participation across the life span

Communications/ Public Education: Systematic, consistent Public Education, including mass media to raise awareness of the benefits, and change social norms physical activity.

Action is needed across all, not just one or two of these areas if we are to achieve the transformation necessary. That is why CPPs are so important to this agenda. Whilst further work is required to define the most effective interventions and approaches in these areas, some CPPs and individual partners could be taking action now to step up to the challenge.

The economic benefits of enhanced physical fitness

The National Institute for Health and Clinical Excellence (NICE) established that brief advice/ interventions for physical activity cost between £20 and £440 per quality adjusted life year (QALY) when compared with no intervention. This is significantly below the £30,000 threshold for cost-effectiveness and therefore indicates exceptional value for money[23].

Switzerland, which has attributed a similar number of deaths each year as Scotland to physical activity has estimated that it causes 1.4 million cases of illness annually and costs the economy a sum in the region of 1 billion Swiss francs[24]. This suggests that annual costs to Scotland are in the region of £660 million. Moderate expenditure

on enhancing physical fitness are likely to save considerable sums as well as enhancing significantly quality adjusted life expectancy.

CHAPTER 4

Implementation: How to deliver radical change in complex systems

Over the years, many policies have been launched with the express purpose of transforming Scotland in one way or another. Most have failed to make more than a marginal impact. There have been many causes of failure. A culture of providing funds only for short term projects has often failed to provide for sustainability. Erosion of will to see policies through and lack of support in civic institutions have often contributed to failure, causing a degree of cynicism in front line workers who become weary of "the next big idea."

Achieving radical change and ambitious aims will require that Scotland does things differently. Continuing to operate according to the same rules as before will deliver the same, disappointing outcomes. Doing things differently will require us to understand and adopt the emerging concepts of improvement science.

What is improvement science? It has been defined as:

> "….an emerging field of study focused on the methods, theories and approaches that facilitate or hinder efforts to improve quality and the scientific study of these approaches."

An alternative description which sums up the aims of this approach concisely is:

> "Improvement Science is a body of knowledge that describes how to improve safely and consistently. Improvement Science is not the same as Research. Research is designed to find out what is possible. Improvement Science is not the same as Audit. Audit is designed to find out what is actual. Improvement Science describes how to reduce the gap between what is actual and what is possible."

Improvement science focuses on systematically and rigorously exploring 'what works' to improve quality in services and the best ways to measure and disseminate this to ensure positive change. In focusing on evidence, it reduces the scope for disagreement and debate. If there is a problem and there is evidence of a set of interventions that can solve that problem, the question for society is not "what should we do to solve this problem" but "what's stopping us?"

Scottish experience with improvement science

The Scottish Patient Safety Programme has used improvement science techniques to deliver significant change in health care outcomes in Scotland over the past 4 years. It identified a number of risk factors for poor outcome, defined evidence based changes it could make to influence those risk factors and health systems agreed to implement those changes at scale, across Scotland. The outcome is a 10.6% reduction in mortality across Scottish hospitals in the past 4 years. The decline in mortality seen in the preceding 10 years was around 1%. Systematic application of evidence across whole system is effective.

If we are now to use this knowledge to make a step change in Scottish society, then we need to do three things. We need to:

1. Assemble the knowledge that explains why Scotland is the way it is and what needs to change to achieve our preferred state.

2. Build amongst our organisations and the population in general, the will to change.

3. Implement the changes, at scale, across Scotland and do it consistently, measuring the impact and celebrating the outcomes

Assembling the knowledge

This is, perhaps, the most complex of the three steps. There is a wealth of experience and understanding across Scotland of how health inequalities affect communities. There is considerable experience of how to work with communities to agree local solutions to local problems. As previously outlined, much is known about the mechanisms which underlie SES associated poor health. However, there is still much to be elucidated. The interventions suggested above are highly likely to have a positive effect if they are implemented effectively.

Building the will

The evidence that we can, through concerted action across society, change lives for the better is compelling. Knowing this, we are obliged to act. How should leaders respond to this challenge? It has been argued that the role of leaders is to help accelerate the transfer of best practices across the systems they manage. This process starts by building will for change in their organisations through a clear understanding of current performance. Too often, however, organisations rely on static assessments of performance. Too often, these assessments are out of date and easily ignored. Knowing the current state of a particular problem for which there is a solution requires leaders to act to implement those solutions. Using current information and making it available to those charged with delivering the interventions is powerful encouragement for change.

Implementing the change

Improvement is not top-down or bottom-up. Agreeing what interventions will make the greatest impact is something all the players in a complex system take ownership of. At the beginning of the process, they share information on the evidence and agree how and when they will implement the change. They agree how they will measure the change and agree to share the outcomes of their efforts with others attempting the same change. Regular meetings of those involved are essential to share good practice and to learn across the system. This shared learning arrangement takes place within a “collaborative” and the data is used for improvement, not for assessment or monitoring.

CHAPTER 5

Vitamin D – panacea or distraction?

When considering determinants of health in Scotland, the issue of vitamin D frequently arises. Vitamin D levels in Scotland are low in comparison to many other countries and many scientists believe that such deficiency had to be a major contributor to Scotland's poor health. There are some who believe that vitamin D can be harmful to some people and, in the middle of the debate, there is a body of opinion that believes that the case for vitamin D supplementation beyond existing recommendations is not yet proven. A recent publication from Holland[25] described vitamin D levels in individuals from families in which several members were particularly long lived. These individuals had significantly lower levels than controls. The authors attributed this observation to the presence of a particular gene in the study group which predisposed to low blood levels of vitamin D but which might also be associated with longevity. The low vitamin D might not have been the cause of the longevity but rather both outcomes were the result of a third factor. This pattern of association rather than causation is encountered frequently in debates about vitamin D and points to the pressing need for properly conducted intervention trials.

What is vitamin D?

Like vitamins A, E and K, vitamin D is a fat-soluble vitamin. It is naturally present in very few foods, added to others, and available as a dietary supplement. It is also produced within the body when ultraviolet rays from sunlight cause vitamin D to be synthesised in the skin. Vitamin D obtained from sun exposure, food, and supplements is biologically inert and must undergo two chemical changes in the body for activation. The first occurs in the liver and converts the vitamin D synthesised in the skin to 25-hydroxyvitamin D, also known as calcidiol or vitamin D2. The second occurs primarily in the kidney and forms the physiologically active 1,25-dihydroxyvitamin D also known as calcitriol or vitamin D3. Being fat soluble, it is stored in body fat.

What does it do?

Vitamin D promotes absorption of dietary calcium from the gut and maintains adequate serum calcium and phosphate concentrations to enable normal mineralization of bone and to prevent disorders of electrical activity in nerves and muscles due to low serum calcium. It is also needed for bone growth and bone remodelling by special bone cells called osteoblasts and osteoclasts. Without sufficient vitamin D, bones can become thin, brittle, or misshapen. Adequate vitamin D prevents rickets in children and its adult equivalent, osteomalacia. Together with calcium, vitamin D also helps protect older adults from osteoporosis.

Vitamin D is, chemically, a type of steroid and, like other steroids, it is involved in many other physiological processes including modulation of cell growth, neuromuscular and immune function, and inflammation. At least 50 genes encoding proteins that regulate cell proliferation, differentiation, and cell death are modulated in part by vitamin D and many cells have vitamin D receptors. Given its involvement in so many cellular functions, it is quite understandable that there is wide speculation about its role in the development and course of many illnesses. Its relevance to Scotland is based on speculation that vitamin D deficiency increases the risk of

diseases common in Scotland such as heart disease, diabetes and cancer. Since Scots appear to have low levels of vitamin D, it is argued, Scotland's high incidence of these diseases must, at least in part, be due to the vitamin deficiency. There are several issues to consider in evaluating this argument.

What constitutes vitamin D deficiency?

The definition of vitamin D deficiency is not clear and there is no universally agreed "normal" blood level. The Office of Dietary Supplements of the National Institutes of Health in the US concluded in June 2011 that: "optimal serum concentrations of 25(OH)D for bone and general health have not been established; they are likely to vary at each stage of life, depending on the physiological measures selected. Also, while serum vitamin D functions as a biomarker of exposure to vitamin D (from sun, food, and dietary supplements), the extent to which such levels serve as a biomarker of effect (i.e., health outcomes) is not clearly established."

In addition, there is considerable variation between individuals in vitamin D levels related to differences in sunshine exposure as a result of latitude and seasonal variation, clothing style, skin pigmentation, skin thickness (which reflects age), and adiposity. As a result, a standardised method of assessing deficiency has not been agreed internationally.

Concentrations of 20ng/ml (50nmoles/litre) are quoted as being "deficient," and 30ng/ml (75nmoles/litre) as "insufficient", but there are other definitions. The Vitamin D Council, an organisation sponsored by industry, goes further and recommends serum levels of 50ng/ml (125mmoles/litre) as a minimum to confer optimal health. A recent Scottish publication summarises reports on the prevalence of vitamin D deficiency in different groups by geographic location, demographic features, and health status. By current definitions, a significant proportion of the world's population is vitamin D deficient. Indeed, it has been stated that over one billion people worldwide need to increase their vitamin D intake to counter "vitamin D deficiency". This number equates to roughly one-sixth of the world's population, which, if it is true that this deficiency exists and is causing widespread damage to health, would be an astonishing revelation for public health.

Vitamin D and disease

The Vitamin D Council lists evidence that vitamin D deficiency is implicated in numerous conditions from dental caries to a wide range of cancers. The problem with this evidence is that it is mainly based on observational data which links "low" blood levels in patients who have the disease. There are several possible confounding factors which need to be resolved before accepting that low levels of the vitamin are causally related to a disease.

Confounding

Many other risk factors are related to both low vitamin D and poor health outcomes. For example, low vitamin D levels are associated with diabetes and heart disease. So are obesity and low levels of physical activity which are both risk factors for diabetes and heart disease. The illness and the low vitamin levels are both caused by a third factor which is described as a "confounding factor". Vitamin D is stored in fat tissue and obese people may have high levels of the vitamin in their bodies

despite low blood levels. The low vitamin D may also be contributed to by a low level of physical activity and poor sunlight exposure because the patient is ill. The risk factors for low vitamin D and heart disease and diabetes are the same and the low vitamin D cannot be considered as a cause of the disease without further evidence. Observational studies cannot prove the causal link unless the confounding factors are also measured and accounted for in the analysis[26].

Reverse causation (1)

Sunlight exposure is a major determinant of circulating vitamin D. Pain or illness in patients with inflammatory conditions such as rheumatoid arthritis may limit sunlight exposure through inactivity, thus disease may cause “deficiency” rather than the reverse. This mechanism may also influence studies of multiple sclerosis. Clinical diagnosis of multiple sclerosis may be preceded by a period of preclinical disease where less time is spent outdoors.

Reverse causation (2)

Acute inflammation causes a metabolic response which involves changes in the blood levels of many proteins and hormones. This is known as the acute phase response . There is evidence that the metabolic response to illness or injury may drive down circulating vitamin D so that in acute illnesses low vitamin D levels are secondary to an acute phase response.

Publication and citation bias

Negative findings are less likely to attract attention or even be published particularly in research areas where there is an overwhelming perception of a positive association. Authors whose studies show no benefit from an intervention are less likely to pursue publication or persist after manuscript rejection. Negative findings which are published are cited less frequently, and result in less media interest. Thus, perception of the weight of evidence can be heavily skewed. An example of such bias is a comparison between two papers reporting virtually identical studies. Marniemi et al (2005) reported no association of vitamin D with 130 cases of heart attack in elderly men and women[27]. This was published in Nutrition, Metabolism & Cardiovascular Diseases and has been cited 32 times in the intervening 6 years. Wang et al (2008) reported vitamin D deficiency associated with 120 cases of heart disease in Americans. This was published in Circulation[28]. In the intervening 3 years, it has been cited 460 times by other publications. The rate of citation is 50 times higher for the publication reporting a positive effect. Evidence of no effect tends to be ignored giving a false impression of the balance of the argument.

Reviews of the evidence on the relation between low blood levels of vitamin D and incidence or severity of disease, for reasons of uncertainty as to the significance of blood levels, uncertainty as to the total body availability of the vitamin and uncertainty as to the temporal relationship of the blood levels with the onset of disease mean that these reviews have concluded that the observational data which is the basis for much of the pressure for supplementation provides no convincing evidence of a causal relationship between any disease, apart from bone disease. There is a pressing need for randomised controlled trials of vitamin D supplementation to examine its impact before any robust conclusions can be drawn as to its benefit.

More vitamins must be better

The argument that vitamins are good for health and therefore, more must be better is not always true. Two vitamins for which claims of considerable benefit from supplementation have been made and which have been subjected to randomised controlled trials are vitamins C and A.

In 1970, Linus Pauling, a double Nobel prize winner, announced in Vitamin C and the Common Cold that taking 1,000 mg of vitamin C daily will reduce the incidence of colds by 45% for most people but that some people need a much larger amount (the recommended daily intake for vitamin C is 60 mg.) The 1976 revision of the book, titled Vitamin C, the Common Cold and the Flu, suggested even higher dosages. A third book, Vitamin C and Cancer (1979) claimed that high doses of vitamin C may be effective against cancer. Yet another book, How to Feel Better and Live Longer (1986), stated that megadoses of vitamins "can improve your general health . . . increase your enjoyment of life and can help in controlling heart disease, cancer, and other diseases and in slowing down the process of aging." Pauling himself reportedly took at least 12,000 mg daily and raised the amount to 40,000 mg if symptoms of a cold appeared. In 1993, after undergoing radiation therapy for prostate cancer, Pauling said that vitamin C had delayed the cancer's onset for twenty years. This was not a testable claim. He died of the disease in August 1994.

In 1976, Pauling and Mr. Ewan Cameron, a surgeon at the Vale of Leven, reported that a majority of one hundred "terminal" cancer patients treated with 10,000 mg of vitamin C daily survived three to four times longer than similar patients who did not receive vitamin C supplements. However, Dr. William DeWys, chief of clinical investigations at the National Cancer Institute, found that the study was poorly designed because the patient groups were not comparable[29]. The vitamin C patients were Cameron's, while the other patients were under the care of other physicians. Cameron's patients were started on vitamin C when he labelled them "untreatable" by other methods, and their subsequent survival was compared to the survival of the "control" patients after they were labelled untreatable by their doctors. DeWys reasoned that if the two groups were comparable, the lengths of time from entry into the hospital to being labelled untreatable should be equivalent in both groups. However, he found that Cameron's patients were labelled untreatable much earlier in the course of their disease—which means that they entered the hospital before they were as sick as the other doctors' patients and would naturally be expected to live longer. In epidemiology, this error is known as “lead time bias”.

Scientific fact is established when the same experiment is carried out over and over again with the same results. At least 16 well-designed, double-blind studies have shown that supplementation with vitamin C does not prevent colds and at best may slightly reduce the symptoms of a cold. Slight symptom reduction may occur as the result of an antihistamine-like effect, but whether this has practical value is a matter of dispute.

Beta-carotene and vitamin A

In the 1980s, there was interest in the possibility that vitamin A and beta-carotene could reduce the incidence of lung cancer in smokers. Studies had shown low levels of the vitamin in people subsequently diagnosed with lung cancer and randomised trials were set up to examine the possible preventive effect.

Two large randomised studies not only showed no protective benefit from vitamin supplementation but the smokers receiving the supplement experienced an increase in cancer incidence of 18% in one study and 28% in another[30].

In an attempt to examine the impact of a wider range of vitamins in cancer prevention, The VITamins And Lifestyle (VITAL) study was carried out. It reported in 2009. It looked at the effect of beta carotene, retinol, vitamin A, lutein, and lycopene supplements on lung cancer risk. 77,126 people aged between 50 and 76, in Washington State, USA filled in a questionnaire[31]. Some questions asked about whether they had taken dietary supplements, what doses, and how long they took them for. People in the study were monitored and it was found that those who had taken beta carotene, retinol, or lutein supplements for more than a few years had a significantly higher risk of developing lung cancer and dying from it. There were plausible biological arguments for believing vitamin supplementation would protect smokers from lung cancer. Then the study was carried out, the opposite was true.

The lesson from these studies is that vitamin supplementation is not a risk free intervention. It may produce benefit, it may, as in the case of vitamin C be futile or it may be harmful. It should only be advocated when there is a body of unequivocal evidence supporting it.

Current consensus statements

In 2010, the Institute of Medicine in the US reviewed dietary advice in the US. It concluded that:

"Calcium and vitamin D are two essential nutrients long known for their role in bone health. But since 2000, the public has heard conflicting messages about other benefits of these nutrients—especially vitamin D—and also about how much calcium and vitamin D they need to be healthy. To help clarify this issue, the United States and Canadian governments asked the IOM to assess the current data on health outcomes associated with calcium and vitamin D, as well as updating the nutrient reference values, known as Dietary Reference Intakes (DRIs) [32].

In this report, the IOM proposes new reference values that are based on much more information and higher-quality studies than were available when the values for these nutrients were first set in 1997. The IOM finds that the evidence supports a role for vitamin D and calcium in bone health but not in other health conditions. A recent study supports this conclusion[33.]

Could vitamin D be harmful to some people?

Emerging evidence indicates that too much of some common nutrients may be harmful, challenging the concept that "more is better."

The adverse effects of high intakes of vitamin D are most commonly thought of as being due to its effect on calcium metabolism. At high levels, vitamin D causes re absorption of calcium from bone. Reports in Britain in the 1950s, when foods were being liberally fortified with vitamin D, indicated an unusually large number of cases of "idiopathic hypercalcemia", a condition in which high levels of calcium were found in the blood. Given the number of foods fortified at the time, the British Paediatric Association estimated an intake of about 4,000 IU of vitamin D per day for an infant who consumed a typical diet of milk (1.5 pints), cereal (1 ounce), and cod liver oil (1

teaspoon). The outbreak of idiopathic hypercalcemia that took place was attributed to vitamin D supplementation[34], but the cause cannot be determined with certainty. Anecdotally, physicians who were in clinical practice at that time remember some deaths amongst children as a result of hypercalcaemia.

There is some concern that higher levels of vitamin D may be associated with increased risk of some cancers in adults. The Institute of Medicine considered evidence of association between higher blood levels of vitamin D and cancer of the breast, pancreas and prostate. The report concluded that publications reporting associations of high intakes with increased risk were subject to the same methodological uncertainties as those reporting associations with low levels.

Vitamin D and Multiple Sclerosis

The IOM report specifically considered the relationship between vitamin D and MS. It concluded that: “Taken together, these observational studies show widely variable outcomes for associations between serum 25(OH)D levels and MS and such associations are not supported by meta-analyses. In addition, the lack of causal evidence further diminishes the likelihood for a relationship between vitamin D and MS.”

Conclusion

There is no doubt that vitamin D is an important modifier of many biological processes. Uncertainty about the significance of blood levels and measurements of total body stores, however, have made it difficult to gather evidence about the effects of deficiency. Until further studies are carried out it seems that the evidence that blood levels of vitamin D seen in Scotland are responsible for high levels of chronic disease in Scotland remains inconclusive. The argument that high levels of supplementation will have an impact on any chronic disease in Scotland requires testing in randomised controlled trials. In the meantime, the Food Standards Agency has confirmed existing guidelines for vitamin D intake in Scotland pending a review of evidence by the Scientific Advisory Committee on Nutrition. It is expected that the SACN will provide a preliminary report of its finding next year.

In 2011, I wrote to all doctors in Scotland reminding them of the frequency of low blood levels of vitamin D in Scots and the need to ensure that certain groups in the population received supplements. Early in 2012, the Chief Medical Officers of England, Wales and Northern Ireland sent out a similar letter across the UK.

CHAPTER 6

Health Protection and Healthcare Associated Infection 2011

Introduction

2011 has been a busy year in terms of Health Protection and Healthcare Associated Infection. Significant progress has been made in certain areas. This progress gives us further encouragement to maintain our collective efforts in the continuing battle to improve Scotland's health. The surveillance of communicable diseases of significant public health risk (i.e. that may require monitoring, prevention or control) is mainly undertaken through formal notification and reporting systems underpinned by legislation.

Looking at some of these hazards in more detail, some important disease trends during 2011 are highlighted below.

Measles

Notifications for measles are on the basis of clinical suspicion. As measles has become rare in Scotland, due to high uptake of vaccination, it is difficult to diagnose clinically without laboratory tests. There were 82 measles notifications in 2011 and 24 laboratory confirmed cases. This compares with 93 notifications and 11 laboratory confirmed cases in 2010. The majority of measles cases and suspected cases continue to occur in unimmunised or under-immunised individuals.

Mumps

In the whole of 2011 there were 609 notifications of mumps, which is a decrease from the 698 notifications made in 2010. Since 2004 there has been an ongoing widespread outbreak of mumps which has affected all areas of the UK. Although the total number of cases continues to fall since the peak in 2005, mumps continue to occur steadily in Scotland. This outbreak is mainly affecting the young adult age group (aged 15-24 years), who are often not fully protected against mumps either because they were not routinely offered two doses of MMR vaccine or the immunity conferred by vaccination has waned.

In 2011, for those reaching five years of age, uptake of at least one dose of MMR was on average over 96%, above the 95% target for children before starting school. Uptake of two doses of MMR fell slightly to 89.6% at age 5 years in 2011, but continued to increase as children got older reaching 92.8% at six years.

Meningococcal infection

There were 103 cases of meningococcal infection notified in 2011, compared to 93 in 2010. Despite the small increase in 2011 compared to 2010, the overall trend has been a decline since the introduction of the Meningococcal C (MenC) vaccine in 1999, when 329 cases were notified. More than half the cases notified in 2011 (61%; 63 cases) were in children aged under 15 years.

Pertussis (whooping cough)

There were 85 notifications of pertussis in 2011 compared to 45 in 2010. Although the number of notifications in 2011 was an increase of 88% compared to 2010, the

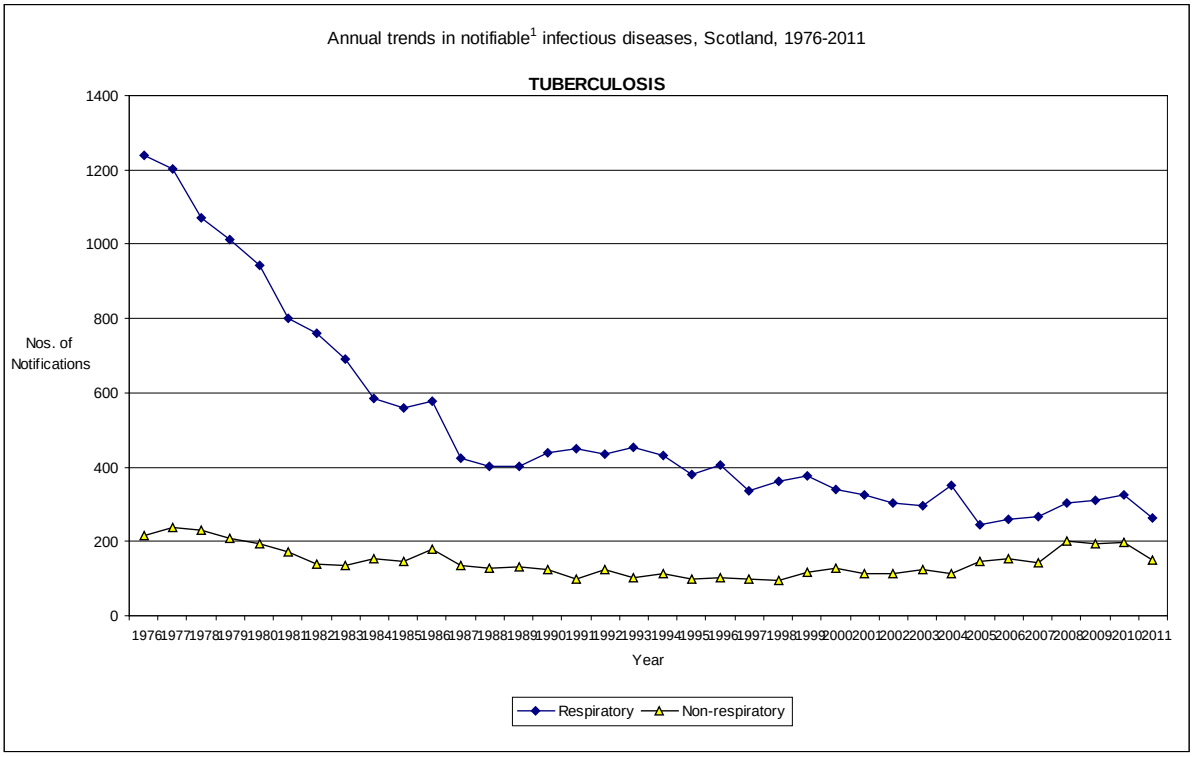
notifications in 2011 were less than those reported in 2007, 2008 and 2009 (98, 134 and 104 respectively).

Tuberculosis

There were 457 notifications of tuberculosis in 2011. This was a decrease of 12.9% (68 cases) compared to 2010 when 525 cases were notified. Of the notifications in 2011, 291 were respiratory cases, fewer than the 326 in 2010, and 166 were non-respiratory compared to 199 in 2010.

The decrease in notifications of cases of Tuberculosis is also mirrored by Enhanced Surveillance of Mycobacterial Infections (ESMI). The ESMI scheme provisionally reported 453 cases in 2011, compared to 503 in 2010 which is the first decrease in numbers reported to ESMI since 2005.

Figure 4 Annual trends in notifiable infectious diseases, Scotland, 1976-2011: Tuberculosis



Of the 453 cases reported in 2011, 62.5% were classified as pulmonary tuberculosis and 37.5% as non-pulmonary tuberculosis. The proportion of pulmonary and non-pulmonary is consistent with previous years. Of the 86% of cases where place of birth is known, 53.1% were born outside the UK. While the absolute number of non-UK born cases declined in 2011, this group still represents the majority of cases reported in 2011. Two cases were classified as multi-drug resistant, consistent with the numbers reported in previous years.

Gonorrhoea

In 2011, 1547 diagnoses of gonorrhoea were reported to HPS, representing a 12% increase on the 2010 total of 1378. This is the highest number recorded, although

the totals during the past four years (2008-2011) are not comparable to previous years due to an increase in gonorrhoea testing and diagnosis.

When compared to 2010 data, the gender totals observed during 2011 reflect a 5% increase in the number of diagnoses among women (from 446 to 468) and a 16% increase in those among men (from 930 to 1,077).

The most notable trends were an increase in episodes in NHS Lothian and NHS Tayside and a decrease in NHS Greater Glasgow & Clyde. In 2011, the highest rates of gonorrhoea infection (at >60 per 100,000 population) for men were seen in Greater Glasgow & Clyde, Lothian and Tayside NHS Boards and, for women (at >34 per 100,000 population), in Greater Glasgow & Clyde and Lothian NHS Boards. The increase in gonorrhoea among males, observed between the late 1990s to 2006, is considered to be due, largely, to transmission among men who have sex with men (MSM). While a decrease in diagnoses was recorded between 2007 and 2009, the subsequent increase observed in the past three years may also be due to a rise in infection in this group.

Hepatitis C infection

During 2011, 2,147 new cases of hepatitis C antibody-positivity were diagnosed. This figure compares with 2038 and 2131 for 2009 and 2010, respectively, and an average of 1635 per year during 2001-2008. Thirty three percent of cases resided in the Greater Glasgow and Clyde NHS board area. The number of new cases of hepatitis C antibody-positivity was at least 20% greater in 2011 compared to in 2010 for a number of NHS board areas (including Borders, Forth Valley, Grampian, Highland, Lanarkshire, Lothian and Tayside).

Forty eight percent were known to have injected drugs, representing 95% of those with a known risk factor. At the time of diagnosis, 23% (499) were aged 20-29 years, 36% (779) were aged 30-39 years, 26% (556) were aged 40-49 years, 9% (195) were aged 50-59 years and 4% (86) were aged over 60 years.

In total, 31,468 cases of hepatitis C antibody-positivity had been ever diagnosed as at 31 December 2011 (67% (21120) were male and 32% (10027) female. Of the 27376 cases, not known to have died, 55% were aged 40 years and over. At the end of 2011, one stark observation is that approximately 0.9% of Scotland's population aged 15-59 years had been diagnosed hepatitis C antibody-positive.

Invasive pneumococcal disease (IPD)

Invasive pneumococcal disease (IPD) is a type of infection caused by the bacterium *Streptococcus pneumoniae*. It is a major cause of morbidity and mortality. It particularly affects the very young, the elderly and those with impaired or absent immunity.

The total number of cases reported in 2011 was 499, compared to 540, 579 and 606 cases reported in the same periods of 2010, 2009 and 2008 respectively, showing a continued downward trend in the number of IPD cases reported which started in 2006. The downward trend began around the time Pneumococcal conjugate vaccine (PCV-7) was introduced into the routine childhood immunisation schedule in September 2006. In spring 2010, PCV-7 was replaced with PCV-13 to provide broader protection against more serotypes of *S.pneumoniae*. The new vaccine

follows the same three dose immunisation schedule at two and four months of age followed by a booster at 12-13 months. Information on cases reported in 2011 indicates that IPD occurs more frequently in older age groups: 43.7% (218 cases) were aged 65 years and older. Although case numbers have decreased overall.

Of the IPD cases reported in 2011, 36 were in children under five years of age and eligible for PCV vaccination. This is similar to the number of cases reported in this age group in the same period of 2008, 2009 and 2010 (34, 39 and 28 cases, respectively) but much less than the number of cases in the same period of 2005 (i.e. before the introduction of PCV) when 95 cases were reported. The continuing value of the vaccine is illustrated by the fact that 14 cases of IPD in children aged under five years were caused by serotypes that are included in PCV-13. Six cases were not vaccinated and a further 6 had received all three doses of PCV-7 vaccination but were infected with additional serotypes included in PCV-13. The remaining two for other reasons, were not sufficiently protected against the organism by vaccination.

Campylobacter Infection

During 2011, 6366 isolates of *Campylobacter* were reported to HPS, a decrease of 235 (3.6%) compared to 2010 when 6601 isolates were reported. Despite this decline, the 2011 figure is still one of the highest recorded so far in Scotland. The 2010 total (6601) had been the highest to date, greater than the previous peak in 2000, when there had been 6482 reports. In Scotland the overall rate of *Campylobacter* infection in 2011 was 121.9 per 100,000 compared to 127 per 100,000 in 2010.

Most cases of *Campylobacter* are apparently sporadic with few identified outbreaks. In 2011, one of two general outbreaks of *Campylobacter* was reported to HPS, in which chicken livers were reported as the suspected vehicle of infection.

Significant events during 2011

Outbreak of *Escherichia coli* O157 associated with raw vegetables

Of the 253 cases of *E. coli* O157 in 2011, 44 (17%) occurred during an outbreak of an unusual strain of *E. coli* O157 phage type 8 (PT8) which also involved other UK countries. Between December 2010 and July 2011, the Health Protection Agency (HPA), Health Protection Scotland and Public Health Wales received reports of 250 cases of infection with this particular subtype of *Escherichia coli* O157, distributed across England, Scotland and Wales. Most of these cases were mild to moderate but 74 people were assessed in hospital. Four developed haemolytic uraemic syndrome (HUS) and one patient with underlying health problems died. No cases were reported in Northern Ireland.

The multi-agency outbreak control team's investigation found a statistically significant association between illness and handling loose raw vegetables (particularly leeks and potatoes) in the home, which, although safe to eat, could have had soil on them containing harmful bacteria. Handling raw vegetables in the home explained many, of the cases.

The vegetables could have carried traces of contaminated soil. It was possible people caught the infection from cross contamination in storage, inadequate washing

of loose vegetables, insufficient hand washing after handling the vegetables or by failing to thoroughly clean kitchen equipment, utensils or surfaces after preparing the vegetables. It is also being stressed that raw loose leeks and potatoes from sacks might not be the only source of contamination and that it is nonetheless safe to eat such produce as long as it has been stored correctly, thoroughly washed before cooking and good kitchen hygiene practices are followed.

Thankfully, there is no evidence to suggest that this strain of PT8 is any more virulent than other strains of E. coli O157. The cases were not related to the outbreaks in Germany or France in 2011 which were both caused by a different strain of *E. coli*.

Incident of Botulism

Clostridium botulinum is a bacterium which makes a harmful toxin (or poison) which causes botulism when eaten. The toxin is only produced when *Clostridium botulinum* is in a location without any oxygen. Certain foods that are stored in air-tight containers (e.g. cans, jars, vacuum packaging or modified atmosphere packaging) or in oil can potentially represent a botulism risk and so care needs to be taken when they are manufactured and stored.

Companies must take *C.botulinum* and other food safety issues into account and formulate and process their products to ensure that they will be safe to eat.

Botulism is very rare in the UK. However, 3 cases of *Clostridium botulinum* occurred in a single household in Scotland. These were the first cases of food-borne botulism to have been reported or notified in Scotland since records were computerised in 1988. A multi-agency and multi-disciplinary team lead by HPS investigated these cases and the report from this team has been published at http://www.hps.scot.nhs.uk/pubs/redirect.aspx?id=52313. As a result of the team's investigation, a batch of Lloyd Grossman Korma Sauce linked to the two cases of botulism in Scotland was recalled.

Scotland's sexual health and BBV framework 2011-2015

The Sexual Health and Blood Borne Virus Framework published in 2011 and accessible at http://www.scotland.gov.uk/Publications/2011/08/24085708/0, sets out the Scottish Government's agenda in relation to sexual health, HIV, hepatitis C and hepatitis B for the next four years.

For the first time, these four policy areas have been brought together into a single integrated strategy. The Scottish Government, NHS boards, local authorities and third sector organisations all have essential roles to play in achieving the Framework outcomes, both individually and in partnership, and all organisations have been involved in the development of the policy.

The Framework also recognises the commonalities that exist across Scottish Government policy areas, including drug and alcohol policy, Early Years, child and maternal health, long-term conditions, Curriculum for Excellence and Equally Well. It will build on these to support improvements in sexual health and wellbeing and to tackle bloodborne viruses in Scotland effectively.

Tuberculosis action plan for Scotland

In 2011, the Scottish Government published an action plan to help health professionals in Scotland tackle tuberculosis (TB). Scotland's rate of TB has been relatively low and stable but recently there has been evidence that the number of cases, while still low, is increasing.

The TB action plan for Scotland is designed to tackle this trend by ensuring Scotland increases the effectiveness of its:

- laboratory services and diagnostic tests
- clinical services
- surveillance and contact tracing
- public health services including neonatal immunisation

The action plan is aimed at reducing the incidence of TB across Scotland. It is therefore important that doctors and nurses caring for those with TB work in a truly multidisciplinary way to ensure sharing of specialist knowledge and expertise in order to provide the best of treatment for this group of patients. Progress on the Action plan will be monitored over the coming years.

Continued emphasis is needed on raising awareness about TB with the public and indeed other professionals so all see it as a curable disease when medication is taken regularly, know whom to contact and where people can be screened or investigated for TB at as early a stage as possible and of course where to get general information and advice about TB.

Healthcare Associated Infection

Significant progress continues to be made in reducing the burden of healthcare associated infection (HAI) in Scotland. These infections, nevertheless, remain a significant public health threat and result in avoidable costs to NHS Scotland. Microorganisms associated with healthcare are often resistant to common antibiotics. The importance of infection prevention and control in healthcare cannot be underestimated and substantial programmes of work continue both at a national and local level to minimise the risk of infection in healthcare in Scotland.

Scottish National HAI and Antimicrobial Prevalence Survey 2011

The second Scottish National Healthcare Associated Infection and Antimicrobial Prescribing Point Prevalence Survey (PPS) was undertaken during September and October 2011. The findings indicated that approximately one in twenty patients in acute care hospitals had an HAI at the time of survey. Also, the epidemiology of HAI has changed since the first national survey was carried out in 2005/2006. The prevalence of HAI was lower by approximately one third in acute and non-acute hospitals and the types of HAI commonly identified had also changed. Urinary tract infections accounted for almost a quarter of HAI in acute hospitals and two fifths in non-acute hospitals. Surgical site infections remained a common HAI particularly following orthopaedic, vascular and gastrointestinal surgery.

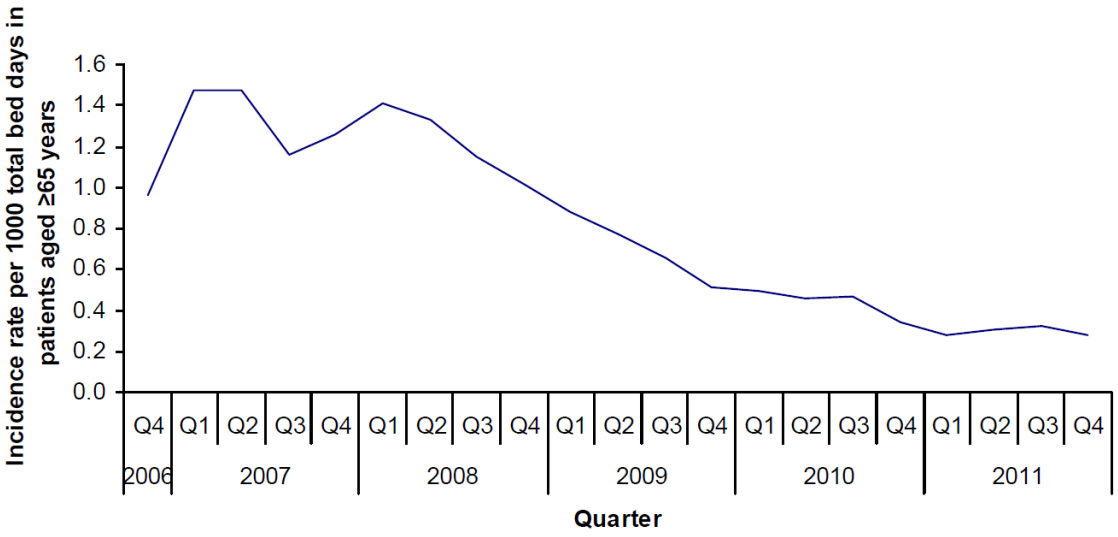
Gastrointestinal infections including *Clostridium difficile* infection accounted for a smaller proportion of all HAI in 2011 reflecting the significant reductions observed in the mandatory CDI incidence surveillance programme. In 2011, the prevalence of infection caused by *Staphylococcus aureus* was lower compared with 2005/2006. In contrast, the prevalence of infections caused by *Escherichia coli* was higher.

For the first time, the prevalence of HAI in paediatric and independent hospitals was reported. The prevalence did not differ significantly from the acute care setting, although the distribution of HAI types differed; and are relative to the differing populations and procedures in these settings.

Clostridium difficile infection (CDI)

During 2011, 2079 cases of CDI were reported in patients aged 15 years and over. The annual incidence rate of CDI in patients aged 65 years and over in 2011 reduced by 33%, a significant reduction compared with 2010. A decrease in the rate of CDI in patients aged 15-64 years was also observed (7%) though this was not significant. Quarterly incidence rates in 2011 have been steady and represent the lowest rates reported in patients aged 65 years and over, since the start of mandatory surveillance (Figure 5).

Figure 5 Quarterly CDI incidence rates per 1000 total bed days for patients aged 65 years and over in Scotland, October 2006-December 2011



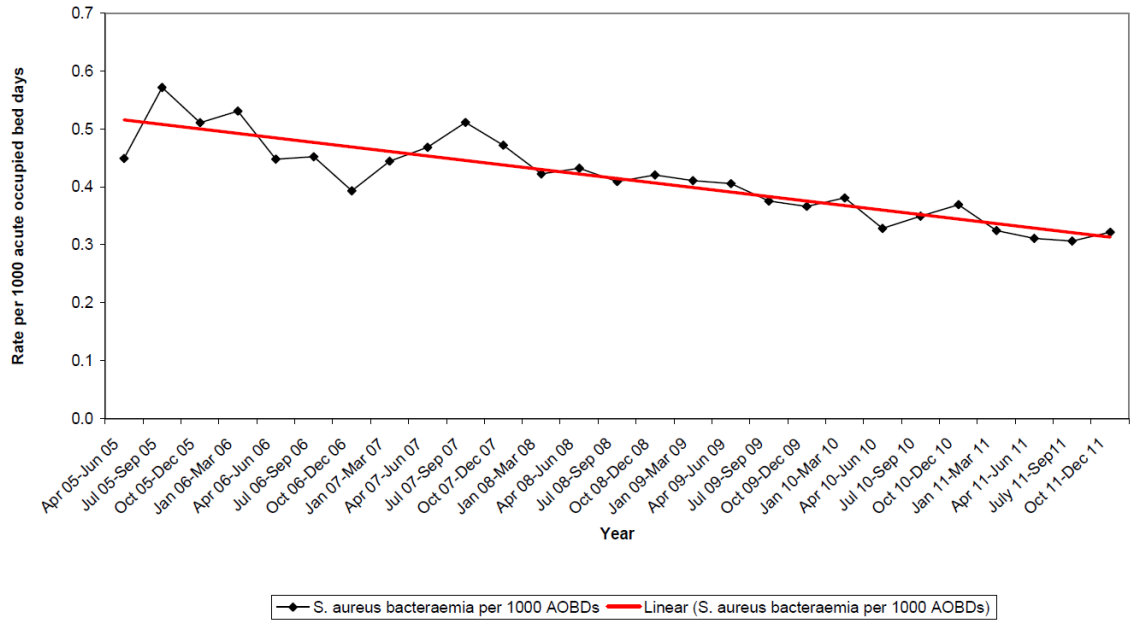
Source: Health Protection Scotland

Staphylococcus aureus bacteraemia

During 2011, a total of 1609 *S. aureus* bacteraemias in Scotland were reported compared with 1835 in 2010. The majority of the bacteraemias in 2011 were due to MSSA (1390, 86.4%). The annual incidence of *S. aureus* bacteraemia in 2011 had decreased by 11.3% compared with 2010. There has been a significant year on year reduction in *S. aureus* bacteraemia incidence rates of 7.4% since April 2005 (Figure 6). The MRSA and MSSA incidence rates have decreased year on year by 20.1% and 1.8%, respectively.

The proportion of *S. aureus* bacteraemia that were MRSA had significantly reduced from 19% to 14% in 2011. This compares favourably with other European countries and the change is temporally associated with the introduction of the national policy for MRSA screening in Scotland.

Figure 6 Quarterly *S. aureus* bacteraemia rates per 1000 acute occupied bed days for Scotland with trend line, April 2005-December 2011

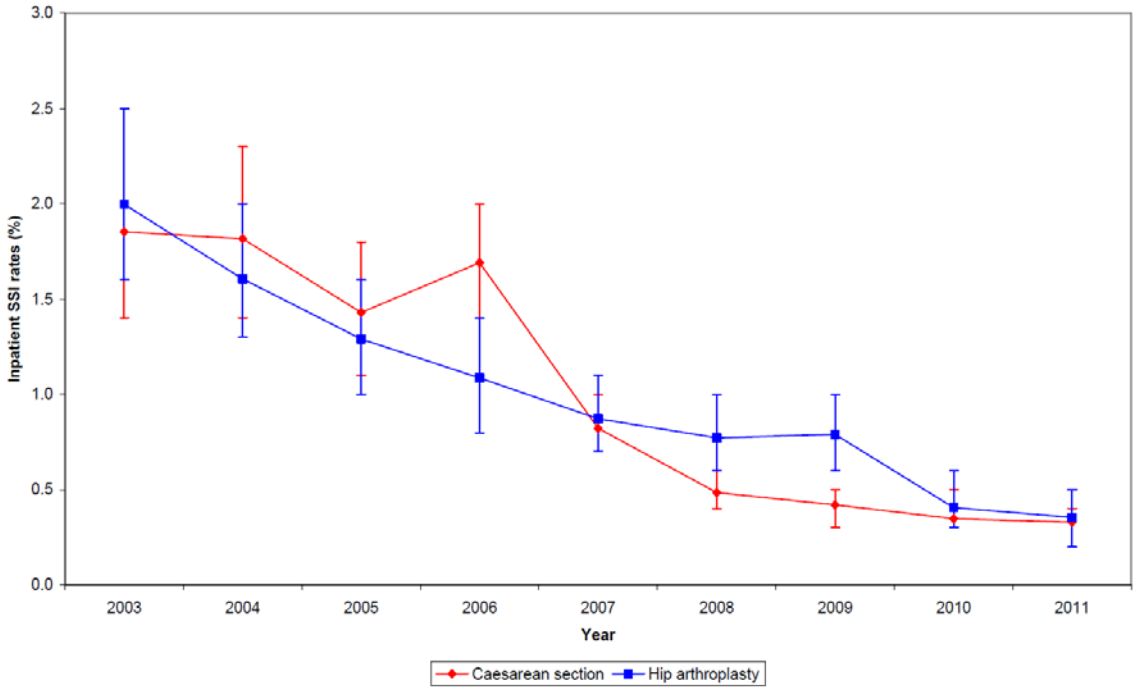


Source: Health Protection Scotland

Surgical site infection

Inpatient SSI rates following hip arthroplasty and caesarean section procedures have decreased significantly since 2001 (Figure 7). The incidence of SSI following caesarean section surgery (inpatient and post-discharge to day 10) had decreased significantly in 2011 compared with 2010. A reduction was also observed in the incidence of SSI following hip arthroplasty (inpatient and SSI identified on readmission to hospital within 30 days of surgery) though this was not significant.

Figure 7 Incidence of inpatient SSI following caesarean section and hip arthroplasty surgery in Scotland, 2003 to 2011



Source: Health Protection Scotland

Antimicrobial Resistance and Emerging Threats

In Scotland resistance to nearly all clinically important classes of antibiotics, including aminopenicillins, cephalosporins, fluoroquinolones and aminoglycosides has been reported for the Gram-negative bacteraemia isolates in recent years. Unlike the situation in Europe where increasing trends of resistance have been observed, resistance among Scottish isolates of Gram-negatives (*E. coli*, *K. pneumonia* and *Pseudomonas aeruginosa*) showed, with few exceptions, stable or decreasing trends in the period 2008-2011.

Until 2008 reporting of carbapenemase producing organisms in Enterobacteriaceae and non-fermentors was rare in Scotland. An increasing number of carbapenemase-producers were reported and investigated further at the Antibiotic Resistance Monitoring and Reference Laboratory (ARMRL) from 2009 to date. To date a total of 71 Scottish isolates have been confirmed as carbapenemase producers of known phenotypes, including KPC, VIM, IMP, IMI, NDM-1 and OXA-48. The majority of cases identified in the UK have overseas travel links and have received healthcare abroad, but spread within the UK is currently also being investigated as risk factors have not been established for all cases.

In response to the emerging threat of AMR, surveillance of antimicrobial resistance in UTI (in a representative number of samples from each NHS board) was established in Scotland in 2012. This will give us an early indication of emerging resistance, as resistance often evolves in organisms in other body sites (including respiratory, urinary and gastrointestinal tract) before these enter the bloodstream and cause life-threatening disease.

Priorities over the next 3 years

The changing epidemiology of HAI, identified by the results from the second PPS, has demonstrated successes in the implementation of targeted interventions in the period between surveys. Infection prevention and control interventions will now be refocused, using the results from the PPS, to ensure that the burden of HAI continues to reduce.

Key priority areas over the next three years will include a further focus on urinary tract infections, surveillance of antimicrobial resistant organisms, and continued development of guidance for emerging threats from antimicrobial resistance and best practice infection prevention and control. A review of national surveillance will ensure that mandatory requirements in Scotland are fit for purpose and that priorities are set using current epidemiological intelligence.

In addition to targeting these new emerging threats identified by the PPS and AMR surveillance, a focus needs to continue on implementing standard infection control precautions, inclusive of hand hygiene, to ensure the scale up of interventions and impact on outcome over recent years is sustained and built upon. A second chapter of the national infection control manual will be issued in 2012 giving guidance for generic infection prevention and control measures for known or suspected infections and implementation of this will be key in ensuring we tackle all types of HAI across all healthcare settings. The PPS points us to an HAI burden out with acute care, in other hospital settings, and with health and social care integration, our infection prevention and control efforts must be joined up; with health protection teams working in partnership with those in infection prevention and control in order that we strive toward the irreducible minimum of HAI in Scotland.

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