

Incredible Years

Strengthening Families

HIV infection

Healthwise

Director of Public Health

Annual Report

2015

FAMILY NURSE

PARTNERSHIP

Cardiovascular
disease



Public Health
Agency

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Foreword



 **Dr Carolyn Harper**

In the words of Benjamin Franklin: “an ounce of prevention is worth a pound of cure.” In these days of budget cuts and budget increases which are less than the rate of growth in demand, it is all the more important that we spend health and social care resources wisely. The old adage still stands and this report aims to show that, for investments that have been made in a range of public health programmes.

A healthy population and a healthy economy go together. By detecting disease early and tackling primary risk factors such as smoking, physical inactivity, and obesity, public health interventions can help mitigate the huge cost burden associated with chronic diseases in the future. In fact, public health interventions offer a win-win solution for the individual, the health service, the economy, and for society as a whole. They not only help to prolong life, but also help people to lead happier, healthier lives and thereby create a population that can contribute to growing the local economy.

In common with other parts of the UK, the health and social care (HSC) budget in Northern Ireland is under immense pressure. An increasing, and ageing population, and new technologies and drugs are key drivers of the estimated annual increase in HSC costs of 4-6%. The HSC budget has been relatively protected by the Northern Ireland Assembly and has increased by 2-4% per year. This is a very welcome growth when other sectors are facing cuts. This report shows that investment in public health programmes, and a preventive public health approach, has brought a return on investment that can help to close the gap between increasing costs and funding available.

This, the seventh Director of Public Health Annual Report, focuses on a number of interventions and programmes that are currently being funded and implemented by the Public Health Agency (PHA) across each of the three public health domains – health improvement, service development/screening and health protection – and demonstrates their ‘impact’ in monetary terms. By using a range of economic techniques to demonstrate the economic worth of public health interventions, the case for prevention is set out.

Dr Carolyn Harper
Director of Public Health

Further information

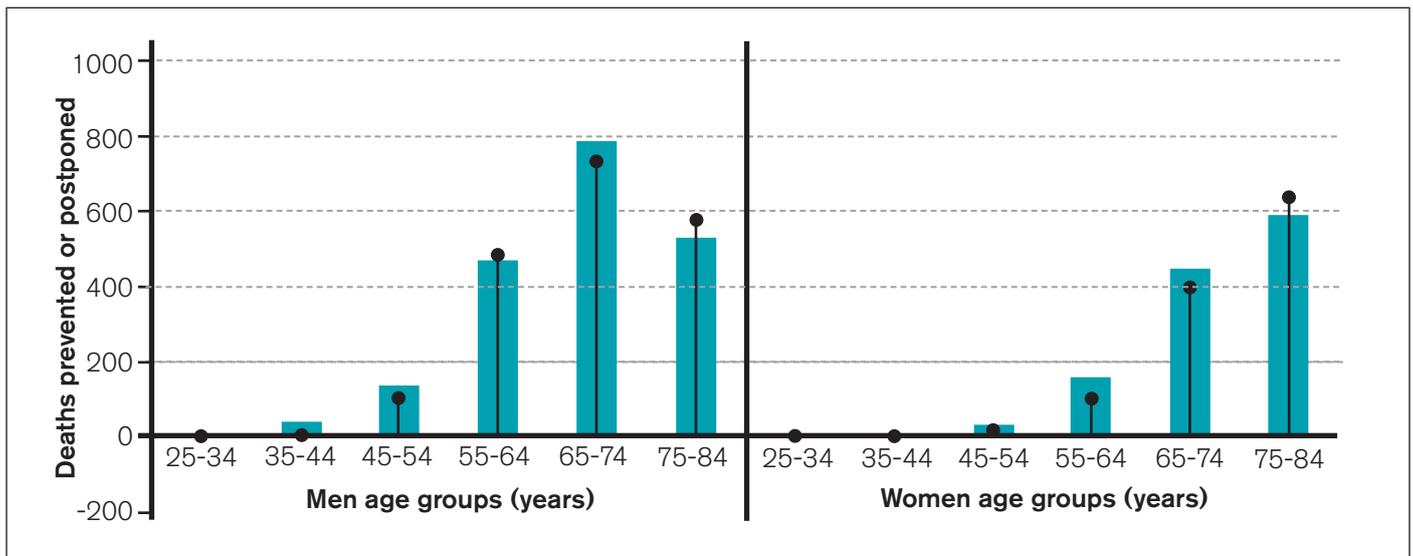
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Health improvement

Deaths from cardiovascular disease have more than halved

In line with other European countries, since the mid-1980s deaths from cardiovascular disease have more than halved in Northern Ireland. A recent modelling study by researchers from UKCRC Centre of Excellence at Queen's University Belfast, conducted between 1987 and 2007, has shown that 35% of this decline can be attributed to the increased uptake of new cardiovascular drug treatments and procedures, while 60% can be attributed to reducing major cardiovascular disease risk factors, primarily blood pressure, total cholesterol levels and smoking.¹ In fact, decreases in average blood pressure (by 1.46mmHg) and total cholesterol (by 0.73mmol/l) explained more than half (54%) of the decrease in mortality while a decline in smoking prevalence (by 7.2%) explained one fifth. While these reductions were partially offset by adverse trends in other population risk factors – increases in physical inactivity, the prevalence of diabetes and obesity levels – overall reductions in risk factors prevented or postponed approximately 1,900 deaths (95% confidence intervals (CIs) 1,400–2,340).¹

Figure 1: Total cardiovascular deaths prevented or postponed, from 1987–2007, by age and sex.¹



Columns show observed decrease in deaths (%) in each age group; Dots show the best model estimate; bars show the extreme minimum and maximum estimates in sensitivity analysis.

Considering that the value of a statistical life (VSL) is approximately £1,742,988, that is, the amount of money a person or society is willing to spend to save a life, then just considering the deaths prevented alone due to decreases in cardiovascular disease risk factors, would suggest a potential cost avoided of approximately £3 billion over 20 years for Northern Ireland.²

Dietary changes are likely to be responsible for the decreases in blood pressure and total cholesterol levels seen. A recent UK Diet and Nutrition Survey has shown that levels of saturated fat have dropped to 12.6% of food energy intake, compared to 16.5% in Northern Ireland in the mid-1980s.^{3,4} At the time of the study the 2007 smoking ban in public places had just been introduced and so its full impact on cardiovascular disease mortality is yet to be determined. The PHA is instrumental in continuing to

implement and invest in many interventions designed to tackle primary risk factors for cardiovascular disease and indeed, many other chronic diseases.

Tackling primary risk factors for chronic disease

Smoking

In line with the most recent evidence which suggests that combined pharmacotherapy and behavioural interventions are the most effective methods to stop smoking, the PHA commissions specialist quality assured Stop Smoking Services. These are delivered in a range of local settings across Northern Ireland including GP practices, pharmacies, hospitals and community/voluntary settings. The current service offers intensive treatment over 6–12 weeks with structured support available for up to four weeks after the client's quit date. The most recent figures show that since 2001/02 Stop Smoking Services in Northern Ireland have supported more than 200,000 people to stop smoking with over 59% of these clients still having quit by four weeks. This figure is the highest quit rate for any region in the UK. Of those smokers registered with the Stop Smoking services in 2013/14, 25% remained quit by one year, approximately 6,605 people.⁵

While the smoking prevalence in adults has indeed decreased remarkably since the mid-1980s, for the last two years it has decreased on average by 1% per year and currently rests at 22%.⁶ As a result, smoking related diseases continue to place a huge cost burden on health services. Based on a smoking prevalence of 22% in adults, it was estimated that the cost of treating smoking related illness in hospitals alone was £164 million per year, while costs to the economy were approximately £450 million per year (this includes all smoking related costs including health care, premature death, excess sickness absence, smoke breaks, deaths due to second hand smoke, smoking related litter and fire in the business place or home).⁶ This would suggest that every 1% decrease in the prevalence of smoking potentially yields an annual cost saving of £7.5 million in terms of healthcare and £20.5 million to the local economy. If we consider that last year the total PHA spend on smoking cessation was approximately £3 million (this includes the cost of Stop Smoking Services as well as other work carried out by hospitals and the community such as working towards smoke-free hospitals, pathway development, training and schools prevention work) then the return on investment was 2.5 times in terms of hospital costs only, or 6.8 in terms of net revenue gain to the Northern Ireland economy.

Physical activity

Physical activity is also a strong modifiable risk factor for many chronic diseases and a number of physical activity interventions supported by the PHA have demonstrated significant returns on investment. One example is the Healthwise physical activity GP referral scheme which was a pilot study undertaken within the Belfast Health and Social Care Trust (BHSCT) area. It allowed GPs to refer patients who were currently inactive and had one or more chronic diseases to their local gym for 12 weeks' free membership. Under the guidance of a physical activity instructor, they set goals and undertook supervised exercise. These schemes are currently recommended by NICE.⁷ In 2012/13 the scheme engaged with 786 referred users who significantly improved their physical and mental health.

They also reported gains in confidence, a greater awareness of the benefits of physical activity and the range of services available. A social return on investment (SROI) analysis, which aims to place a monetary value on social outcomes, was used to evaluate the project. By valuing the total economic and social outcomes of the project, it was found that for every £1 invested, the project generates a return of approximately £7.⁸

The PHA has also helped support the Connswater Community Greenway (CCG) project (www.communitygreenway.co.uk). This is a £35 million major urban rejuvenation project currently underway in East Belfast which is jointly funded by the Big Lottery, the Northern Ireland Rivers Agency and the PHA. Studies have consistently found a positive association between the built environment in which someone lives and their physical activity levels.⁹ The integral component of the CCG project involves the construction of a 9km linear park or greenway combined with major flood alleviation measures to protect approximately 1,700 homes from future flooding. It is anticipated that around 100,000 people living adjacent will benefit from a better living environment, opportunities for leisure, exercise, recreation and support for healthier behaviours. A return on investment study lead by the UKCRC Centre of Excellence at Queen's University Belfast considered the total anticipated impact of the project including health, environmental and economic outcomes, and demonstrated that the project should pay for itself between two and six times over approximately 40 years.¹⁰

Obesity

Obesity is still one of the most important public health challenges facing Northern Ireland. According to the Northern Ireland Health Survey in 2014/15, 25% of those aged 16 years and over were obese and a further 35% were overweight, making a total of 60% who were either overweight or obese.¹¹ It is estimated that loss to the local economy as a result of obesity is approximately £400 million per year with £100 million due to direct healthcare costs.¹² The workplace has been recommended as a potentially valuable setting for behavioural weight management interventions, due to the amount of time potentially spent sedentary in work, the food consumed there, and the social norms and support within organisations. The £ for lb challenge is a workplace based, 12 week behavioural weight management programme that has proved very successful and is now in its third year. It is delivered in partnership with Business in the Community (BITC; a national corporate social responsibility charity), the PHA, the BHSCT and a corporate sponsor. Weight loss is incentivised by the organisation, the participant or both, pledging £1 to a relevant charity for every 1lb of weight loss achieved. Prizes are awarded to organisations and participants during a celebration event at the end of the programme.

In 2014, the first year of the project, 734 employees participated and lost a total of 1,541.4kg in weight, an average of 2.1kg/person.¹³ In 2015, a total of 1,585 employees participated and lost a total of 3,989.4kg, an average of 2.5kg/person.¹⁴ The programme received £10,000 in sponsorship in its second year. Hence, the programme cost £6.31 per person or £2.51 per kg of weight lost. If participants sustain their weight loss then this cost is well below the cost-effectiveness level specified by NICE.¹⁵

Early years interventions

There is a growing body of literature which demonstrates that intervening early and creating the right conditions for early childhood development is likely to be more effective and much less costly than addressing problems at a later age. In order to make the case for early intervention, a recent report for England and Wales calculated that nearly £17 billion per year is spent by the state on short-run 'late' interventions dealing with issues such as crime and anti-social behaviour, school absenteeism and exclusion, child protection, child injuries and mental health problems, youth substance misuse and economic inactivity.¹⁶ However, only £200 million is spent each year on early intervention.

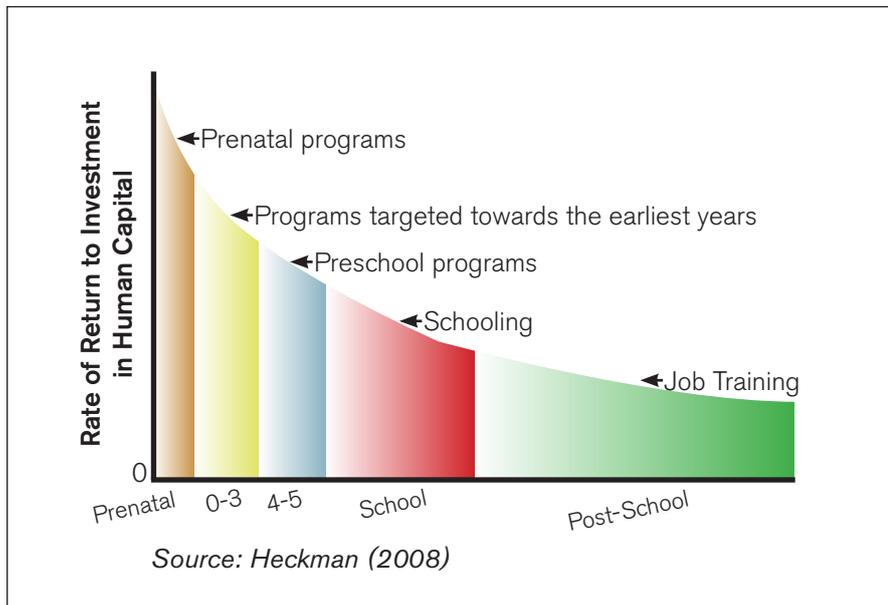
To develop an informed profile of investment on the early intervention agenda, the Northern Ireland Commissioner for Children and Young People led a study to calculate the total annual expenditure on children's services in Northern Ireland in 2012/13 and assess to what extent the spend was on preventative evidence-based services. In 2012/13, total public expenditure in Northern Ireland was approximately £15 billion with £2.28 billion spent on services for children, young people and their families. Of this £2.28 billion, just over one-tenth (13%, £0.29 billion) was spent on selective or indicated preventive child interventions.¹⁷ However, investment in evidence-based programmes was near zero except for some interventions funded by the PHA. It is obviously vital that current investment is spent on effective and cost-effective interventions in order to ensure the greatest return on public spending.

On the theme of early intervention, the First and Deputy First Minister announced the delivery of the Early Intervention Transformation Programme (EITP) from April 2014 to March 2018. Its aim is to embed early intervention approaches within mainstream children's services. It is jointly funded by six government departments (providing £15 million) and The Atlantic Philanthropies (contributing £10 million over four years), as part of the Delivering Social Change initiative. The programme has three workstreams:

1. Equipping parents with the skills to give their child the best start in life.
2. Supporting families locally when problems arise at an early stage.
3. Changing outcomes for children facing particular adversity.

The PHA is responsible for the coordination and ensuring implementation of workstreams 1 and 2 with a budget of £7.4 million over three years.

NICE has now issued guidance on "Promoting the social and emotional wellbeing of vulnerable children (under 5's): through home visiting; and early education and childcare".¹⁸ The economic modelling performed by the School of Health and Related Research (SchARR) to inform this guidance concluded that interventions in the early years are potentially cost effective or cost saving.¹⁹ Improving child cognition should, in turn, improve educational outcomes, leading to higher wages and tax revenues. Below is a graph by the Nobel Prize winner and renowned economist, James Heckman, which highlights that the earlier the investment in children, the greater the rate of return on investment.

Figure 2: Graph to show the rate of return to investment in human capital by age of child.²⁰

As part of workstream 2, the PHA is implementing a number of evidence-based parenting programmes including Incredible Years and Strengthening Families. Both of these programmes have been modelled by the Social Research Unit at Dartington and found to deliver positive returns on investment. Incredible Years is a 14 week programme aimed at parents or teachers of children aged from birth to 12 years. It aims to reduce behaviour problems and promote problem solving skills, social competence and emotional regulation. Each programme costs £6,555 to deliver and can enrol 12 families, costing approximately £546 per family. Strengthening Families is also a 14 week programme, designed to reduce risk factors for children in families with a history of parental drug and alcohol abuse, and/or families experiencing difficulties. It tries to improve the family environment by teaching parents discipline techniques and to understand the importance of rewards and positive attitudes in their children. Each programme costs £10,300 and can enrol 12 families, costing £858 per family.

The PHA has allocated £150,000 each year to invest in parenting programmes. The plan is to deliver two Incredible Years and two Strengthening Families programmes each year in each of the five trusts. Modelling by the Social Research Unit at Dartington has found that every £1 invested in Incredible Years and Strengthening Families programmes generates £1.37 and £2.33 respectively, in the long term.²¹ Therefore, each year, investment in these interventions could produce long-term cost savings in the region of £329,793.

Another parenting intervention currently funded by the PHA which has recently received some research attention is the Family Nurse Partnership (FNP) programme. This is a programme of intensive support and home visits from early pregnancy until a child is two years old. It is aimed at vulnerable first-time mothers and their children. (Vulnerable mothers are considered to be first-time mothers with one of the following risk factors: single, low socio-economic status, under the age of 19, less than 12 years of education, or unemployed.) The goal is to promote child development, provide support and teach

parenting skills to parents. They were first trialled in the United States in Elmira (NY), Memphis (TN), and Denver (CO), and all three evaluations found positive results for prenatal health behaviours, birth outcomes, sensitive child care, child and adolescent functioning, and maternal life course.^{22,23} A further study conducted in the Netherlands also reported positive outcomes.^{24,25} However, these results have recently been challenged by the results from a multisite trial of FNP in the UK which was not able to show that FNP was significantly better than 'usual care'.²⁶

Several reasons have been suggested to explain the lack of difference in outcome between the UK trial groups.²⁷ First, the intervention group in the UK study was not quite as 'vulnerable' as in US studies. The UK FNP intervention focused on first-time mothers less than 20 years of age, whereas US studies focused on mothers "living in concentrated disadvantage" with "few psychological resources to cope with adversity"; the Netherlands study focused on "highly vulnerable mothers, irrespective of their age." Results were further diluted as the comparator group in the UK FNP study received 'usual care' which already involves quite intensive support for mothers. In addition, and fundamentally, the UK FNP study measured different primary outcomes to the US studies which FNP does not claim to affect, including birthweight and children's emergency department encounters. Primary outcomes which previous FNP studies were found to affect were not measured, including cognitive development and serious injury. In light of these differences, FNP continues to be considered to be an effective and cost-effective intervention until further evidence emerges.

In 2010, the Western Health and Social Care Trust piloted the programme and in 2012 the PHA expanded the programme across Northern Ireland with 27 nurses now trained to deliver the programme. Each year the PHA invests approximately £1.6 million in five FNP programmes – one in each trust – and each programme is able to enrol approximately 100 mothers each year for support which lasts for two and half years. The cost of the programme per mother is therefore approximately £3,200/mother. To date 440 mothers in total have been enrolled. Modelling performed by the Social Research Unit at Dartington has found that for every £1 invested in the FNP programme, a cost saving of £1.94 in the longer term can be expected through reduced healthcare, crime, education and child and adolescent mental health service (CAMHS) costs via a reduction in disruptive behaviour and increased earnings of the child through improved educational attainment.²¹ Therefore, each year the £1.6 million invested in FNPs generates a return of £3.1 million in the long term.

Breastfeeding

Breastfeeding is an area where there is still more to do in Northern Ireland. The UK has one of the lowest rates of breastfeeding worldwide (81%) with Northern Ireland having the lowest breastfeeding initiation rates among the UK countries: 64% compared to England 83%, Scotland 74% and Wales 71%.²⁸ In 2010, the prevalence of breastfeeding in Northern Ireland at one week was 47%, 33% at six weeks, and 16% at six months with no statistically significant increase since 2005.²⁸ Yet breastfeeding, as well as providing essential nutrients for baby, has positive health benefits for both mum and baby. Breastfed children have been found to have a lower incidence of otitis media and gastroenteritis, and a lower risk of obesity and asthma. Decreased rates of sudden infant death syndrome, types 1 and 2 diabetes, certain

cancers and improved cognitive development have also been reported. For mothers, reported benefits include greater weight loss postpartum and a decreased incidence of breast and ovarian cancer.²⁸ Results from local surveys can help explain some of the reasons why mothers in Northern Ireland choose not to breastfeed. A review of antenatal education in Northern Ireland found that although breastfeeding is strongly encouraged, there is a perceived lack of support in the days and weeks after birth to assist mothers.²⁹ In response to the Infant Feeding Survey, mothers said they were discouraged from breastfeeding in public due to three main factors including lack of suitable places (51%), lack of confidence (35%) and concerns about hygiene (35%).³⁰ Approximately one in five mothers (19%) stated that they had concerns about being made to feel uncomfortable and 1% said they had been stopped.

A recent article in the *Lancet* summarised the evidence on interventions to improve breastfeeding practices.³¹ Within healthcare systems, many of the interventions included in the Baby Friendly Hospital Initiative (BFHI) including individual counselling or group education, immediate breastfeeding support at delivery and lactation management were all effective at increasing breastfeeding rates. The BFHI works with health services to ensure a high standard of care for pregnant women and strengthen maternity practices to support breastfeeding. BFHI was introduced in Northern Ireland in 1994 and is currently supported by the PHA in all five HSC Trusts. Almost 100% of maternity units have now achieved the UNICEF Baby Friendly Standards. However, this article suggests that for the UK (and Northern Ireland) lower breastfeeding rates may not be due to a lack of intervention but more as a result of a lack of robust policy changes. While code legislation exists, it is poorly enforced, and the UK legislation protecting breastfeeding in public is not widely understood. Challenging the interests of the infant feeding industry has also been met with professional resistance. In spite of the WHO code, professional development opportunities have been supported by the industry.

To quantify the healthcare cost savings that could be achieved through improved breastfeeding rates, the same *Lancet* article modelled the potential cost savings achieved through the reduced incidence of five common childhood diseases for which the evidence for the protective effects of breastfeeding is strongest (otitis media, diarrhoea, necrotising enterocolitis, pneumonia, and bronchiolitis). If a 10 point increase in exclusive breastfeeding up to six months was achieved across the UK, healthcare costs would reduce by £6.5 million.³¹ Alternatively, if exclusive breastfeeding up to six months improved from current levels to 45% in the UK, it would reduce treatment costs by at least £25 million.³¹ These figures do not include the additional healthcare cost savings made through improved maternal health. Investment in breastfeeding brings returns and benefits for baby, mum and society as a whole.

The role for legislation and taxation

There are a number of key areas where public health indices are worsening such as obesity, alcohol-related harm, and road traffic accidents where legislation and fiscal intervention could play an important role.

It is estimated that for every £1 spent by the UK government on promoting healthy eating, the food industry spends £100 on advertising processed foods, soft drinks and chain restaurants.³² Of particular

concern is the growing consumption of sugar sweetened beverages (SSBs) particularly by children, which are associated with being overweight or obese, as well as with type 2 diabetes, cardiovascular disease and dental caries. The average child obtains a tenth of their daily calorie intake from SSBs.³³ In response, the UK Chancellor of the Exchequer, George Osborne, has recently announced a sugar tax on the soft drinks industry as part of the 2016 budget which will come into effect in two years' time. It has been estimated that a 20% duty on SSBs in the UK would reduce the prevalence of obesity (BMI >30) by 1.3% (approximately 180,000 people – 5,300 within Northern Ireland) and generate revenue of £276 million.³⁴ Hopefully with time Northern Ireland will follow suit.

In Northern Ireland, the personal, social and economic costs of alcohol are estimated to be approximately £900 million per year with almost £250 million of these costs borne by the health and social care sector.³⁵ While the majority of the population recognises the harm that alcohol causes, it is also accepted as an integral part of daily life. Alcohol is readily available, advertised widely and has become progressively cheaper over the years. Alcohol in 2013 was nearly 61% more affordable than it was in 1980.³⁶ Implementing a minimum unit price (MUP) of at least 50p per unit of alcohol has been suggested as one way to reduce demand. Modelling performed by the Sheffield Alcohol Research Group (SARG) has found that a MUP for alcohol of 50p in Northern Ireland would result in 63 lives saved and 2,425 fewer hospital admissions per year. This would lead to a cost saving to the health service of £1.8 million in year 1 and £397 million over 20 years.³⁵ In addition, 5,293 criminal offences and 35,000 days off sick could be prevented each year. For a 50p MUP policy, SARG estimated the total societal value of the harm reductions for health, crime and workplace absence in Northern Ireland to be £956 million over 20 years.³⁵

In 2014, there were 6,085 road traffic collisions of which 74 were considered fatal, 577 serious, and 5,434 slight.³⁷ As a result 789 people were killed or seriously injured and of these 158 were pedestrians, 62 cyclists and 70 children (0–15 years). The total value of prevention of road traffic accidents in Northern Ireland in 2014 was estimated at £368.2 million.³⁸ (This figure encompasses all aspects of the valuation of collisions including human costs; direct economic costs of lost economic output; medical costs; costs of damage to vehicles and property; police and administration costs of accident insurance.) Inappropriate speed contributes to 15% of crashes resulting in a serious injury and 24% of collisions which result in a death.³⁹ This equates to approximately 225 serious and 29 fatal accidents in 2014 due to speeding at a cost of £261.8 million. The measures that are most effective in reducing vehicle speeds and thereby reducing road death and injury are area-wide traffic calming schemes and 20 mph zones.

Service development/screening

Abdominal Aortic Aneurysm (AAA) screening

The Northern Ireland AAA Screening Programme (NIAAASP) was introduced in 2012. It aims to reduce AAA-related mortality by providing a systematic population-based screening programme for the male population during their 65th year and, on request, for men over 65.

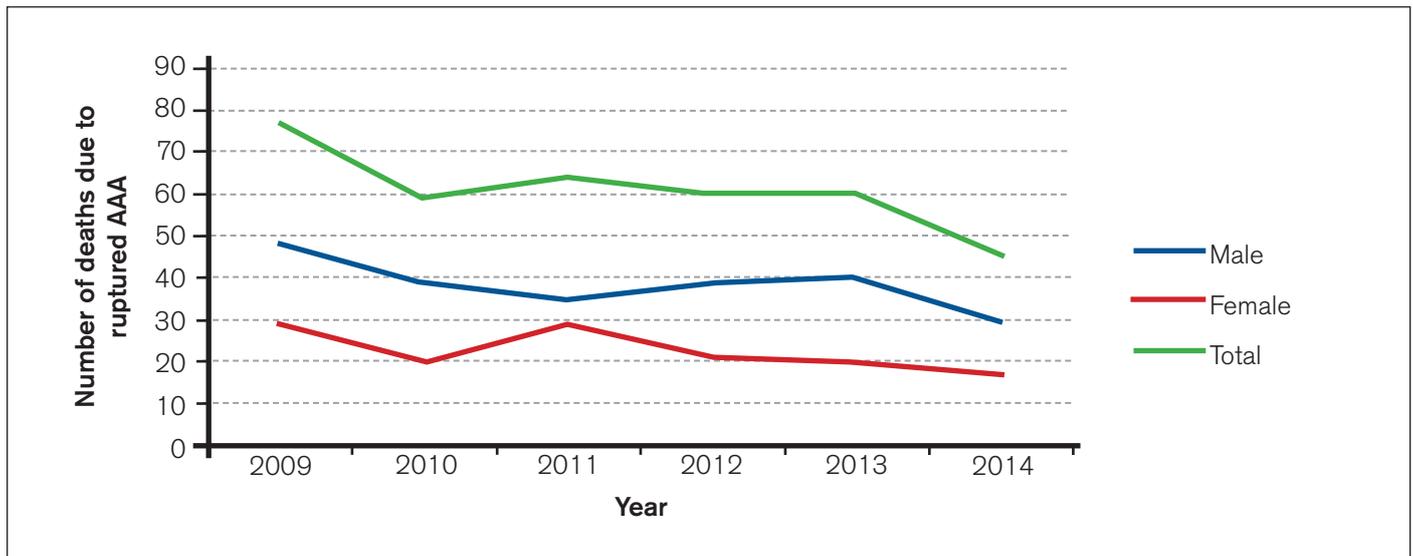
An aneurysm is a widening of an artery due to a weakness in its walls. When this occurs in the main blood vessel from the heart, as it passes through the abdomen, it is called an AAA. These aneurysms are normally asymptomatic, but approximately one third will rupture, with those larger than 5.5cm in diameter carrying the greatest risk.⁴⁰ AAAs are most common in men aged 65 and older. Other factors known to increase the risk of developing an AAA are smoking, high blood pressure, high blood cholesterol, other vascular diseases and a positive family history of AAA. The prevalence of AAAs is approximately 1.6% in men in Northern Ireland, while research has shown that women are six times less likely to have an AAA than men in all age groups.⁴¹ AAA screening for women is therefore currently not offered as it is not considered cost-effective.

Mortality following rupture is high. Around 50% of those who suffer a ruptured aortic aneurysm die in the community before reaching hospital.⁴⁰ Of those who undergo emergency repair, the mortality rate is between 30 and 70%.⁴⁰ However, elective repair (either open or endovascular) of an AAA has a much lower post-operative mortality rate, currently 1.2% in Northern Ireland.⁴¹ As aneurysms are largely asymptomatic until the point of rupture, screening allows the identification of men with unrecognised AAAs before rupture. Identifying these men and offering elective repair has been found to reduce mortality related to AAA by approximately 50%.⁴⁰

Screening consists of a single ultrasound scan to visualise the abdominal aorta. Over 98% of men will have a normal result and be discharged from the programme. Men identified with a small or medium sized aneurysm (between 3 and 5.4 cm) are kept under surveillance within the programme and given advice on secondary prevention measures including statin and antiplatelet therapy. Men identified with a larger aneurysm (greater than or equal to 5.5 cm) are referred to the vascular service and considered for intervention.

Outcomes

Since the start of the programme, 30,820 men have been screened, equivalent to an uptake rate of approximately 83%, 64 men have been referred for surgery and 418 are under active surveillance.⁴¹ In the long term, the programme should lead to a reduction in the incidence of ruptured AAAs, the number of emergency repairs and overall AAA mortality, with an increase in male life expectancy. As the programme has been running for less than four years, these benefits have not yet been fully realised. However, a general downward trend in the absolute number of deaths due to ruptured AAAs in Northern Ireland has been seen (see figure 3), with a more marked decrease since 2012. The reason for the downward trend prior to 2012 is probably due to the on-going decrease in cardiovascular risk factors as discussed earlier. However, more long-term data is required before any definite conclusions can be made.

Figure 3: The number of deaths due to ruptured AAAs from 2009 until 2014.

Source: Data supplied by Northern Ireland Statistics and Research Agency (NISRA).

In addition, the programme has been found to have a number of unplanned benefits. Firstly, the screening appointment has proved an ideal setting to deliver opportunistic health advice to men, particularly to address cardiovascular risk factors such as smoking, physical inactivity and diet. Typically men are less likely to engage with health services and can be a hard group to reach. However, such a high uptake rate of AAA screening has meant this group of 65 year olds can be readily targeted.

The implementation of the Northern Ireland AAA Screening Programme was preceded by local implementation of a national AAA quality improvement programme. In accordance with the UK National Screening Committee and Department of Health, Social Services and Public Safety (DHSSPS) guidance, before a systematic, population-based AAA screening programme could be introduced in Northern Ireland, the vascular service to which men are referred for treatment had to comply with the national standards set by the Vascular Society of Great Britain and Ireland. At the time, BHSC was the only trust in Northern Ireland which met the required standards with regard to AAA case volume, mortality and a comprehensive endovascular service. Mortality associated with AAA procedures now sits at 1.2%, which is considerably lower than the quality standard of 3.5%.^{41, 42}

Value for money

The total annual recurrent cost of the AAA programme is just under £600,000. While it is too early to assess the monetary 'return' of this investment, as the programme has not been running long enough to capture all its benefits, its cost-effectiveness can be argued logically. In the long term, we would expect the number of emergency repairs to decrease, elective repairs to increase and overall AAA mortality to decrease. Compared to elective repairs, emergency repairs are associated with higher mortality, longer hospital stays, and higher use of ICU beds, and are subsequently more costly (emergency repair costs around £20,000, elective repair around £13,000.) While it is expected the increase in elective repairs will be greater than the decrease in emergency repairs, leading to an overall increase in cost,

modelling studies have shown that the increase in life expectancy, and subsequently quality adjusted life years (QALYs), more than offsets this additional cost. In fact, modelling studies have demonstrated that the programme should be cost-effective after approximately 10 years and very cost-effective after 30 years, with an incremental cost-effectiveness ratio (ICER) of £7,370/QALY – well below the UK cost-effectiveness threshold of £20,000/QALY.⁴³

The Northern Ireland AAA screening programme has led to significant improvements in care for patients identified with a screen-detected AAA and it is hoped that these improvements can be extended to all patients with AAA.

Colorectal Cancer (CRC) screening

CRC is the second most common cause of cancer death in Northern Ireland with 1,196 people diagnosed each year and approximately 421 die from it.⁴⁴ However, if detected at a very early stage there is a 90% chance of successful treatment.⁴⁴ The Northern Ireland Bowel Cancer Screening Programme was launched in April 2010 with the aim of reducing mortality and morbidity from colorectal cancer through early detection and treatment. Initially men and women aged 60–69 years who were registered with a GP were invited to participate. The age range was subsequently extended to 71 years in April 2012 and to 74 years from April 2014.

Screening involves the use of a home collection kit to collect a sample of bowel motions which are then analysed to detect traces of blood. This is called a guaiac faecal occult blood test (FOBT). The presence of hidden blood in the stools indicates a positive test and those participants are offered a colonoscopy procedure to visualise the bowel as they may be at risk of CRC. Those who have a negative screening result are returned to routine recall in two years and those with an equivocal result are offered a more sensitive test called the Faecal Immunochemical Test (FIT).

On colonoscopy, if the bowel looks normal, the participant is returned to routine recall. However, if polyps are seen, they are excised and/or biopsies taken. Polyps are an abnormal growth of the bowel wall and some, if left, can develop into cancer. Depending on the number and size of the polyps seen, participants are deemed to be at either low risk and returned to routine recall, intermediate risk and offered a repeat colonoscopy in three years, or high risk and offered a repeat colonoscopy in one year.

Outcomes

The uptake rate of bowel cancer screening has not been as high as that seen in other screening programmes but continues to improve. There are a number of potential reasons for this, including the fact that the procedure is based on a home test which requires the participant to follow a set of instructions. Some people find that collecting the sample is unpleasant, particularly as it needs to be undertaken over several days. In 2013/14, out of 63,357 participants with a completed test result, 1,522 had a positive result and were offered further investigation giving a positivity rate of 2.4%; 1,330 subsequently had a colonoscopy performed, the outcomes of which are outlined in the table below.⁴⁵

Table 1: Outcomes of colonoscopy as a result of the 2013/14 bowel cancer screening programme.

Colonoscopy result	Number of participants
Cancer detected	105
High risk	202
Intermediate risk	303
Low risk	143
Normal – no abnormalities detected	575
Surgery performed to remove complex polyps	<5
Total	1,330

CRC cancers are staged according to a classification scale called Dukes Staging. Very early stage cancers, where the disease is limited to a polyp, are classified as Dukes A*. Dukes D is advanced disease with other organ involvement. The five year survival rate is 91.5% for Dukes A but just 7.1% for Dukes D, highlighting the importance of early diagnosis.⁴⁴

Of the screen-detected cancers in 2013/14, 59% of them were considered as early stage, ie Dukes A* or A. None of the screen-detected cancers were classified as Dukes D. The Northern Ireland Cancer Registry has also seen a shift in staging of CRCs detected from late to early stage since the introduction of the screening programme. In 2009, ie before screening was introduced, 14% of 60–70 year olds diagnosed with CRC were early stage (Dukes A) compared with 22% in 2013. In addition, late-stage diagnoses (Duke D) have decreased from 23% in 2009 to 18% in 2013.⁴⁶ This is very welcome.

Value for money

At the end of 2013, there were 7,764 people living with CRC in Northern Ireland. It has been estimated that the average annual HSC cost of a case of CRC is approximately £2,523.⁴⁷ Therefore, each year Northern Ireland is spending approximately £19.6 million to provide HSC services for those with CRC. The costs of delivering the screening programme in 2013/14 to those aged 60–71 years, including the quality assurance costs, amounted to approximately £2.6 million. In return, just considering the year 2013/14, the programme detected 105 cancers of which 59% (61 cases) were early stage with an over 90% chance of survival at five years. Furthermore, 648 participants had polyps detected and removed which may have developed into cancer sometime in the future.⁴⁵ These participants will now be entered into a surveillance programme and monitored for further polyps.

As with AAA screening, bowel cancer screening has not been in existence long enough to demonstrate its cost-effectiveness. However, considering the lifetime treatment costs associated with Dukes A (£12,455) are less than half those of Dukes D (£25,703), detecting cancers at an earlier stage should extend life expectancy and reduce overall treatment costs.⁴⁸ In addition, detecting and excising polyps before they become cancerous will avoid the high treatment costs associated with CRC. Furthermore, a recent report for the NHS Bowel Cancer Screening Programme which appraised the different options for CRC screening in England, found screening every two years with FOBT at 60-69 years to be cost saving compared to no screening.⁴⁹ They also found screening in the long term would reduce the incidence of CRC by 6.5% and CRC mortality by 9.9%.⁴⁹

Health Care Associated Infections (HCAIs)

Since the early 2000s, the number of HCAIs identified among patients receiving care in Northern Ireland's acute hospitals has decreased dramatically. This is the result of a focused and collaborative improvement programme involving healthcare providers across all parts of the health and social care system. The main role of the PHA is in implementing DHSSPS policy on HCAIs by providing support to trusts, primary care and the independent care sector through robust regional HCAI surveillance programmes and by providing expert knowledge and advice on HCAI and antimicrobial resistance and stewardship (AMRS).

The dramatic decrease in both *Clostridium difficile* infections (CDI) and *Methicillin-Resistant Staphylococcus aureus* (MRSA) bloodstream infections over the last decade among patients identified in the hospital setting has been the result of a combination of interventions. First the DHSSPS published its Antimicrobial Resistance Action Plan (AMRAP) 2002–2005.⁵⁰ Following this, in 2006 the DHSSPS published "Changing the Culture" which was the first regional HCAI improvement and reduction strategy for Northern Ireland.⁵¹ This was subsequently updated and reissued in 2010 at a time of significant health service restructuring in Northern Ireland.⁵² Learning also arose as a result of a number of serious outbreaks across Northern Ireland including a large CDI ribotype 027 outbreak within the Northern Health and Social Care Trust in 2008 and *Pseudomonas* outbreaks in a number of neonatal units in 2011/12.

Other key developments included the establishment of a performance management and multi strand HCAI improvement programme in 2008, which included the introduction of formal performance targets for CDI and MRSA. In 2010, independent inspections of hospital and healthcare environments by the Regulation and Quality Improvement Authority (RQIA) began and an environmental cleanliness taskforce was established by the DHSSPS. Complementing all of the above, there has been ongoing work addressing antimicrobial prescribing and stewardship practices, leading to the publication of guidelines for best practice in prescribing, the establishment of multi-disciplinary antimicrobial stewardship teams and the introduction of antimicrobial pharmacists in all trusts.

The incidence of Surgical Site Infections (SSIs), particularly following orthopaedic surgery, has also significantly decreased year on year since 2003. A number of factors have contributed including increased awareness through feedback of orthopaedic SSI rates to trusts. This is thought to have influenced improved adherence to established surgical principles and practices. In 2008, NICE developed guidance on surgical site infections and in 2009, the DHSSPS recommended that all trusts make use of the WHO surgical checklist.^{53,54} Furthermore in 2009, individual trusts in Northern Ireland implemented SSI care bundles, ie evidence-based care processes shown to reduce the risk of infection if implemented consistently.

Outcomes

Figure 4: *Clostridium difficile* infection rate for patients in the hospital setting, aged 65 years and older, from 2006–2015 (with 95% CIs).⁵⁵

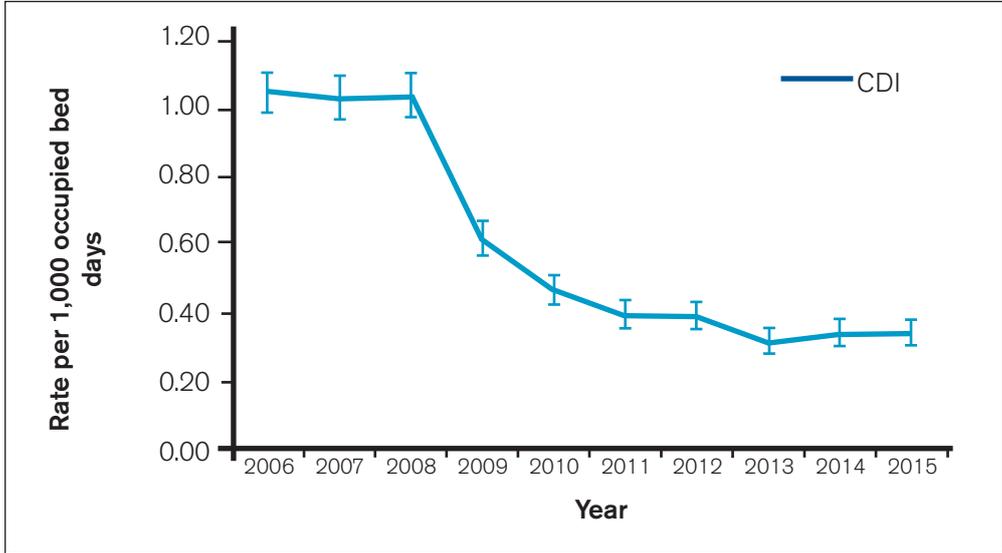


Figure 5: MRSA infection rate for patients in the hospital setting, all ages, from 2006–2015 (with 95% CIs).⁵⁵

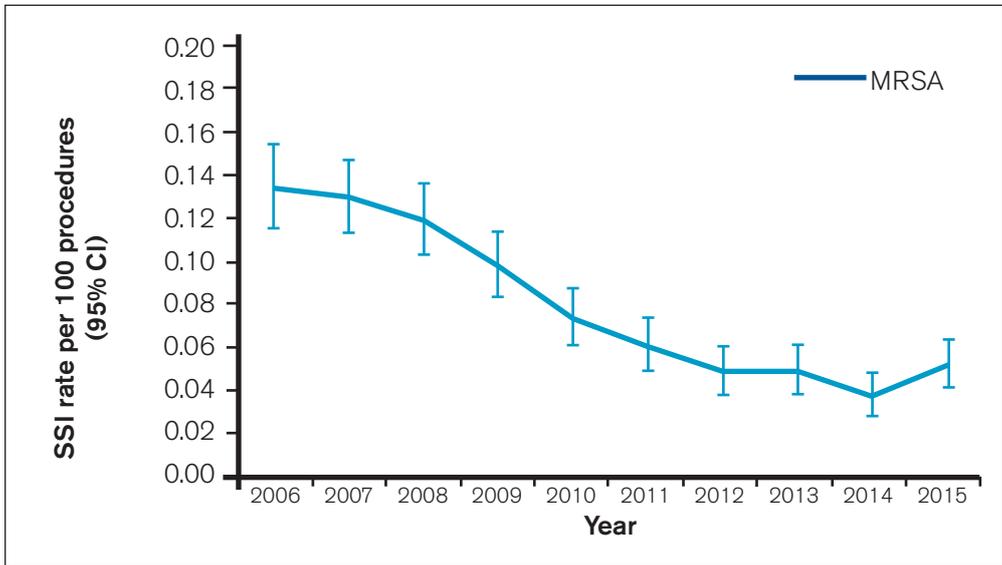
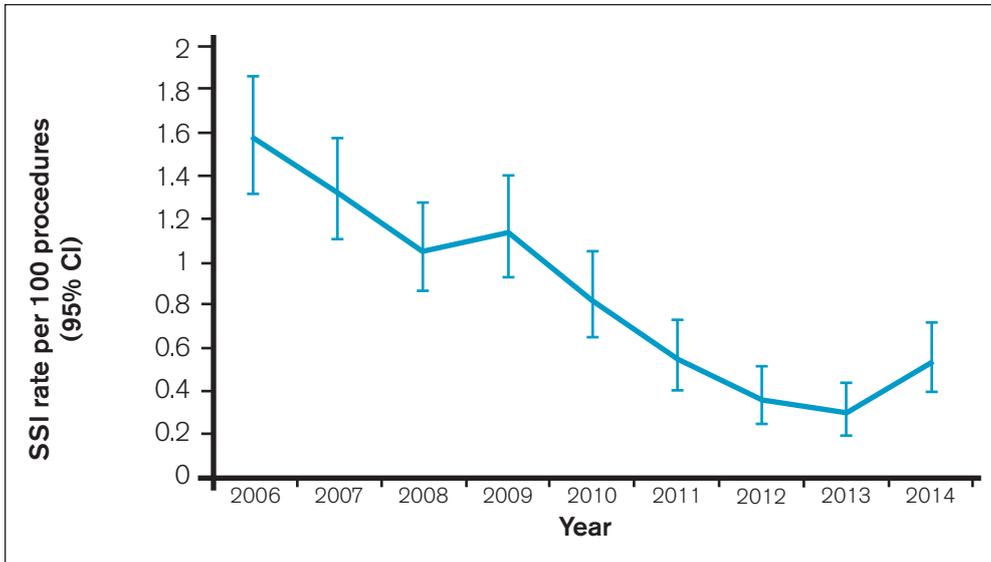


Figure 6: Surgical site infection rate, all ages, following orthopaedic procedures from 2006–2014 (with 95% CIs).⁵⁵



Value for money

Over the period 2006 to 2014, there has been a year-on-year decrease in infections:

- CDI – 12% year-on-year decrease (1,073 cases from 1,026,937 in-patient days in 2006; 293 cases from 861,064 in-patient days in 2014).⁵⁵
- MRSA – 14% year-on-year decrease (182 cases from 1,359,898 in-patient days in 2006; 57 cases from 1,535,861 in-patient days in 2014).⁵⁵
- Orthopaedic SSIs – 5% year-on-year decrease of deep and organ/space SSIs (90 infections from 7,941 procedures in 2006; 36 infections SSIs from 8,283 procedures in 2014).⁵⁵

If infection rates had remained constant between 2006 and 2014, there would have been an additional 3,263 CDI, 719 MRSA and 537 SSIs (142 superficial incisional and 395 deep/organ space).

Based on an estimated hospital cost of £4,900 per single case of CDI, £5,430 per single case of MRSA and £35,600 per deep or organ/space SSI, the total cost saving through cases avoided equals approximately £34 million over eight years – CDI £16 million, MRSA £4 million and SSIs £14 million.^{56,57}

Rotavirus vaccine

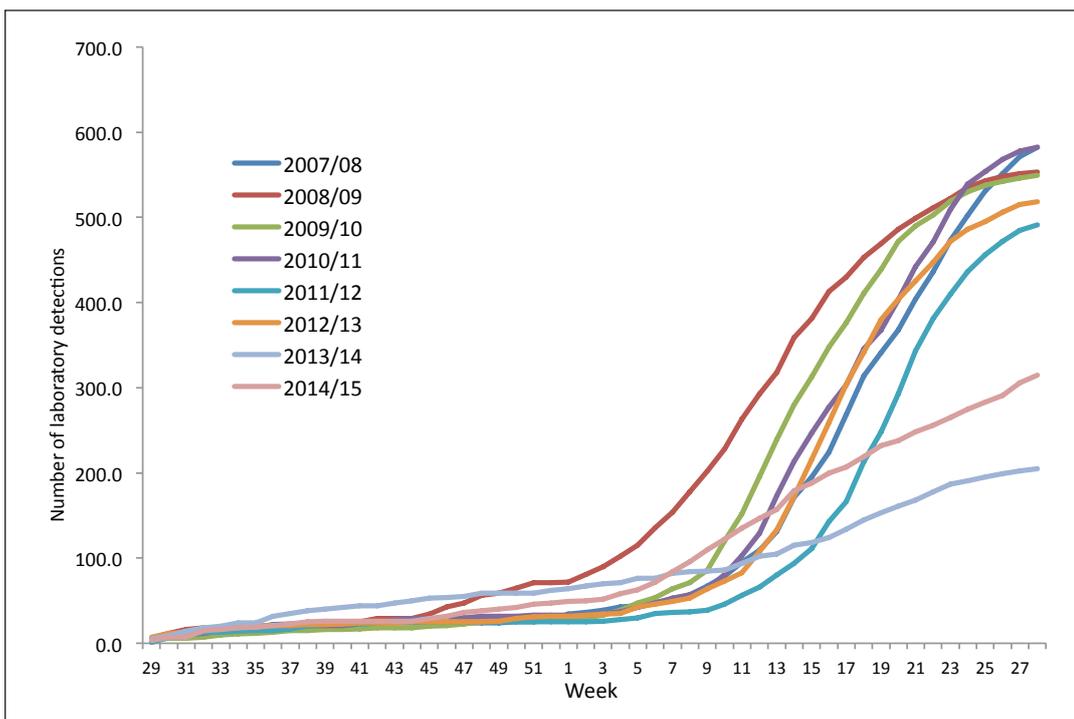
Prior to the introduction of the rotavirus vaccine, rotavirus infection was the main cause of gastroenteritis in children under five in the UK. Overall, 45% of hospital admissions, 25% of GP consultations and 20% of emergency department (ED) attendances due to acute gastroenteritis in those under five were thought to be attributable to rotavirus.⁵⁸ It was therefore a major cause of childhood morbidity and a significant drain on scarce healthcare resources. As a result, a number of vaccines were developed and in July 2013, Northern Ireland in line with the rest of the UK, introduced Rotarix into the childhood immunisation programme. The vaccine is given in two doses at two and three months of age and is known to protect against 88% of the rotavirus strains in circulation in the UK with an efficacy of 91.8% against rotavirus gastroenteritis requiring medical attention in the first year of life.⁵⁹

Outcomes

A team from within the PHA has been investigating the impact of the Rotarix vaccine in Northern Ireland to date and hopes to publish its findings during 2016.⁶⁰ Below follows a short synopsis of the main findings so far.

To assess the impact of the vaccine programme on overall disease burden, weekly reports of laboratory confirmed rotavirus infection were extracted for children under five years for an eight year time period from 2007/08 to 2014/15. In the graph below, the number of detections per week can be seen for each year. In the six year pre-vaccine period, 2007/08 to 2012/13, on average there were 546 laboratory notifications per year compared to 260 per year in the two-year post-vaccine period, 2013/14 to 2014/15. This amounted to a 54% reduction in the cumulative incidence proportion per 100,000 population.

Figure 7: Cumulative rotavirus laboratory detections in Northern Ireland by season/week⁶⁰



The rotavirus vaccine has also had a significant impact on healthcare utilisation. Using the Patient Administration System (PAS) which records all inpatient admissions, admissions in children under five years for rotavirus enteritis (A08.0) and acute unspecified viral intestinal infection (A08.4) were extracted over five years from 2010/11 to 2014/15. Comparing the three years pre-vaccine (2010/11–2012/13) to the two years post-vaccine (2013/14–2014/15), the admission rate decreased by 58%.

Similar data on ED attendances for rotavirus or gastroenteritis are currently not available as the equivalent coding system does not exist, and population based data on primary care utilisation is also difficult to obtain due to a lack of integration of primary care databases. However, a UK study found the annual

incidence of ED and GP attendances due to rotavirus in the absence of a vaccine was 9.3 and 28-44 per 1,000 children under five years of age, respectively.⁵⁸ Applying these rates to the total number of children under five years in Northern Ireland would mean during the three years pre-vaccine (2010/11–2012/13) there were on average 1,169 ED and 3,518–5,529 GP attendances each year due to rotavirus. Assuming these rates decreased by 58% in line with the decrease seen in hospitalisation rates, would mean in the two years post-vaccine (2013/14–2014/15) there were on average 493 ED and 1,485–2,334 GP attendances; a reduction of 676 and up to 3,195 visits respectively.

In Northern Ireland, gastroenteritis is a notifiable disease in children under two. By extracting the number of notifications made by primary care during the pre and post vaccine periods, it was found that the cumulative incidence proportion reduced by 53%. While in terms of absolute numbers, GP notifications in children under two is likely to grossly underestimate primary care utilisation, this downward trend provides supportive evidence for the reduction in GP attendances seen above.

Cost savings

Assuming the average hospital admission, ED and GP consultation rates prior to vaccine had remained constant until the year 2014/15, the additional number of hospitalisations, ED and GP consultations due to rotavirus would have been approximately 1,000, 1,362 and 4,102–6,460 respectively, had no vaccine been introduced. Based on an average cost of a rotavirus hospitalisation of £727, £160 for an ED attendance, and £45 for a GP consultation, this represents a cost avoided of £1.1–1.2 million over two years.^{61,62} The vaccine should offer immunity up to five years of age and as the vaccine has only been introduced for the past two years, the full impact of the vaccine will take a further three years to be realised.

In addition, just considering health and care costs avoided is likely to be a considerable underestimation of the true burden of rotavirus disease as children generally present with non-specific symptoms of acute gastroenteritis, with only a minority seeking medical attention, and laboratory confirmation is rarely sought.^{63,64} In fact, it is estimated that for every laboratory confirmed case of rotavirus there are another 43 cases in the community.⁶⁵ Also, these costs do not include the impact of the vaccine on wider societal costs. For instance, it has been found that in 52% of families where a child has acute gastroenteritis due to rotavirus, subsequently one other family member develops acute gastroenteritis and for working parents, 69% are absent for a mean of 2.9 days to care for their children.⁶⁶

Overall, the vaccination programme has already resulted in considerable savings to the health service directly, and is likely to have also brought wider societal benefits. As the full benefits are seen over the next two to three years, these savings are likely to increase further.

HIV infection

HIV infection is an area where the PHA is currently bolstering its prevention efforts for a number of reasons. While the prevalence of HIV infection in Northern Ireland remains lower than in the UK, the

percentage increase in annual new diagnoses in Northern Ireland between 2000 and 2014 is highest of the UK countries. From 2004 to 2014, Northern Ireland has seen a 47% increase in the number of new cases.⁶⁷ In 2014, 94 new cases of HIV were diagnosed in Northern Ireland, 49% of which occurred through men who have sex with men (MSM) and 41% occurred through heterosexual transmission.⁶⁷ Cumulative data from 2000–2014 show that for cases acquired through MSM exposure, the majority were infected within the UK (82%, 378/460).⁶⁷ By contrast, for cases acquired through heterosexual exposure, and where probable location of exposure was known, the majority were infected outside the UK (71%, 284/400).⁶⁷ Considering the average lifetime cost of treating a HIV infected man aged 30 years, assuming a life expectancy of 72 years, is estimated at £360,800, this increase in cases will result in significant additional healthcare costs.⁶⁸

According to Public Health England estimates, at any one time, approximately 20% of people living with HIV infection are unaware of their infection and therefore the risk of passing on the infection is greater.⁶⁹ Furthermore, in Northern Ireland, 51% of newly diagnosed individuals are diagnosed at a late stage when their viral load is higher and spread of infection is more likely.⁶⁷ Early diagnosis and treatment is associated with a normal life expectancy; individuals are also less likely to pass on their infection due to treatment and behaviour change.

Therefore, to diagnose HIV early, prevent onward transmission and curb increasing healthcare costs, the PHA have taken a number of steps, the impact of which will take time to be realised. In 2015, the PHA launched a sexual health campaign “Choose to protect yourself – always use a condom” to encourage the use of condoms which should decrease the spread of all sexually transmitted diseases, including HIV. The expansion of HIV testing is now accepted as critical to reducing late HIV diagnoses and the number of people with undiagnosed infection. In 2008, UK National Guidelines for HIV testing were released and subsequently endorsed by the Chief Medical Officer for Northern Ireland.⁷⁰ The PHA promotes HIV testing in healthcare settings (GP practices, GUM hospital clinics and emergency departments) and funds programmes that test outside the traditional GUM setting such as the voluntary sector including Rainbow and Positive Life, outreach clinics in high risk venues, and in the Northern Ireland New Entrant Service. As a result, there has been a greater than ten-fold increase in testing between 2000 and 2014.

In addition, evidence is mounting around the benefits of HIV prevention strategies such as Treatment as Prevention (TasP) and HIV Pre Exposure Prophylaxis (PrEP) where antivirals are given to those without HIV infection but at risk of acquiring it. England is currently considering these at policy level along with the commissioning implications and Northern Ireland may follow suit.

Summary table

Health improvement	Main outcomes	Time to accrue benefit	Cost savings	Return on investment
Decrease in CVD mortality	1,900 deaths avoided	20 years	£3 billion	
Stop Smoking Services	Since 2001/02, 200,000 people supported to stop smoking with over 50% still having quit by 4 weeks.	1 year	1% decrease in NI smoking = annual cost saving of £7.5 million to healthcare and £20.5 million to the NI economy.	2.5 times in healthcare costs, 6.8 times to NI economy.
GP Exercise referral scheme	2012/13–786 users significantly improved their physical and mental health.	5 years		£1:£7 return
Connswater Community Greenway	100,000 residents benefit from a better living environment and support for healthier lifestyles.	40 years		2–6 times return
£ for lb challenge	In 2015, 1,585 participated. Average weight loss 2.5kg per person.	12 weeks		£6.31 per person or £2.51 per kg of weight lost.
Early Years Interventions:				
1. Incredible Years	Anticipated benefits include reduced healthcare, crime, education and CAMHS costs via a reduction in disruptive behaviour and increased earnings of the child through improved educational attainment.	Lifetime	Each year PHA invests £150,000 in Incredible Years and Strengthening Families, which generates a cost saving of £330,000 in the long term. PHA also invests £1.6 million in Family Nurse Partnerships, which generates a cost saving of £3.1 million in the long term.	1. £1:£1.37
2. Strengthening Families				2. £1:£2.33
3. Family Nurse Partnership				3. £1:£1.94

Breastfeeding*	Anticipated benefits include: baby – decreased incidence of many childhood diseases, mum – decreased incidence of breast and ovarian cancer.	1 year	If 10 point increase in UK rates of exclusive breastfeeding up to 6 months, £6.5 million in UK healthcare cost savings per year.	
20% tax on SSBs*	Expected to reduce the prevalence of obesity in UK by 1.3% (approximately 180,000 people – 5,300 within NI)	1 year	£276 million generated in revenue across UK.	
MUP for alcohol of 50p	63 lives saved and 2,425 fewer hospital admissions per year. 5,293 criminal offences and 35,000 days off sick prevented each year.	1 – 20 years	£1.8 million in NI healthcare costs in year 1 and £397 million over 20 years or £956 million over 20 years if include health, crime and workplace absence costs avoided.	
20mph speed limits +/- traffic calming measures	Potential to prevent 29 fatal and 225 serious accidents per year	1 year	£261.8 million per year if 39% of fatal/serious accidents prevented through reduced speeding. (This figure encompasses all aspects of the valuation of collisions.)	
Screening	Main outcomes	Time to accrue benefit	Cost savings	Return on investment
AAA screening	To date, 30,820 men screened – 64 referred for surgery and 418 under active surveillance. Full impact of programme still to be seen.	10 years until programme becomes cost saving		Programme should pay for itself after 10 years. (ICER is £7,370/QALY after 30 years.)

*Cost savings estimated for the UK. All other monetary estimates are for NI.

CRC screening	2013/14 – 105 cancers detected (59% at an early stage), 648 participants had polyps detected and removed. Full impact of programme still to be seen.		NI spends approx. £19.6 million/ year treating CRC patients. This could be avoided through early detection. Early stage CR costs less than half as much to treat as late, with > 90% survival at 5 years. UK modelling studies have found the programme to be cost saving.	
Health protection	Main outcomes	Time to accrue benefit	Cost savings	Return on investment
Healthcare Acquired Infections	CDI – 12% year-on-year decrease (1,073 CDI cases from in-patient days in 2006; 293 CDI cases from 861,064 in-patient days in 2014) MRSA – 14% year-on-year decrease decrease (182 cases from 1,359,898 in-patient days in 2006; 57 cases from 1,535,861 in-patient days in 2014). Orthopaedic SSIs – 5% year-on-year decrease of deep and organ/space SSIs (90 infections from 7,941 procedures in 2006; 36 infections SSIs from 8,283 procedures in 2014).	8 years	£34 million in terms of direct NI healthcare costs.	
Rotavirus Vaccine	Comparing the pre and post vaccine period, laboratory notifications of rotavirus in the under 5s decreased-cumulative incidence proportion per 100,000 population reduced by 54%. Hospital admissions in children under 5 years with rotavirus decreased by 58%.	2 years	£1.1–1.2 million in terms of direct NI healthcare costs.	
HIV prevention	-	1 year	Potential cost saving of approximately £360,800 in terms of treatment costs per case of HIV avoided.	

Concluding remarks

The above discussion has highlighted a diverse range of evidence-based interventions and programmes currently supported by the PHA. Many of these interventions have already resulted in major cost savings for the health sector with many delivering wider societal cost savings too. Others like the population screening programmes are still in their infancy and will take time for their full 'return' to be realised. It is clear, however, that public health interventions not only improve population health but represent good economic investment. It is important to emphasise that the success of many of these programmes has been the result of collaborative working with a wide range of organisations, including all health and social care trusts, primary care providers, HSCB, other public sector bodies, academic institutions, and a wide range of voluntary and community organisations.

There is now growing recognition that improving health is too important to be left for the sole responsibility of the health sector. Employers and organisations external to health all have a social responsibility to do what they can to improve the health of our population. This has led to a drive for cross-governmental funding of projects. Examples of these are the Early Intervention Transformation Programme (£25 million investment) and the Connswater Community Greenway project (£35 million investment), described above. For many health improvement programmes to make significant change, programmes need to be delivered on a large scale and over time. Cross-governmental funding is essential to realising these benefits.

Considering the various cost savings or returns on investment estimates for the programmes above, it is clear that the greatest value for money can be achieved from implementation of health improvement interventions. This is consistent with estimates from other public health bodies such as the World Health Organization (WHO), the King's Fund and indeed the UK Faculty of Public Health. These bodies encourage public health efforts to focus on health improvement and the social determinants of health. However, while these projects have the potential to deliver major economic returns with wider benefits beyond health, they usually require large upfront investments and their success is largely dependent on their delivery. In addition, for them to be considered effective and/or cost-effective, usually requires sustained behaviour change. While challenging, progress has been made, particularly in smoking reduction and stabilisation of the prevalence of obesity.

By contrast, other public health interventions such as population screening and vaccination programmes deliver more modest economic returns but benefits can be estimated more easily. While they do require high uptake rates, they do not require sustained behaviour change to be effective. However, modelling studies have found that even with an uptake rate of 50%, screening still significantly decreases bowel cancer morbidity and mortality and is cost saving. Meanwhile, vaccine coverage rates in Northern Ireland are at an all-time high with over 97% of children completing the primary vaccination programme by 12 months of age. The reduction in HCAs is yet another example of a very clear-cut successful healthcare intervention where substantial cost savings have been made.

Therefore, while health improvement interventions offer the greatest potential for large economic returns, in terms of health and wider societal benefits, they are influenced by many factors and are less certain.

Screening and vaccination programmes on the other hand, offer more modest returns, are focused on health gains with less societal benefits but are less affected by the same uncertainty. Nevertheless, both types of interventions are essential if the greatest potential health gain for the Northern Ireland population is to be realised.

References

1. Hughes J, Kee F, O'Flaherty M, Critchley J, Cupples M, Capewell S, et al. Modelling coronary heart disease mortality in Northern Ireland between 1987 and 2007: broader lessons for prevention. *Eur J Prev Cardiol.* 2013;20(2):310–21.
2. Reported Road Casualties Great Britain: 2013 annual report. Available from: <https://www.gov.uk/government/statistics/reported-road-casualties-great-britain-annual-report-2013>. Accessed 16 March 2016.
3. Public Health England. National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 - 2011/2012). London; 2014. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf. Accessed 16 March 2016.
4. Evans A, McCrum E, McClean R, Scally G, McMaster D, Patterson C. Sources of Fat in the Northern Irish Diet. *Rev Epidemiol Sante Publique.* 1990;38(5-6):345–550.
5. Department of Health, Social Services and Public Safety. Statistics on Smoking Cessation Services in Northern Ireland : 2014/15. Belfast: DHSSPS, 2015. Available from: <https://www.dhsspsni.gov.uk/news/statistics-smoking-cessation-services-northern-ireland-1-april-2014-31-march-2015>. Accessed 16 March 2016.
6. Public Health Agency, Health Intelligence. Tobacco Control Northern Ireland. Belfast: PHA, 2015. Available from: <http://www.publichealth.hscni.net/publications/tobacco-control-northern-ireland>. Accessed 16 March 2016.
7. National Institute for Health and Care Excellence. Physical activity - exercise referral referral schemes: NICE public health guidance 54. London: NICE, 2014. Available from: nice.org.uk/guidance/ph54. Accessed 16 March 2016.
8. Gauge NI. Healthwise Physical Activity Referral Scheme. Belfast: Gauge NI, 2014. Available from: <http://www.makinglifebettertogether.com/wp-content/uploads/2016/03/Healthwise-Social-Return-on-Investment-Report-May-2014.pdf>. Accessed 16 March 2016.
9. O Ferdinand A, Sen B, Rahurkar S, Engler S, Menachemi N. The relationship between built environments and physical activity: a systematic review. *Am J Public Health.* 2012 Oct;102(10):e7–13.
10. Dallat M, Hunter R, Tully M, Kee F. Return on Investment study of the Connswater Community Greenway. 2016. (Unpublished)
11. Department of Health, Social Services and Public Safety. Health Survey Northern Ireland First Results 2014/15. Belfast: DHSSPS, 2015. Available from: <https://www.dhsspsni.gov.uk/sites/default/files/publications/dhssps/hsni-first-results-14-15.pdf>. Accessed 24 March 2016
12. Department of Health, Social Services and Public Safety. Making Life Better. A whole system strategic framework for public health 2013-2023. Belfast: DHSSPS, 2014. Available from: <https://www.dhsspsni.gov.uk/articles/making-life-better-strategic-framework-public-health>. Accessed 16 March 2016.
13. Bradley D, McComb A, Owen T. £ for lb. challenge 2014. Belfast: PHA, 2015. (Unpublished)
14. Bradley D, McComb A, Owen T. £ for lb. challenge 2015. Belfast: PHA, 2016. (Unpublished)

15. National Institute for Health and Care Excellence. Weight management: lifestyle services for overweight or obese adults: NICE public health guidance 53. London: NICE, 2014. Available from: nice.org.uk/guidance/ph53. Accessed 16 March 2016.
16. Chowdry H, Oppenheim C. Spending on late intervention. How we can do better for less. London: Early Intervention Foundation, 2015. Available from: <http://www.eif.org.uk/wp-content/uploads/2015/08/SPENDING-ON-LATE-INTERVENTION.pdf>. Accessed 16 March 2016.
17. Kemp F, Ohlson C, Raja A, Morpeth L, Axford N. Fund-Mapping: The investment of public resources in the wellbeing of children and young people in Northern Ireland. 2015. Available from: [http://dartington.org.uk/inc/uploads/Fundmapping_in_Northern_Ireland_October_2015\).pdf](http://dartington.org.uk/inc/uploads/Fundmapping_in_Northern_Ireland_October_2015).pdf). Accessed 16 March 2016.
18. National Institute for Health and Care Excellence. Social and emotional wellbeing - early years: NICE public health guidance 40. London: NICE, 2012. Available from: <https://www.nice.org.uk/guidance/ph40>. Accessed 16 March 2016.
19. Hummel S, Chilcott J, Rawdin A, Strong M. Economic outcomes of early years programmes and interventions designed to promote cognitive , social and emotional development among vulnerable children and families . Sheffield: University of Sheffield School of Health and Related Research, 2011. Available from: <https://www.nice.org.uk/guidance/ph40/documents/social-and-emotional-wellbeing-early-years-economic-appraisal-part-12>. Accessed 16 March 2016.
20. Heckman J. Schools, Skills and Synapses. 2008. Available from: www.heckmanequation.org/content/resource/presenting-heckman-equation. Accessed 16 March 2016.
21. Social Research Unit at Dartington. Available from: <http://investinginchildren.eu/search/interventions>. Accessed 16 March 2016.
22. Olds DL, Robinson J, Brien RO, Luckey DW, Pettitt LM, Henderson CR, et al. Home Visiting by Paraprofessionals and by Nurses: A Randomized, Controlled Trial. *Pediatrics*. 2002;110(3):486–96.
23. Olds DL, Kitzman H, Cole R, Robinson J, Sidora K, Luckey DW, et al. Effects of nurse home visiting on maternal life-course and child development: age-six follow-up of a randomized trial. *Pediatrics*. 2004;114(6):1550–9.
24. Mejdoubi J, Heijkant SCCM Van Den, Leerdam FJM Van, Heymans MW, Crijnen A, Hirasing RA. The Effect of VoorZorg , the Dutch Nurse- Family Partnership , on Child Maltreatment and Development : A Randomized Controlled. *PLoS One*. 2015;10(4):1–14.
25. Mejdoubi J, Heijkant SCCM Van Den, Leerdam FJM Van, Heymans MW, Hirasing RA, Crijnen AAM. Effect of Nurse Home Visits vs. Usual Care on Reducing Intimate Partner Violence in Young High-Risk Pregnant Women : A Randomized Controlled Trial. *PLoS One*. 2013;8(10):1–12.
26. Robling M, Bekkers M, Bell K, Butler CC, Cannings-john R, Channon S, et al. Effectiveness of a nurse-led intensive home-visitation programme for first-time teenage mothers (Building Blocks): a pragmatic randomised controlled trial. *Lancet*. 2016;387(10014):146–55.
27. Kamradt-scott A, Harman S, Wenham C. Building evidence to improve maternal and child health. *Lancet*. 2015;6736(15):2015–7.
28. Public Health Agency, Health Intelligence Unit. Breastfeeding in Northern Ireland – November 2014. Belfast: PHA, 2014. (Unpublished)

29. Glass K. Review of Antenatal Education Final Report. 2014. (Unpublished)
30. Infant Feeding Survey 2010. Chapter 10 Feeding outside the home. Health & Social Care Information Centre, 2012. Available from: <http://www.hscic.gov.uk/catalogue/PUB08694/ifs-uk-2010-chap10-feed-outside-home.pdf>. Accessed 16 March 2016.
31. Rollins NC, Bhandari N, Hajeebhoy N, Horton S, Lutter CK, Martines JC, et al. Why invest , and what it will take to improve breastfeeding practices ? *Lancet*; 2016;387(10017):491–504.
32. Sustain. A Children's Future Fund. How food duties could provide the money to protect children's health and the world they grow up in. London: Sustain, 2013. Available from: http://www.sustainweb.org/publications/a_childrens_future_fund/. Accessed 16 March 2016.
33. Ng SW, Mhurchu CN, Jebb SA, Popkin BM. Patterns and trends of beverage consumption among children and adults in Great Britain , 1986 – 2009. *Br J Nutr*. 2012;108:536–51.
34. Briggs ADM, Mytton OT, Tiffin R, Rayner M, Scarborough P. Overall and income specific effect on prevalence of overweight and obesity of 20% sugar sweetened drink tax in UK : econometric and comparative risk. *BMJ*. 2013;6189(October):1–17.
35. Angus C, Meng Y, Ally A, Holmes J, Brennan A. Model-based appraisal of minimum unit pricing for alcohol in Northern Ireland. Sheffield: University of Sheffield School of Health and Related Research, 2014. Available from: [http://www.drugsandalcohol.ie/23125/1/Model-based appraisal of minimum unit pricing for alcohol in Northern Ireland.pdf](http://www.drugsandalcohol.ie/23125/1/Model-based%20appraisal%20of%20minimum%20unit%20pricing%20for%20alcohol%20in%20Northern%20Ireland.pdf). Accessed 16 March 2016.
36. Health & Social Care Information Centre. Statistics on Alcohol - England, 2014. Health & Social Care Information Centre, 2014. Available from: <http://www.hscic.gov.uk/catalogue/PUB15483>. Accessed 16 March 2016.
37. Northern Ireland Statistics and Research Agency. Police Recorded Injury Road Traffic Collision Statistics. 2014 Key Statistics Report. Belfast; 2015. Available from: https://www.psni.police.uk/globalassets/inside-the-psni/our-statistics/road-traffic-collision-statistics/documents/psni_2014_rtc_key_statistics_published_27.3.15.pdf. Accessed 16 March 2016.
38. A valuation of road accidents and casualties in Great Britain: Methodology note. 2014. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254720/rrcgb-valuation-methodology.pdf. Accessed 16 March 2016.
39. The Royal Society for the Prevention of Accidents. Road Safety Information - Inappropriate Speed. 2011. Available from: <http://www.cetsp.com.br/media/412367/5-inappropriate-speed.pdf>. Accessed 16 March 2016.
40. Scott R. The Multicentre Aneurysm Screening Study (MASS) into the effect of abdominal aortic aneurysm screening on mortality in men: a randomised controlled trial. *Lancet*. 2002;360(9345):1531–9.
41. Public Health Agency, Quality Assurance Reference Centre. Figures from the Northern Ireland AAA Screening Programme. Belfast: PHA. (Unpublished)
42. The Abdominal Aortic Aneurysm Quality Improvement Programme. National Abdominal Aortic Aneurysm Quality Improvement Programme (AAAQIP) Interim Report 2011. London: Vascular Society of Great Britain and Ireland, 2011. Available from: <http://www.vascularsociety.org.uk/wp-content/uploads/2012/11/National-AAA-QIP-Interim-Report.pdf>. Accessed 16 March 2016.

43. Laustsen J, Lindholt JS. Cost effectiveness of abdominal aortic aneurysm screening and rescreening in men in a modern context : evaluation of a hypothetical cohort using a decision. *BMJ*. 2012;4276(July):1–13.
44. Northern Ireland Cancer Registry. Colorectal cancer fact sheet. Belfast: NICR, 2013. Available from: <http://www.qub.ac.uk/research-centres/nicr/FileStore/PDF/FactSheets/Filetoupload,531395,en.pdf>. Accessed 16 March 2016.
45. Public Health Agency, Quality Assurance Reference Centre. Figures from the Northern Ireland Bowel Cancer Screening Programme 2013/14. Belfast: PHA. (Unpublished)
46. Northern Ireland Cancer Registry. Available from: <http://www.qub.ac.uk/research-centres/nicr/>. Accessed 16 March 2016.
47. Luengo-Fernandez R, Leal J, Gray A, Sullivan R. Economic burden of cancer across the European Union: a population-based cost analysis. *Lancet Oncol*; 2013 Nov;14(12):1165–74.
48. Pilgrim H, Tappenden P, Chilcott J, Bending M, Trueman P, Shorthouse A, et al. The costs and benefits of bowel cancer service developments using discrete event simulation. *J Oper Res Soc*. 2009;60:1305–15.
49. Whyte S, Stevens J, Chilcott J, Cooper K, Essat M, Wong R, et al. Re-appraisal of the options for colorectal cancer screening Report for the NHS Bowel Cancer Screening Programme. Sheffield: University of Sheffield School of Health and Related Research, 2011. Available from: legacy.screening.nhs.uk/policydb_download.php?doc=130. Accessed 16 March 2016.
50. Department of Health, Social Services and Public Safety. Antimicrobial Resistance Action Plan 2002-2005. Belfast: DHSSPS, 2005.
51. Department of Health, Social Services and Public Safety. Changing the Culture: an Action Plan for the Prevention and Control of Health Care Associated Infections in Northern Ireland 2006-2009. Belfast: DHSSPS, 2006.
52. Department of Health, Social Services and Public Safety. Changing the culture 2010. Belfast: DHSSPS, 2010. Available from: <https://www.dhsspsni.gov.uk/sites/default/files/publications/dhssps/changing-the-culture.pdf>. Accessed 16 March 2016.
53. National Institute for Health and Care Excellence. Surgical site infections - prevention and treatment: NICE guideline 74. London: NICE, 2008. Available from: <https://www.nice.org.uk/guidance/cg74/resources/surgical-site-infections-prevention-and-treatment-975628422853>. Accessed 16 March 2016.
54. World Health Organization. WHO Surgical Safety Checklist. WHO, 2009. Available from: <http://www.who.int/patientsafety/safesurgery/checklist/en/>. Accessed 16 March 2016.
55. Public Health Agency, Surveillance Team. Health Care Associated Infections Surveillance Data. Belfast: PHA. (Unpublished)
56. NHS Innovations South East Annual Report 2010-2011. Didcot: NHS Innovations South East, 2011. Available from: http://www.innovationsoutheast.nhs.uk/files/9013/9228/2054/NISE_Annual_Report_2010_2011.pdf. Accessed 16 March 2016.
57. Peel TN, Dowsey MM, Buising KL, Liew D, Choong PFM. Cost analysis of debridement and retention for management of prosthetic joint infection. *Clin Microbiol Infect*. 2013;19(2):181–6.

58. Harris JP, Jit M, Cooper D, Edmunds WJ. Evaluating rotavirus vaccination in England and Wales Part I . Estimating the burden of disease. *Vaccine*. 2007;25:3962–70.
59. Rotarix Summary of Product Characteristics. Available from: www.medicines.org.uk/emc/medicine/17840/SPC/Rotarix. Accessed 16 March 2016.
60. Armstrong G, Gallagher N, Cabrey P, Graham A, McKeown P, Jackson S, et al. A population based study comparing changes in rotavirus burden on the Island of Ireland between a highly vaccinated population and an unvaccinated population. Belfast: PHA. (Unpublished).
61. Department of Health, Social Services and Public Safety. Northern Ireland Reference Costs 2014/15. Available from: <http://dhsspsextra.intranet.nigov.net/index/statistics/hib/hib-hrg/content-newpage.htm>. Accessed 16 March 2016.
62. Personal Social Services Research Unit. Unit Costs of Health and Social Care 2015. Available from: <http://www.pssru.ac.uk/project-pages/unit-costs/2015/index.php>. Accessed 16 March 2016.
63. Wheeler JG, Sethi D, Cowden JM, Wall PG, Rodrigues LC, Tompkins DS, et al. Study of infectious intestinal disease in England: rates in the community, presenting to general practice and reported to national surveillance. *BMJ*. 1999;318(April):1046–50.
64. Malek MA. Diarrhea- and Rotavirus-Associated Hospitalizations Among Children Less Than 5 Years of Age: United States, 1997 and 2000. *Pediatrics*. 2006;117(6):1887–92.
65. Tam C, Viviani L, Adak B, Bolton E, Dodds J, Cowden J, et al. The Second Study of Infectious Intestinal Disease in the Community (IID2 Study). London: Food Standards Agency, 2012. Available from: https://www.food.gov.uk/sites/default/files/711-1-1393_IID2_FINAL_REPORT.pdf. Accessed 16 March 2016.
66. Marlow R, Finn A, Trotter C. Quality of life impacts from rotavirus gastroenteritis on children and their families in the UK. *Vaccine*; 2015;33(39):5212–6.
67. Public Health Agency. HIV surveillance in Northern Ireland 2015. Belfast: PHA, 2015. Available from: <http://www.publichealth.hscni.net/publications/hiv-surveillance-northern-ireland-2014>. Accessed 16 March 2016.
68. Nakagawa F, Miners A, Smith CJ, Simmons R, Lodwick K, Cambiano V, et al. Projected Lifetime Healthcare Costs Associated with HIV Infection. *PLoS One*. 2015;10(4):1–12.
69. Public Health England. HIV in the UK – Situation Report 2015. Incidence, prevalence and prevention. London: PHE, 2015. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/477702/HIV_in_the_UK_2015_report.pdf. Accessed 16 March 2016.
70. British HIV Association, British Association of Sexual Health and HIV, British Infection Society. UK National Guidelines for HIV Testing 2008. London: British HIV Association, 2008. Available from: <http://www.bhiva.org/documents/guidelines/testing/glineshivtest08.pdf>. Accessed 16 March 2016.

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