Mobile phones
The Stewart Report - then, now and the foreseeable future

Child death rates falling...
but not everywhere

Accidental misuse of chemicals and chemical products

Development of a pilot children’s environment and health toolkit

The National Anonymous Tonsil Archive

LENTICULE DISCS
Health protection in miniature
In this issue:

Comment
3 Sir William Stewart, Chairman of the Health Protection Agency

Features
4 Mobile phones: The Stewart Report - then, now and the foreseeable future
Sir William Stewart, Chairman of the HPA, argues that the debate about the health effects of mobile phones, base stations and transmitters should be better informed by a resilient expanded knowledge base.
7 Child death rates falling ... but not everywhere
8 LENTICULE discs: health protection in miniature
Danka Tharagommet, manager of the HPA's LENTICULE manufacturing unit in Newcastle, tells Karen Lloyd why these miniscule discs are such life-savers.
10 Accidental misuse of chemicals and chemical products
The DeNaMIC research project seeks to provide an overview of the nature and extent of accidental poisoning from household chemical consumer products.
11 Development of a pilot children’s environment and health toolkit
Lorraine Stewart, Patrick Saunders and Sue Ibbotson of the HPA outline the development of a pilot in the West Midlands.
14 The National Anonymous Tonsil Archive and human exposure to mad cow disease
Jonathan Clewley describes how the Agency’s work will clarify the extent of the problem of silent vCJD infection.
17 Radiation doses from medical X-ray examinations in the UK
David Hart of HPA’s Radiation Protection Division explains how collecting such data enables us to set ‘national reference doses’.
20 Summer of 1928
Eighty years ago Alexander Fleming observed that a mould, Penicillium notatum, inhibited the growth of staphylococci on a Petri dish in his laboratory at St Mary’s Hospital, London.
22 Bathing water microbiology: past, present and future
Britain’s coastal waters have become less polluted but Keith Jones of Lancaster University suggests that southern Europe will have fewer problems in meeting the microbial standards of a revised EU Bathing Water Directive (2006/7/EC), but in the north-west of England compliance will be more difficult.
26 Health Protection 2008
28 Radiation protection implications of the use of Cone-Beam CT systems
Andrew Gulson of the HPA’s Dental X-ray Protection Services describes plans to develop and publish guidance for the safe use of cone-beam CT scanners in general dental practice.
30 Expanding chemical sampling
Andrew Kibble and Toby Smith of the HPA describe new developments in taking environmental samples to test for risks to public health.
32 Molecular diagnosis in clinical microbiology
Molecular diagnostics is the fastest growing area of the in-vitro diagnostic market, says Melvyn Smith, principal clinical scientist at HPA London.
35 A toe in the water of the Thames Tideway
Agency microbiologists and epidemiologists are assessing the safety of the Thames Tideway as a recreational water.
38 Diarrhoea and vomiting – a comedy illness?
Sarah I O’Brien, Professor of Health Sciences and Epidemiology at the University of Manchester, argues that viral gastroenteritis is no joking matter.
40 Radon, tobacco and lung cancer – the significance of smoking cessation programmes
Public health experts from Northampton suggest that smoking cessation programmes appear to have significant added value in radon affected areas.
46 Young people disproportionately affected by STIs
Sexually transmitted infections (STIs) remain one of the most important causes of illness due to infectious disease among young people aged between 16 and 24-years-old.

News and media
49 A round-up of news stories from the Health Protection Agency

The Last Word
52 Sustainable Communities - the right paradigm!
The Turnberg Lecture, Professor Stephen Palmer
Evolving to meet expanding needs

The Health Protection Agency (HPA) continues to evolve to meet the expanding needs and interest in public health protection.

This is a global issue. Infectious disease can traverse the world in less than a day, so can terrorists capable of transporting chemical, biological and radiation health hazards. Transport systems into and out of the UK carry many more people per annum than there are residents in the UK. International travel is the name of the game and its effects are increasingly being felt across the Agency from its specialist research laboratories at Colindale, Chilton and Porton, through to the regions, and to its local and regional services. This network allows us to deal effectively with public health protection issues, whenever, and wherever they arise.

Aligning the network
We have harnessed our links with the NHS, for example through increasingly aligning our HPA Regional Microbiology Network with the NHS facilities in Manchester, Newcastle, and increasingly in Birmingham and elsewhere. I see our enhanced links with NHS teaching hospitals and with regional authorities as being very important. We have also been enhancing our research base with academia. For example, we have recently been involved in major research programmes in public health protection with the University of Oxford and with Imperial College, London, as well as with many other higher education centres. These links are hugely important to the Agency.

Our Centre for Infections has been largely reshaped and restructured into bigger groupings more capable of flexibly addressing infectious disease issues. Our Centre for Radiation, Chemicals and Environmental Hazards at Chilton, and its laboratories in Leeds and Glasgow have had no break following the polonium-210 incident, with a particular focus now being on radioactive waste disposal and the current national interest in new nuclear power plants.

Upgrading facilities
At Porton, Professor Chatfield has focused not only on emergency preparedness and response issues but importantly on expanding and upgrading the Porton facilities in translational research and its research base generally.

Finally in April 2009, the work of NIBSC will be incorporated into the Agency. This will hugely strengthen the Agency’s research base and provide for the UK an Agency fully fitted to meet the expanding public health protection challenges which lie ahead.

There are many other positive issues that I could have mentioned but the above give a sense of the way that the Agency is moving as it continues to focus on strengthening the UK capacity to be at the forefront of public health protection.

Sir William Stewart

STRENGTHENING THE AGENCY

The National Institute of Biological Standards (NIBSC) is set to join the Agency in April 2009.

The role of NIBSC is to protect public health through supporting the safe development and use of biological medicines such as vaccines, products made from blood and tissues.

NIBSC is internationally renowned for its broad-based and vibrant research programme, and developed the UK Stem Cell Bank - the first of its kind in the world - to support the safe, effective and ethical development of stem cell therapy.

Stem cells are the body’s master cells, with the potential to become many different types of tissue. Stem cell research could provide new and novel ways to repair and replace diseased and damaged body tissues for the future benefit of patients.

NIBSC produces almost all of the world’s international standards for ensuring that biological medicines are safe and effective.

It is also the UK’s Official Medicines Control laboratory responsible for testing biological medicines produced by the pharmaceutical industry to make sure they are up to scratch.

World class
Stephen Inglis, Director of NIBSC, said: “The merger with the Agency will create an organisation with a wider range of relevant scientific expertise, and a more coordinated approach to safeguarding public health. Our world class scientific experts are regularly called on when things go wrong with biological medicines, such as the severe adverse events that followed the trial of an experimental drug at Northwick Park Hospital in 2006.”

With the addition of NIBSC the Agency will extend its range of expert services. NIBSC is one of only a handful of laboratories around the world with the capability to develop safe vaccine strains from potentially threatening virus strains such as H5N1, and it will complement the Agency’s work to prepare for pandemic influenza.
Ten years ago, government decided that an independent expert group should be established to examine possible effects on health of mobile phones, base stations and transmitters. It was a milestone report driven by public demand. As I said in my foreword to the report, which became known as the “Stewart Report”: there was “probably no other technology in recent times which has been so quickly and widely adopted by the general public”. In April 2000 there were about 25 million mobile phones in circulation in the UK. Today there are 70 million mobile phone subscriptions and, according to Ofcom, mobile calls are set to outnumber fixed calls within 12 - 18 months. Globally the numbers in circulation have escalated.

Every member of the group signed up to the following:

- The balance of evidence to date suggests that exposures to RF radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population.
- There is now scientific evidence, however, which suggests that there may be biological effects occurring at exposures below these guidelines. This does not necessarily mean that these effects lead to disease or injury, but it is potentially important information.
- There are additional factors that need to be taken into account in assessing any possible health effects. Populations as a whole are not genetically homogeneous and people can vary in their susceptibility to environmental hazards. There are well-established examples in the literature of the genetic predisposition of some groups, which could influence sensitivity to disease. There could also be a dependence on age. We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that gaps in knowledge are sufficient to justify a precautionary approach.
- In the light of the above considerations we recommend that a precautionary approach to the use of mobile phone technologies be adopted until much more detailed and scientifically robust information on any health effects becomes available.

The above conclusions were carefully crafted and emphasise the uncertainty that existed in 2000.

**The last decade**

Since then, a plethora of new papers, reports and views have become available; these are listed below under four headings. Throughout the ages views and perceptions have had to change as a result of new findings, new observations and new analyses.
**National studies:** there have been a series of national studies set in place and reported upon, for example from the Netherlands, Germany, France and the UK. In the UK, the £8.8 million Mobile Telephones and Health Research Programme (MTHR1), set up in 2001 and jointly funded by the government and industry, supported 28 research projects. Over that period two case controlled studies of brain cancers and acoustic neuromas found no association with the incidence of mobile phone use for less than 10 years, with the results being less clear for people who used the phone for more than 10 years. A second MTHR programme (MTHR2) has recently been announced. There has been criticism of the fact that the MTHR programme was partly funded by industry, but as chair of the programme when decisions on MTHR were assessed, I can assure everyone that, whilst supported by industry, the decisions on what should be funded were taken by an independent group after peer review in which industry was not involved.

**International programmes:** there are the various international programmes such as the Interphone study which link together national studies. It deserves comment that more than two years after the end of the Interphone study some of the findings have not yet been published. That needs explanation. There are also important individual papers, reports and observations from across the world, including evidence from Sweden, for example, of an increase in benign acoustic neuromas. However, what is clear in the detailed studies published to date, is that no proven adverse risk to health has yet been unequivocally established, although some such studies have been criticised, and many questions remain, including the important fact that some cancers can take more than 10 years to develop and mobile phones have not been widely used for much longer. Remember smoking and lung cancer.

**New compilations:** there have been important collections and compilations of papers which have focussed on perceived adverse health effects, in particular the recent BioInitiative Report.

**Pressure groups:** outputs from pressure groups concerned about possible adverse effects of RF radiation have increased substantially over the past decade and have become increasingly professional in promoting their views. The Radiation Research Trust is a good example, but there are others.

What is clear from all of these inputs, from the web, and from the media who in the UK do a pretty balanced job, is that there is ongoing debate and controversy about the impact and/or potential impact of mobile phone technologies on health. There is a need to develop a way forward based on scientific knowledge and risk analyses. If not, there will be another 20 or more years of argument. We need a consensual approach.

**A consensual way forward?**

I believe that some of the issues that need consideration include the following.

First, it should be accepted that there is a need to get away from the polarity of views which currently persists and seek to better understand the existing knowledge base and the reasons for differing views.

Second, to help resolve uncertainty, the fundamental need is for a stronger underpinning knowledge base. Particularly, there needs to be a much stronger, well-funded science base with individuals, organisations and centres being well equipped nationally, and for more complementary international programmes to be set in place. The EU, in Europe, and the WHO must continue to proactively promote international studies. Support for the science base must come from both the public and private sectors. Guidelines cannot be secure unless there is a strong encompassing knowledge base upon which to build.

Third, attention has to be given to the existing international guidelines on NIR, and RF in particular. The guidelines followed in the UK are those of ICNIRP (International Commission on Non-Ionizing Radiation Protection), the ‘formally recognised non-governmental organisation for NIR (non-ionising radiation) protection for the World Health Organization (WHO), the International Labour Organization (ILO) and the European Union (EU)’. In the United States, Russia and China different guidance is in use. There is a need to harmonise the different guidelines. But let me touch a little further on the ICNIRP guidelines. ICNIRP’s operational mode is that it “continuously monitors and periodically carries out critical reviews of the scientific literature concerned with the physical characteristics and sources of NIR and possible biological and adverse health effects. In doing so ICNIRP limits its surveillance to published original scientific papers and reports that are generally available. ICNIRP performs such critical scientific analysis by evaluating the relevance and scientific quality of each report”.

ICNIRP’s understandable dilemma is that when it produced its guidance, there was no sound evidence of adverse health effects caused by exposure to EMF. So it framed its guidance on the basis of heating effects only. Understandably, using heating effects as the measured end-point, emissions from mobile phones and mobile technology were unlikely to cause adverse health effects. However, the problem is that you cannot readily dismiss a condition because of lack of evidence as to why the condition exists, especially when people have symptoms which they attribute to mobile phone technology but not caused by heating - unless the effects are not caused by RF, and that is not proven. And, what do you put in place of heating effects when non-ionising radiation (NIR) has no other clearly measured end-points? And, let’s say you want to reduce the guideline levels, what do you reduce them to? The existing guidelines may be the best we have, but they have limitations.

Fourth, brings me back to the paucity of the knowledge base, and to the need for a stronger underpinning research base with, for example, a move beyond dosimetry alone, important though it has been, and remains. There is a need to turn the question round and start with the people who express symptoms and seek scientific explanations for the symptoms. That is a difficult approach because at this stage with mobile phone technology there are multiple perceived end-points: sleeplessness, headaches, nausea etc, and many possible causes of such end-points. Such an approach may not resolve the issues overnight, but there is a chance to move part of the way forward and I believe, looking ahead, that it is an important approach which requires much more research effort and priority.

**Existing concepts**

For a start, there is a need to get rid of two existing concepts.

We need to get away from the idea that if there is no mechanism to explain the observations then the observations have to be
disregarded. There are numerous examples where initial observations without crucial scientific explanation have been hugely important. Take the London cholera epidemic of the 1800’s when hundreds of people living particularly close to a water pump in Broad Street were dying from cholera. Dr John Snow, who lived nearby, observed what was happening and surmised that the deaths were due to contaminated water from the pump. Although his view was dismissed by the Health Board and by the Water Company, and the cholera microbe had not then been discovered, when the pump handle was removed from the pump in 1854 at Dr Snow’s instigation, and the water thus became unavailable, the local epidemic quickly subsided.

Think about it! Similarly take vitamin C and scurvy. Although vitamin C had not been discovered, it was recognised from observation that sailors on long sea journeys developed scurvy, and that this could be prevented by the provision of citrus fruit and vegetables in the diet.

There is also a need to get away from the often expressed assumption that everything that cannot be explained is due to psychological problems. From perusal of the literature on mobile phones/masts, the peer reviewed hard evidence for the effect of mobile phone technology being due to psychological causes alone has scarcely been scratched. There is an urgent need for more work to be carried out in the social sciences area focusing on the individual, the community, the general public and on the societal impact.

Looking to the future
Finally, there are two other factors which should be addressed.

The first factor is that since 2000 there has been a mass of publications, reports, observations, and views purporting at the very least to implicate phones/base stations as a cause of adverse health effects. At a time of uncertainty when more information is required, non-peer reviewed articles should not be ignored. Doing so is ridiculous. They may be right but unproven and/or offer pointers to be thought about and followed up. Also, the fact that observations may not have been independently replicated under identical conditions can be eschewed as fair criticism but it would surely be wrong to dismiss such observations out of hand, especially when there is a general consistency of observation. What I am advocating is that, somehow, there should be incorporated in to the analytical system fuller consideration of many of the observations noted and only having done that dismiss them or not. It is worse to do nothing.

The second factor is that looking to the future there is the potentially huge impact that molecular biology/genetics may bring in explaining symptoms and effects, and in helping to assess the risk of experiencing perceived and/or real adverse health effects. Epidemiological studies have played a major role in elucidating major effects, for example of smoking and lung cancer. But 10–40 years to elicit a cancer risk is a long time, especially when confounding factors may be in play. Equally conventional epidemiological studies cannot readily explain short term impacts on a small proportion of people, especially if there is no clearly defined and readily measurable end-point. There is a need to see, in the examination of possible NIR effects, whether there are specific genetic links involved. Studies on potential NIR effects need to become aligned to the world of genetic profiling, biomarkers and molecular epidemiology. Not easy, but with effort it should be achievable. One problem is that there are few specialists who can individually couple the physics and molecular genetics necessary in this area. But the way forward is to work as partners in jointly funded research programmes. The HPA is keen to develop this area.

Impact of mobile phone technology
Finally, ten years on, let us look at the known impact that mobile phone technology has had on the population as a whole.

What has changed over that period is that its major beneficial impact has been widely recognised: in the home, at work and at play. It is used to communicate information, threats, dangers, accidents etc. It is part of modern life. It has benefited business with the UK having an enviable mobile telephone communications industry. Our international competitiveness would be disadvantaged if it was unavailable and the UK would be globally less competitive. The benefits are huge and easily demonstrable. The technology is here for the foreseeable future.

What has not changed is the ongoing debate about whether mobile phone technology causes adverse effects on health. What is clear is that despite the increased number of phones in use, there is no evidence to date that the health of the general population is being adversely affected by mobile phone technology. Also peer reviewed papers to date, although not without critics, have almost entirely dismissed suggestions that radiation from mobile phone technologies cause adverse effects on health. There are one or two specific areas where there is conflicting scientific information available, for example, on acoustic neuromas and this needs to be followed up. This is important.

Precautionary approach
The main ongoing area of debate is whether there is a sound scientific basis for certain of the unexplained and/or as yet unproven assertions being made about RF radiation and its impact on health. It would be prudent not to dismiss these out of hand. There is a need for a resilient expanded knowledge base to move such issues forward. In the interim, as a general principle, it would be sensible to continue to adopt a precautionary approach but, as the UK Government has done, by sensibly tempering it with a proportionate response to meet social and economic needs.

Personally, having done a risk/benefit analysis, I continue to use my mobile phone when helpful and necessary, and shall continue to do so until there is stronger evidence of adverse health effects than exists at present.
Unicef’s recent report, published in the *Lancet*, shows there has been a fall of 28 per cent in child deaths since 1990. But the UN children’s agency warns many poorer countries will not meet the 2015 Millennium Development Goal (MDG) of cutting that figure by two thirds. Last year, 9.2 million children aged under five died across the world.

Central and eastern Europe, Latin America and the Caribbean, and East Asia and the Pacific countries have cut deaths among under-fives by over 50 per cent since 1990. But over the same period, deaths in western and central Africa have fallen by just 18 per cent; in sub-Saharan Africa the figure was 21 per cent, while in eastern and southern Africa it was 26 per cent.

A number of countries have made particularly good progress in reducing under-five mortality, including Lao PDR, Bangladesh, Bolivia and Nepal, each of which has reduced their under-five mortality rates by more than 50 per cent since 1990.

There has also been significant progress in parts of Africa: Eritrea’s under-five mortality rate fell by 52 per cent between 1990 and 2007, and in Malawi, Mozambique, Niger, and Ethiopia child mortality rates have declined by more than 40 per cent across the same period. However in Sierra Leone, the country with the worst under-five mortality rate in the world, 262 out of every 1,000 children die before their fifth birthday.

**Under-nutrition**

Unicef warns that under-nutrition is a contributing cause of more than one-third of the 9.2 million under-five deaths worldwide. While there has also been progress in reducing the percentage of children under five who are underweight since 1990, an estimated 148 million children in the developing world remain under-nourished.

Unicef executive director Ann Veneman said: “Since 1960, the global under-five mortality rate has declined more than 60 per cent, and the new data shows that downward trend continues. There are also encouraging improvements in many of the basic health interventions, such as early and exclusive breast-feeding, measles immunisation, Vitamin A supplementation, the use of insecticide-treated nets to prevent malaria, and prevention and treatment of HIV/AIDS. These interventions are expected to result in further declines in child mortality over the coming years.”

**Grossly insufficient**

Unicef says that while interventions in some areas, such as immunisations or insecticide-treated bednets to prevent malaria, have been effective, there is a “disappointingly” low coverage of services to treat pneumonia and diarrhoea.
LENTICULE discs: health protection in miniature

Danka Tharagonnet, manager of the HPA's internationally recognised LENTICULE manufacturing unit in Newcastle, tells Karen Lloyd why these miniscule discs are such life-savers.

Tucked away in the HPA's regional laboratory in Newcastle, a small team of biomedical scientists are busily protecting the health of millions of people across the UK, wider Europe and parts of the United States.

Between them this dedicated team helps over 150 water, food and microbiology testing laboratories, to ensure that the tests performed give accurate and reliable results. They do this by supplying the laboratories with a range of live organisms, safely preserved in tiny, lens-shaped discs the size of sequins called LENTICULES. Laboratories across the world use these minute coloured discs manufactured in Newcastle to help them maintain internal quality control and to comply with rigorous accreditation requirements.

What are LENTICULE discs?

Danka Tharagonnet manages the HPA's Newcastle laboratory unit and she describes LENTICULES as microbiological reference materials used by food, water and environmental testing laboratories.

“The discs we manufacture in Newcastle are primarily for water testing laboratories but we also supply food and environmental laboratories too,” she says.

“Each disc contains a predetermined quantity of biologically active organisms suspended in a solid, water-soluble matrix. A single disc can hold anything from five or six organisms up to over a million, all locked safely inside a semi-viscous liquid ‘drop’ which is control dried to make it solid.

“Currently we routinely provide over 20 different types of bacteria and fungi in these tiny discs,” explains Danka. “Even strains such as Campylobacter which are difficult to preserve using conventional freeze-drying methods can be successfully preserved in LENTICULE disc format.

Clostridium perfringens, Coliform bacteria, including E. coli, Klebsiella, Enterobacter Enterococcus faecalis Legionella Pseudomonas aeruginosa Salmonella Staphylococcus aureus

A simple and practical tool

LENTICULE discs are coloured, therefore easily seen despite their small size. As they contain a known organism at a defined level, they conveniently provide reproducibly countable numbers of organisms, and can be incorporated as part of a laboratory’s routine internal quality assurance (IQA) programme.

“Used this way,” says Danka, “LENTICULE discs are one of the most simple and practical tools available to laboratories to check that their processes are consistent and their equipment well calibrated. Testing laboratories need to demonstrate technical competence and LENTICULE discs can help them show that they can meet the rigorous international quality standard ISO 17025, with which all testing and calibration laboratories must comply.”
A unique product

LENTICULE discs were first developed for water EQA schemes in Newcastle in 1993 by consultant microbiologist Dr Arthur Codd when he worked for the Public Health Laboratory Service, a predecessor of the Health Protection Agency. They have been commercially available since 1998 (Codd, AA et al., 1998). Danka worked with Dr Codd in the 1990s when he was refining the manufacturing process so she knows the product and the process inside out.

A similar process was subsequently adopted by the HPA’s Centre for Infections at Colindale who now manufacture and supply LENTICULE discs for food and legionella External Quality Assurance (EQA) schemes.

“It’s such a unique product but so simple,” she says with enthusiasm. “We manufacture all our LENTICULE discs from one subculture of a traceable strain obtained from the National Collection of Type Cultures (NCTC). This means that the characteristics of each strain are retained. We supply each singly, supported on a silica gel insert, and contained in an airtight vial.

“Unlike the freeze-dried alternatives, LENTICULE discs are ready for immediate use following a simple re-hydration process either directly onto an agar plate or into liquid media.

“We recommend that for long term storage they should be kept at -20 °C but short periods at ambient temperature, during transit to customers, don’t affect their viability or their count significantly. We’ve stored them successfully for several years in the Newcastle laboratory without any significant affect on them. They really are quite remarkable.”

An international venture

During the financial year 2007/08 the Newcastle LENTICULE unit manufactured and supplied over 140,000 discs to laboratories across the UK and as far afield as the United States of America, Denmark, Belgium, Spain, Portugal and Ireland.

The Newcastle laboratory is planning to work with the HPA’s Culture Collections (HPACC) business unit to further develop an ‘NCTC LENTICULE discs’ branded, extended range of products that will be marketed internationally through the HPACC network.

“We’ve grown the business from approximately 60 orders in 1998 to almost 600 in the last financial year. Our LENTICULE discs are in terrific demand now and that brings with it quite a responsibility. Every single laboratory we supply depends on us to provide them with quality materials so we have to maintain the highest possible standards. LENTICULE discs for internal quality control (IQC) have ISO registration and we’re audited by BSI every year.

“It certainly keeps us on our toes but I have an excellent team around me and we’ve fine-tuned the process over the years. We’ve just had one of our busiest months ever so we must be doing something right! It truly is an international venture now,” said Danka.


More information about the HPA’s LENTICULE disc manufacturing unit in Newcastle, including a complete stock list and pricing information, is available at: www.hpaweqa.org.uk or by emailing weqa@hpa.org.uk
Accidental misuse of chemicals and chemical products

Children could be better protected from chemical poisoning in the home because of a research project involving the Agency and European partners. The ‘Description of the Nature of Accidental Misuse of Chemicals and Chemical Products’ (DeNaMiC) research project is funded through the Long-Range Research Initiative (LRI) of the European Chemical Industry Council (Cefic).

The project seeks to provide an overview of the nature and extent of accidental poisoning from chemicals in household chemical consumer products in Europe and provide detailed information on the circumstances of where and why such exposures occur, e.g. in the home due to unsatisfactory storage.

First steps
The first step in the process was to define and limit the events and scope of data to be analysed and collected to include only accidental poisonings and exposure to household chemical consumer products, and agree the definitions for a ‘consumer product’ and ‘circumstances of exposure’. Key components included identifying and assessing the existing reporting systems used by poison centres to determine where there are gaps in information, and to summarise accidental poisoning following exposure to these agents.

Attempts to compare product classification schemes between poison centres involved in the DeNaMiC project demonstrated that there was good comparability between some parts of individual classification schemes, but not in others. In some cases there was a high degree of compatibility and similarity in terms of matching product classifications at the highest and broadest level, e.g. drain and oven cleaners.

On examination of more detailed sub-levels of product classification, however, it became clear that the scope of products covered by the higher levels of classification differed significantly between poison centres, e.g. fire products. These findings limited the degree of product matching and mapping between poison centres and, as such, restricted the possibility of performing a detailed analysis.

A literature analysis to identify available published information relevant to the scope of the DeNaMiC project identified 156 publications but only 37 per cent contained relevant information on accidental poisoning with household chemical consumer products. It was not possible therefore to conduct a statistical analysis of this information as the data was too heterogeneous.

The English language versions of the annual reports of European poison centres were also consulted. The information in these reports was varied and highlighted the lack of an agreed standard reporting format for poison centres to publish their activities throughout the European Union.

A retrospective analysis was conducted on poison information enquiries made to Lille and Göttingen (approximately 27,000 cases each). The key data fields for the purposes of analysis were identified and compared between both poison centres. In some cases there was a direct comparison, e.g., sex, and in other key data fields there was limited comparability, e.g. location of exposure. With some adjustments it was possible to conduct a statistical analysis on paired parameters of key data fields.

Project findings to date
The conclusions of the statistical analysis were:

- the majority of accidental poisonings and exposures to household chemical consumer products in children result in no symptoms
- children are more frequently involved in accidental poisoning exposures to household chemical consumer products and cosmetics
- overall there was no significant difference between male and female exposures to household chemical consumer products, however females are more frequently involved in accidental poisonings with cosmetics and males with domestic pesticides
- children have a lower incidence of exposure to potentially corrosive or other hazardous household cleaning products than adults, but have a higher incidence of accidental poisoning and exposure to sanitary cleaning products
- exposures to potentially corrosive or other hazardous household cleaning products are associated with a significantly higher incidence of reported symptoms than other household cleaning products

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The international response to children’s environmental health began in the 1990s and the momentum has continued throughout the 21st century with 53 countries in the WHO European Region committing to the development of national action plans in 2004.

**Children’s Environment and Health Action Plan for Europe (CEHAPE)**

Children are particularly vulnerable to the effects of environmental stressors given their unique exposure - greater intake/exposure in relation to body weight in comparison to adults; behavioural - living and playing closer to the ground; and, developmental - rapidly developing organs/systems - characteristics. Evidence suggests that exposure to environmental risks can contribute to the burden of disease among children; however, there are still information and knowledge gaps about the magnitude and distribution of the risks/hazards as well as the extent of environmentally related outcomes among children.

The World Health Organization (WHO) considers the development of a set of key children’s environmental health indicators as an essential step in the effort to improve children’s health through safer environments. Several international policies, most notably the World Summit on Sustainable Development (WSSD) Plan of Implementation and the Banff Ministerial Statement on the World Summit on Sustainable Development, have called for more effective collaboration on the development of such indicators. A global Initiative on Children’s Environmental Health Indicators (CEHI) was launched at the WSSD in September 2002 in response to these concerns.

At the fourth WHO Ministerial Conference on Environment and Health (2004), ‘The future for our children’, 53 countries in the WHO European Region agreed a declaration to a Children’s Environment and Health Action Plan for Europe (CEHAPE). They are committed to developing and implementing national CEHAP plans and policies to address local priorities to reduce the burden of disease among children caused by environmental risk factors by 2010. In the UK, this is being led by the government’s Interdepartmental Steering Group (ISG) on Environment and Health which has tasked the Health Protection Agency (HPA) and the Environment Agency (EA) to develop a national CEHAP. The UK’s response has included the development of an indicator programme at a sub-national level in the West Midlands region using the experiences of the WHO Environmental Health Information Systems (EHIS) project. This indicators toolkit will help to support the delivery of the Children’s Environment and Health Strategy for the UK.

**Why the West Midlands?**

The population of the West Midlands has a higher proportion of children than the English average and has some regionally distinctive children’s health issues including the highest rates of infant mortality, perinatal and neonatal deaths, stillbirths and low birth weight babies in England. The region also has a higher percentage of children living in poverty in comparison to the average for
Indicators of environmental stress and of environmentally related disease outcomes were prioritised based on plausibility, evidence base and relevance for the region. The core set of seventeen indicators covers a range of environmental health issues including housing, noise nuisance, mortality and environmentally linked diseases, accidents and environmental quality (see Table 1). Indicators considered important but for which data are not currently available at a local authority level and/or specific to children have been identified as ‘gap indicators’.

**Environmental health indicators**

In order to ensure indicators are informed by local intelligence and experience it was essential to engage public health professionals working at a local level. Accordingly, a working group was established to oversee the development of locally appropriate indicators. The group includes representatives from HPA’s Chemical Hazards and Poisons Division (CHaPD), Local and Regional Services Division (LaRS), and the WHO Collaborating Centre of HPA, West Midlands Public Health Observatory (WMPHO), the Department of Health West Midlands (DHWM) plus input from local authority colleagues, primary care trusts and the Environment Agency. The group built on the HPA’s experience of leading the UK’s input to the WHO/EU EHIS programme and recruited input from the local authority community.

The working group agreed definitions of environmental health (Box 1) and children (Box 2), and assessed existing indicator programmes such as EHIS, WHO CEHI programme, National Indicators Set and Community Health Profiles. It established an initial set of indicators following an assessment of the quality, appropriateness and utility of datasets. These initial indicators were then more rigorously assessed on the following criteria:

<table>
<thead>
<tr>
<th>Availability</th>
<th>Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of start</td>
<td>Spatial coverage</td>
</tr>
<tr>
<td>Level of disaggregation</td>
<td>Format</td>
</tr>
<tr>
<td>Quality assurance and control</td>
<td></td>
</tr>
</tbody>
</table>

The group agreed to adopt the definition of a child as a person aged 0 to 19 years (inclusive), including the foetus from the time of conception.

**Table 1: List of core and gap indicators**

<table>
<thead>
<tr>
<th>CORE INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HOUSING</strong></td>
</tr>
<tr>
<td>1. Unfit dwelling</td>
</tr>
<tr>
<td>2. Overcrowding</td>
</tr>
<tr>
<td>3a. Homeless households in priority need</td>
</tr>
<tr>
<td>3b. Homeless in temporary accommodation</td>
</tr>
<tr>
<td><strong>HEALTH</strong></td>
</tr>
<tr>
<td>4. All cause mortality rate</td>
</tr>
<tr>
<td>5. Infant mortality</td>
</tr>
<tr>
<td>6. Hospital admission rate due to acute respiratory illness</td>
</tr>
<tr>
<td>7. Hospital admission rate due to asthma</td>
</tr>
<tr>
<td>8. Immunisation uptake</td>
</tr>
<tr>
<td>9. Obesity</td>
</tr>
<tr>
<td><strong>ACCIDENTS</strong></td>
</tr>
<tr>
<td>10. Hospital admission rate due to non-traffic related injuries</td>
</tr>
<tr>
<td>11. Hospital admission rate due to traffic related physical injuries</td>
</tr>
<tr>
<td><strong>ENVIRONMENT</strong></td>
</tr>
<tr>
<td>12. Exposure to air pollutants</td>
</tr>
<tr>
<td>13. Proximity to heavily trafficked roads</td>
</tr>
<tr>
<td>14. Noise nuisance</td>
</tr>
<tr>
<td>15. Potential exposure to chemical incidents</td>
</tr>
<tr>
<td>16. Physical activity</td>
</tr>
<tr>
<td>17. Access to Green Space</td>
</tr>
<tr>
<td><strong>GAP INDICATORS</strong></td>
</tr>
<tr>
<td>Hospital admission due to diarrhoeal illness/food poisoning notification</td>
</tr>
<tr>
<td>Exposure to ETS</td>
</tr>
<tr>
<td>Access to sports facilities</td>
</tr>
</tbody>
</table>
The most contemporary data are used for the indicators covering the period 2001 to 2007. Although the year(s) data used may differ among indicators, the year(s) for any one indicator will be the same for all the local authorities to facilitate comparisons. Expert advice on the selection of indicators has been sought where necessary and data was collated and analysed by the HPA in collaboration with the WMPHO.

Templates detailing the rationale for each indicator and the sources of the data together with an assessment of data quality (including the limitations) have been developed (see Table 2).

<table>
<thead>
<tr>
<th>Definition</th>
<th>Denominator definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationale</td>
<td>Source of denominator</td>
</tr>
<tr>
<td>Special relevance to children</td>
<td>Geographic coverage</td>
</tr>
<tr>
<td>Other sources of indicator set</td>
<td>Dimensions of inequalities available</td>
</tr>
<tr>
<td>Primary source</td>
<td>Timeliness</td>
</tr>
<tr>
<td>Date last published</td>
<td>Accuracy and completeness</td>
</tr>
<tr>
<td>Time period</td>
<td>Disclosure control</td>
</tr>
<tr>
<td>Numerator definition</td>
<td>Technical guidance</td>
</tr>
<tr>
<td>Source of numerator</td>
<td>Further information</td>
</tr>
</tbody>
</table>

**Table 2**: Criteria for describing the indicators

Data are being presented in graphical format as well as maps together with a commentary. While it is not presently possible to use a ‘traffic light’ system describing whether things are moving in the right direction, e.g. sustainable development indicators, given this is a first snap shot, 95 per cent confidence intervals have been used where possible to identify local authorities as red, amber or green in comparison to the West Midlands average. It is anticipated that as the system matures further statistical techniques, such as statistical control charts, will be used to identify those local authorities which are performing significantly differently.

**Future**

A first draft of the document was circulated among West Midlands local authorities for a one month consultation period in December 2007. The document has been updated accordingly and was published for formal consultation at the launch of the Children’s Environmental Health CEHAP Strategy in the West Midlands on 2 September 2008.

It is anticipated that these indicators will be used to assess the environmental health experience of children in communities at a local authority level and enable a focus on those interventions with the greatest potential for health gain. It is hoped that other regions will adopt the methodology and it is anticipated that other regions will include additional indicators to the core set, responding to specific regional priorities.

This toolkit will be useful for government and non-governmental organisations including local authorities, NHS, Strategic Health Authorities, and non-statutory bodies/persons that play an active part in protecting children’s health from environmental risks.
The National Anonymous Tonsil Archive and human exposure to mad cow disease

It will be another two or three decades before we know the full outcome of the exposure of the British population to BSE in the ten years up to 1996. Jonathan Clewley describes how the Health Protection Agency’s work in this area will clarify the extent of the problem of silent vCJD infection more rapidly.

**Kuru**

In 2004, in Papua New Guinea, a sixty-year-old man of the Foré tribe died of the prion disease known as kuru. Kuru means ‘trembling with fear’ in the Foré language. He was one of the eleven people who died of this condition between 1996 and 2004. These eleven deaths have been remarkable because kuru was thought to have been eradicated by the 1970s, some 20 years after it was first identified as an epidemic in Papua New Guinea.

The most likely explanation for the evolution of the kuru epidemic is now, therefore, that it started with a single case of sporadic Creutzfeldt-Jakob disease (CJD) in the 1920s; that was spread because of the tribal customs of eating body tissues in what are known as mortuary feasts or ‘transumption’; and that the incubation times of kuru can range from a few up to 40 years and more, so that rare cases continue to occur. In all, there have been over 2,700 cases of kuru between 1957 and 2004 in a relatively small population. It is a phenomenon that cannot be ignored when thinking about the rare, largely British disease, variant CJD (vCJD).

**Variant CJD**

So, is what happened in Papua New Guinea a portent for what might happen in Britain with vCJD in the years to come? The prion disease bovine spongiform encephalopathy (BSE) was a novel epidemic in cattle in the UK, lasting from the 1980s to mid-1990s with about 184,000 confirmed cases. Subsequently, 166 people in the UK have died of vCJD, which they almost certainly developed as a result of eating food containing components derived from BSE infected cattle. There have also been four instances of probable transmission of vCJD by blood transfusion. There have not, however, been any new cases over the last two years, and it looks as though the worst of the vCJD epidemic in Britain may now be over.

A contrary view based on several observations must, however, be allowed for. One consideration is the long incubation times of some cases of kuru. Another is that prion diseases are known to be influenced by the genotype of the prion gene - and probably other genes too. It has, therefore, been argued that the 166 cases of vCJD to date represent only a super-susceptible sub-population of the British people, and there may be a larger population of people silently incubating the disease who will go on to terminal illness in 20 or 30 years time. vCJD can be transmitted by blood transfusion and it has long been known that sporadic CJD can be passed on by surgical procedures. So there is the possibility of a vCJD epidemic arising by these routes, the so-called secondary epidemic.

**How many more cases of vCJD?**

There have been several attempts to determine the possible amount of asymptomatic disease and calculate the probable number of future cases of vCJD. As it is known that the pathogenic form of the prion protein (PrP$^{Sc}$) accumulates in lymphatic tissue during the course of vCJD, stored collections of appendix and tonsil tissue have been retrospectively examined for the presence of PrP$^{Sc}$ by immunohistochemistry and Western blotting. One study found three positives out of 12,674 appendix tissue samples tested by immunohistochemistry. Another found no positives in 2,000 tonsil tissue samples tested by Western blotting. However, extrapolating from the figure of 3 in 12,674, the prevalence...
of silent infection might be 237 per million, or approximately 15,000 cases in the UK. This figure is 25 times greater than the highest estimate, 600, based on the back-calculation from the number of clinical cases observed so far. Clearly, there is great uncertainty at this stage.

**Testing for vCJD secondary spread**

If there are people silently incubating vCJD, it will be important to put in place measures to prevent any secondary spread through invasive healthcare procedures. These measures include disposal of surgical instruments that have been used on neural and lymphatic tissue (already in place) and future screening of blood donations. To do this in a cost-effective manner will require the development of screening tests and a more precise estimate of the number of silent cases than we have at present.

The best way to obtain this estimate would be to use a sensitive and specific enzyme immunoassay test on blood samples themselves but, although it is known that blood can carry vCJD infectivity, no one has yet devised an enzyme immunoassay test on blood samples. This has provided the opportunity to develop firmer estimates of the residual prevalence of vCJD in the population based on access to human lymphatic tissues.

**The National Anonymous Tonsil Archive**

These enzyme immunoassays have formed the basis for work on the National Anonymous Tonsil Archive at the HPA Centre for Infections at Colindale. This National Archive was set up to test 100,000 tonsil samples for the presence of PrP^CJD and, to date, more than 55,000 tonsils have been tested by two enzyme immunoassays. These two assays were chosen because of their high sensitivity and specificity, and because they work by different biochemical principles, and should therefore complement each other.

Any tonsil samples that were reactive in either of the two enzyme immunoassays have been further investigated with more specific tests. These confirmatory tests, intended to recognise ‘true’ positives, are Western blotting (by two different methods) and immunohistochemistry. These methods have not yet found vCJD prion in any tonsils in the archive, which is consistent with the more conservative estimates for underlying vCJD infection in the British population.

**Which study is right?**

There is therefore an apparent discrepancy between the best estimate from the work of the National Archive, testing tonsils by enzyme immunoassay, and the estimate of 15,000 or so ‘silent’ vCJD infections obtained through the previous testing of appendix tissues by immunohistochemistry.

Possibly the study that gave rise to the higher estimate found atypical cases that do not represent vCJD itself. Two of the three immunohistochemistry positives were of the valine (VV) genotype at codon 129 in the prion protein gene - the third could not be genotyped - whereas all the vCJD clinical cases to date have been methionine (MM) homozygotes at that codon. The VV genotype is relatively uncommon in the population as a whole, occurring at a frequency of about 12 per cent, compared to MM at 40 per cent, and it is therefore surprising that two of the appendix positives found by immunohistochemistry were VV homozygotes at codon 129.

Furthermore the staining seen by immunohistochemistry in two of the cases was reported to have been atypical compared with previously observed vCJD cases, raising the possibility that it was due to a different disease process. For example, a case of atypical sporadic CJD, with disease onset in 1999, has recently been reported in a young British woman of VV homozygosity at codon 129. On the other hand, the possibility that the tests on the National Archive samples are not wholly sensitive cannot be excluded.

**Whither now?**

The above are all speculations though, and hard laboratory evidence is needed to resolve the discrepancies between the earlier and present studies. It was not possible to do enzyme immunoassay or Western blotting on the appendix samples that were tested by immunohistochemistry as the only tissue available was that fixed onto histology slides. The next step for the National Tonsil Archive...
The National Tonsil Archive group

The National Tonsil Archive is therefore to implement, alongside testing tonsils, testing of a few thousand surgically removed appendix tissue samples by enzyme immunoassay and Western blotting for PrPSc [1]. In addition, with the support of the Department of Health, it is planned that up to 30,000 archived, fixed appendix tissue samples will be tested by immunohistochemistry. As a further addition to the efforts to refine the prevalence estimate of vCJD, discussions with coroners are taking place. These will determine whether it is feasible to recover spleen samples removed at post-mortem and test them for abnormal prion protein.

It will be another two or three decades before we know the full outcome of the exposure of the British population to BSE in the ten years up to 1996, but with improving tests and the prospect of access to a wider range of samples of human tissue, it is hoped that the Health Protection Agency’s work in this area will clarify the extent of the problem of silent vCJD infection more rapidly.

Jonathan Clewley is a clinical scientist in the Virus Reference Section at the Centre for Infections (CFI), where the National Tonsil Archive is based. The work on vCJD and tonsils at CFI is a joint effort of the CJD Section epidemiologists and statisticians and the TSE Unit laboratory scientists. Apart from the enigmas of prions and protein folding diseases, he is interested in the discovery and characterisation of new and emerging viral diseases through the use of the tools and techniques of molecular biology.

References and Further Reading


Radiation doses from medical X-ray examinations in the UK

Monitoring has shown that radiation doses to patients from medical X-ray examinations have steadily decreased over the last twenty years. David Hart of HPA’s Radiation Protection Division explains how collecting such data enables us to set ‘national reference doses’ which hospitals can use to assess their own performance.

One of the functions of the HPA’s Radiation Protection Division is to keep an eye on radiation doses to patients from medical X-ray examinations. It does this by collecting large amounts of data from hospitals throughout the UK.

Ionising radiation is put to use in medicine in a very beneficial way, to aid diagnosis. Such diagnostic X-ray exposures are justified if the benefit outweighs any risk. An important area of work for the Radiation Protection Division is to determine whether such medical radiation doses to patients are being kept as low as reasonably achievable, since they constitute 90 per cent of radiation exposure to the UK population from artificial sources.

X-rays penetrate flesh and bone to differing degrees and allow images to be produced of the inside of the body - these are called radiographs. About 45 million diagnostic medical and dental X-ray examinations are performed in the UK every year. The parts of the body most frequently X-rayed are the chest, the teeth and the limbs - to look for broken bones. These examinations involve very low radiation doses.

A more complex type of examination, which is much less frequent, involves the use of a ‘contrast agent’ to give a good image of soft tissues. A contrast agent is a substance that is more opaque to X-rays than is soft tissue. Barium is commonly used for this purpose, in the form of a drink or an enema, to coat the lining of the oesophagus, stomach or intestines, which allows them to be visualised. Iodine-based contrast agents are also injected into patients to visualise the blood vessels or the kidneys. These types of examination usually involve taking several images, and sometimes many images, so the radiation dose is higher than for a single radiograph of the teeth, chest or limbs.

A computed tomography scan (CT) also uses X-rays but gives more detail than a conventional X-ray examination. The patient lies on a narrow table which passes through a circular hole in the CT scanner. A fan-shaped beam of X-rays passes through a slice of the patient on to a bank of detectors. The X-ray source and the detectors rotate around the patient. An image of the slice is formed by a computer and displayed on a TV screen. The patient moves slowly through the hole while different slices are imaged; often a 3D picture is produced. If many slices are imaged, the radiation dose can be similar to, or higher than, that for a contrast examination as described above.

National Patient Dose Database

The HPA Radiation Protection Division is responsible for maintaining the National Patient Dose Database (NPDD) which was established in 1992. The purpose of the NPDD is to monitor any trends in radiation doses to patients from common diagnostic X-ray examinations carried out in hospitals throughout the UK. It also provides ‘national reference doses’ for specific radiographs and examinations, against which hospitals can assess their own performance. Reference doses are based on the 75th percentile (or third quartile) values of the mean patient doses for each examination and X-ray room in the
Reference doses provide an indication of when the imaging equipment or examination techniques used in a particular X-ray room are producing unusually high doses. If the reference dose is exceeded, there should be further investigation and corrective action, unless the unusually high doses can be clinically justified.

In addition to dose measurements, anonymised data are collected on the patient (e.g. age, sex, and weight but not identity), the radiological equipment, and the examination technique. Three reviews of the data have been published for each of the five-year periods preceding 1995, 2000 and 2005 (Hart et al., 1996, 2002 and 2007). More than 700 hospitals and medical clinics have contributed data to one or more of these reviews.

Radiation doses from dental X-ray examinations have been included for the first time in the latest five-yearly review. Dental practices usually have limited access to radiation protection expertise, and national reference doses can be an important aid to the optimisation of patient doses in these circumstances. It is intended that national reference doses for dental X-ray examinations will be included in future reviews of the NPDD.

Radiation doses to patients from computed tomography (CT) examinations are not included in the NPDD. Such information is stored in a separate database, also maintained by Radiation Protection Division, called PREDICT (Patient Radiation Exposure and Dose in CT). It is intended that the data in PREDICT will be reviewed at regular intervals in a similar manner to NPDD.

**Latest results**

About 288,000 dose measurements for hospital X-ray examinations were analysed for the 2005 review, compared with about 180,000 doses for the 2000 review. Doses for single radiographs can be measured as either an ‘entrance surface dose’ or a ‘dose-area product’. Dose-area product is more suitable than entrance surface dose for complex examinations involving multiple radiographs.

The 2005 data came from 316 hospitals from all regions of the UK, from all sizes of hospital, and from both the NHS and the independent sector. This sample covers about 23 per cent of all hospitals and medical clinics with diagnostic X-ray facilities in the UK.

The dental X-ray data came from over 8000 dental X-ray sets in about 3000 dental surgeries in all regions of the UK, i.e. about 25

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**Figure 1:** Changes in room mean ESD distributions 1995-2005

**Figure 2:** Changes in room mean DAP distributions 1995-2005
per cent of all dental surgeries in the UK (Gulson et al., 2007). Figure 1 compares histograms of room mean entrance surface dose (ESD) for two common radiographs from the 2005 review with corresponding histograms from the 1995 and 2000 reviews. The third quartiles of the room mean ESD values are indicated by a vertical line on the histograms in Figure 1 and it can be seen that they have become progressively lower with each review. It can also be seen that the high dose ‘tails’ of the distributions have decreased over the years so that the distributions have become slightly narrower.

Figure 2 compares the histograms of the room mean dose-area product (DAP) values for two barium studies over the three reviews – 1995, 2000 and 2005. The third quartile values have decreased over the three reviews. The results shown in Figures 1 and 2 are typical for other common radiographs and examinations.

Figures 3 and 4 compare the mean dose values over the period from an earlier survey in 1985 up to the 2005 review, for those radiographs and examinations with sufficient data. It can be seen that the doses have steadily decreased over the last 20 years.

A review of the PREDICT database was performed for the year 2003, and covered more than one-quarter of all the CT scanners in the UK. This showed that patient doses from some common CT examinations (head, chest, abdomen and pelvis) are 10 per cent to 40 per cent lower compared with a survey we carried out in 1989. But the increased use of CT in recent years means that it now contributes half of the total dose to the population from all medical X-ray examinations.

**National reference doses**

For conventional radiology, we compared some of the current national reference doses for the UK with corresponding ones for France, Germany, Italy, Spain, Sweden, Switzerland and the USA. The UK values are typically half or less of those used in these European countries, and are fairly similar to the four that are currently available in the USA. The latest UK reference doses are on average about 16 per cent lower than the reference doses for the 2000 review and have more than halved over the last 20 years. However, there are still high dose ‘tails’ to the dose distributions for some common radiographs and examinations, indicating that there is further scope for patient dose reduction. National reference doses will therefore still be useful in identifying those hospitals and X-ray rooms with the greatest opportunities for patient dose optimisation.

For CT, the current national reference doses in the UK are mostly lower than those used in France, Germany and Sweden, and are fairly similar to those used in Switzerland.

It will be important to monitor how doses change with the widespread use of digital imaging systems such as computed radiography and flat panel detectors. The next review of the National Patient Dose Database should contain much more data for such digital systems because they will probably have largely replaced film-screen systems by 2010. It will also be important to see whether the ongoing trend to use multiple rows of detectors in CT scanners, taking more and more simultaneous slices, has a significant effect on patient doses.

David Hart works in the Medical Exposure Department of the Radiation Protection Division, HPA, at the Centre for Radiation, Chemical and Environmental Hazards in Oxfordshire. He is a physicist and specialises in surveying radiation doses to patients from diagnostic X-ray examinations and from nuclear medicine.

**REFERENCES**


[apart from the first, all are available on the HPA website www.hpa.org.uk]
Eighty years ago, during the late summer of 1928, Alexander Fleming observed that a mould, *Penicillium notatum*, inhibited the growth of staphylococci on a Petri dish in his laboratory at St Mary’s Hospital, London.

At the time Fleming saw the value of penicillin mostly as a superficial antibacterial application, or as a substance to be used in a selective laboratory medium that would allow other bacteria to grow better. These bacteria could then be made into the vaccines for which his ‘Inoculation Department’ at St Mary’s was renowned.

The realisation of penicillin’s exceptionally high ratio of efficacy to toxicity only came twelve years later thanks to the work of Howard Florey’s group at the School of Pathology in Oxford; but whatever may be said of Fleming’s failure to capitalise on his discovery, nothing can detract from his recognition of the phenomenon of antibiosis which has since brought forth such a wide range of clinically useful drugs.

Amid the current anxieties engendered by such pathogens as Methicillin-resistant *Staphylococcus aureus* - which Fleming himself recognised as having a particular capacity to develop drug resistance - it is easy to forget all that antibiotics have done to cure infections, both acute and chronic, in the last half century. The chemical synthesis of these natural products of moulds in the shape of, for instance, the semi-synthetic penicillins, and the industrialisation of their production in pure form, have revolutionised medicine.

The origin of this antibiotic revolution can be traced to Fleming’s tiny laboratory overlooking Praed Street, Paddington. Now a museum, open to the public, it preserves the appearance and ambience of the traditional, dark and cramped bacteriology laboratory. Its curator, Kevin Brown - author of ‘Penicillin Man’, published by Sutton Publishing, 2004 - cares for the hallowed ground where Fleming made his discovery.

Sir Alexander Fleming was born at Lochfield near Darvel in Ayrshire, Scotland on 6 August 1881. He attended Louden Moor School, Darvel School, and Kilmarnock Academy before moving to London. He qualified with distinction from St Mary’s Medical School, London University in 1906 and began research at St Mary’s under Sir Almroth Wright, a pioneer in vaccine therapy.

He served throughout the First World War as a captain in the Army Medical Corps, being mentioned in dispatches, and in 1918 he returned to St Mary’s. He was elected Professor of the School in 1928, Emeritus Professor of Bacteriology, University of London in 1948, and a Fellow of the Royal Society in 1943. He was knighted in 1944.

In 1945, he was awarded the Nobel Prize in Physiology or Medicine jointly with Dr Ernst Chain and Sir Howard Florey “for the discovery of penicillin and its curative effect in various infectious diseases”.

Early in his medical life, Fleming became interested in the natural bacterial action of the blood and in antiseptics. In 1921, he discovered in ‘tissues and secretions’ an important bacteriolytic substance which he named lysosome. About this time, he devised sensitivity titration methods and assays in human blood, which he subsequently used for the titration of penicillin.

In 1928, while working on influenza virus, he observed that mould had developed accidently on a staphylococcus culture plate and that the mould had created a bacteria-free circle around itself. He named the active substance penicillin.

Fleming died on 11 March 1955 and is buried in St Paul’s Cathedral.
COLLABORATE OR DIE:
learning lessons from Fleming

At the time of his death, in 1955, Fleming’s inspiring career story exercised a peculiar magic over weary post-war Britain, and the years since then have seen three major biographies added to the short but excellent one by J.L. Ludovici published in Fleming’s own lifetime.

Other brief accounts continue to be written for schoolchildren, preserving the myth of Fleming as a lone, modest, genius - and let it be conceded straightforwardly that his ascent from obscure beginnings to become the exemplar and ambassador of British science was indeed a remarkable one.

Yet reading about Fleming today one is struck by the contrast between his progress and that of those who have since excelled in health-related scientific research. It is scarcely possible to imagine a modern career in biomedical science that would follow the same path as Fleming’s. Fleming spent forty years in the same department, thirty five of them working for the same boss, Almroth Wright. Throughout, Fleming carried a heavy routine commitment that left only spare time to commit to personal research. He rarely sought external collaborations. His publications were carefully composed by himself alone, or with just one (junior) author. Most of his scientific papers concerned mundane technical issues, elegantly constructed though they were.

Today, the typical scientific career path is different. Modern scientific knowledge edges forward through collaborations between dozens of investigators, each of whom brings to the table a particular skill or know-how. There is little opportunity for the independent researcher who, as Fleming did, makes a virtue out of improvisation and ‘make do’, and prefers to use their own technical ingenuity rather than to be beholden to others for expert help.

**Individualist**

Even if not a lone in the bad sense of ignoring others’ potential contributions, Fleming was certainly an individualist. He was clever, deft, observant, and focussed; but he was also reserved, taciturn - except with close friends outside medicine - and lacking in the gregariousness that is now essential if scientific originality is to find its full expression in joint discovery. Even in his own times the remarkable observational ability that allowed Fleming to make two major discoveries - lysozyme and penicillin - and other more minor ones, was not itself enough to guarantee him immortality. It was a subsequent team effort, headed by an effective leader in the shape of Howard Florey that eventually led to the purification of penicillin and set in motion its industrial scale production. It was this team that brought about Fleming’s apotheosis as a medical scientist extraordinary.

The traditional lesson drawn from Fleming’s career has been that determination, application and a necessary measure of genius will enable any person, no matter from a meagre farming background in the Ayrshire uplands, to take the world by storm by making a discovery that transforms the outcome of serious infectious disease.

**Modern lesson**

However, the modern lesson to be drawn must be different. Try as Fleming did to capitalise on his discovery he failed to find colleagues within his immediate circle who could help him overcome penicillin’s lability and variable yield. Instead, ten years on, an organised group in another university reviewed his 1929 paper, obtained the Penicillium mould and set about preparing pure penicillin. They then drew on the skills of other colleagues to prove its efficacy and lack of toxicity, first in animals, then in humans. Finally, they forged the transatlantic links that delivered the drug in quantity, at first for the benefit of the Allied war machine, eventually for civilian medicine worldwide.

In celebrating Fleming today, it is as well to set sentiment and nostalgia aside and recognise that he should not be seen as a model for success in present day biomedical research. What counts today is not just brains, technical ability, an alert curiosity and a quiet determination - all of which Fleming had - but also the interpersonal skills to set up collaborations, get them funded and keep them going. Success in the supranational world of bioscience demands the capacity to hang onto defined goals in the midst of a sort of semi-chaos. Modern scientists cannot afford to hide away as Fleming did in the little laboratory preserved in his memory above London’s Praed Street. Rather they must interact in an ever-shifting global environment where the main prizes go to effective and lasting research agglomerations built on mutual trust and respect. In short, the modern lesson to draw from Fleming’s life is the contrary one: i.e. “Collaborate or die”.

Fleming finally got recognition for the work he had done many years previously; but full realisation of his work would have come much sooner if his scientific circle had been wider and his instincts more collegiate. Robust individualism like his has now everywhere given ground to collective effort. In line with this the institutions of science are themselves constantly merging and expanding.

Fleming’s own medical school, St Mary’s, and in fact all dozen of the London schools that existed in his day are now part of bigger, aggregated, science and medicine faculties. Among the scientists who work in them the need to collaborate is taken for granted by the younger, and seen as unavoidable by the older generation.
Blackpool Beach at low tide
Photo: Trevor Buttery
Bathing water microbiology: past, present and future

Britain's coastal waters have become less polluted over the past twenty years. Keith Jones of Lancaster University suggests that southern Europe, where bathing waters are warm and clear and exposed to intense sunlight, will have few problems in meeting the microbial standards of a revised EU Bathing Water Directive (2006/7/EC) but, in the north-west of England, where the water is cold and turbid, and where there is less sunshine, compliance will be more difficult.

The past

In the 1950s and 1960s there was a groundswell of public opinion that the UK's bathing waters posed a risk to health. This was largely attributed to the discharge of untreated sewage into coastal waters. Although the supporting epidemiological evidence for a health risk was not strong, there was an overwhelming belief that swimming in dilute sewage was not aesthetically pleasing. It was also recognised that a major clean-up of UK coastal waters was going to be very expensive and little was done nationally, even though the European Parliament had passed legislation in 1976 - Microbiological Parameters of the EU Bathing Water Quality Directive (76/160/EEC) - requiring Member States to comply with bathing water standards.

Testing of the UK's bathing waters is the remit of the Environment Agency (EA). Twenty samples, roughly one a week, are taken during the bathing season, which runs from 15 May to 30 September. To comply with the EC Directive Mandatory standard, 95 per cent of the samples (at least 19 out of 20) must satisfy the following criteria:

- fewer than 10,000 total coliforms per 100ml of water
- fewer than 2,000 faecal coliforms per 100ml of water

To comply with the EC Directive Guideline standard, 95 per cent of samples must satisfy the following criteria:

- fewer than 500 total coliforms per 100ml of water
- fewer than 100 faecal coliforms per 100ml of water
- fewer than 50 enterococci per 100ml of water

The bacterial indicators of faecal pollution, coliforms and enterococci, are not themselves the cause of disease. They are used as indicators because they are ubiquitous in human and animal faeces, and provide a quantitative estimate of faecal contamination.

Attempts to tighten up the standards in 1994 failed at the final legislative hurdle in the European Parliament. Over the next few years there was a steady build-up of negative reports in the media and pressure from groups such as Surfers Against Sewage and the Marine Conservation Society, and above all the EU, which threatened the UK with daily fines if the standards were not met. In 1989, the publicly owned water companies, which had been responsible for providing drinking water and sewage treatment in the UK, were privatised. This enabled the government to accede to the EU legislation by transferring the cost (£10 billion) of the coastal water clean-up to the customers of the newly-privatised water companies.

The next ten years showed remarkable progress. Compliance with the Mandatory standards in the UK increased from 57 per cent in 1990 to 97 per cent in 2001 with the highest level of compliance during the summer of 2006 when 99.5 per cent of the UK's bathing waters met the Mandatory standard. Compliance with the more rigorous Guideline standards increased from 38 per cent in 1998 to 75 per cent in 2006.

This success story can be put down largely to the water companies improving sewage treatment by building new sewage treatment works, ceasing the discharge of untreated sewage into estuaries and coastal waters, replacing the sewer infrastructure, replacing short sea outfalls with long sea outfalls and, more recently, tertiary treatment of effluents with UV radiation. Our own data for three bathing waters in Morecambe Bay show the effectiveness of secondary treatment and lengthening and repositioning a long sea outfall (Table 1). The data also show how much more contaminated bathing waters are in the winter months than in the summer, which should be of concern to wind surfers and water skiers and their ilk.

In north-west England the clean-up has been nothing short of spectacular. In 1994 all the bathing waters between the Ribble estuary and the northern end of Morecambe Bay failed the Directive. By 2001, they all passed, including those at Blackpool! There have been further advances since then with a third of the bathing waters in the north-west achieving Guideline passes in 2007 compared to 11 per cent in 2000.

<table>
<thead>
<tr>
<th>MICRO-ORGANISM</th>
<th>NEW TREATMENT WORKS</th>
<th>GEOMETRIC MEAN BACTERIA 100° SEAWATER</th>
</tr>
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<tbody>
<tr>
<td><strong>Bathing season</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faecal coliforms</td>
<td>before</td>
<td>2535 (30)*</td>
</tr>
<tr>
<td></td>
<td>after</td>
<td>908 (30)*</td>
</tr>
<tr>
<td>Enterococci</td>
<td>before</td>
<td>255 (30)*</td>
</tr>
<tr>
<td></td>
<td>after</td>
<td>169 (30)*</td>
</tr>
<tr>
<td><strong>Non-bathing season</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faecal coliforms</td>
<td>before</td>
<td>4004 (60)*</td>
</tr>
<tr>
<td></td>
<td>after</td>
<td>3565 (42)*</td>
</tr>
<tr>
<td>Enterococci</td>
<td>before</td>
<td>345 (69)*</td>
</tr>
<tr>
<td></td>
<td>after</td>
<td>308 (42)*</td>
</tr>
</tbody>
</table>

Table 1: Comparison of Morecambe Bay bathing waters between the bathing and non-bathing seasons, and before and after a new secondary treatment and long sea outfall came online
with the EU Mandatory standard had only fallen 3 per cent to 96.5 per cent, and this can be blamed on agricultural run-off caused by the record high rainfall.

The 2007 results also highlight intractable problems which beset UK bathing waters, particularly in the north and west. The compliance data for the three bathing waters closest to Lancaster University illustrate the problems rather well (Table 2).

The data show that although the clean-up has worked well on the whole, there are sporadic failures and none of the bathing waters achieved the EU Guideline standard. That sporadic failures continue, even though the sewage treatment infrastructure is in place throughout the UK, shows that there are sources of faecal indicator bacteria unconnected with sewage effluent, the so-called diffuse sources.

**Diffuse sources of pollution**

Diffuse pollution is caused predominantly by agricultural run-off and flocks of wild birds. Agricultural run-off in wet weather can include: faeces from grazing cattle and sheep, farm slurries and manures, and sewage sludge put to land. Animal faeces and farm wastes contain large numbers of faecal indicators.

David Kay’s group at the Centre for Environment and Health has calculated the daily production of faecal coliforms by farm animals and compared them to \textit{E. coli} equivalents from humans. Cattle are equivalent to 2.8 humans, pigs to 4.7 humans and sheep to 9.5 humans. Once on land faecal coliforms can survive for up to eight weeks with a T\textsubscript{90} (time for a log reduction in numbers) of 3.3 days in summer and 13.4 days in winter.

The input from flocks of wild birds is even harder to prevent. Table 3 shows the levels of faecal coliforms excreted by wild birds on Morecambe Bay. As there are many thousands of wild birds on the Bay they have a considerable impact on indicator numbers and may be responsible for the sporadic failures during the bathing season and high densities of the bacteria in winter.

A huge research effort is underway worldwide to pinpoint the origins of pollution and to distinguish whether faecal pollution is caused by humans or livestock or birds. At Lancaster University, we used DNA fingerprinting to match genotypes of \textit{E. coli}, isolated during routine analysis of bathing waters, to \textit{E. coli} isolated from different animals.

We showed that at least 50 per cent of the \textit{E. coli} detected during routine bathing water sampling came from sources other than sewage effluent, and an investigation using \textit{Campylobacter} as a tracer showed that all the campylobacters in Morecambe’s bathing waters derive from wild birds and not sewage.

Diffuse pollution can be made worse by the weather, as seen during the 2007 season, which had the highest rainfall ever recorded. In the north-west of England, 40 per cent of the fresh water reaching Morecambe Bay flows in from the river Lune. It also delivers faecal indicator bacteria from agricultural run-off, rural and town sewage treatment plants, and the large numbers of sheep grazing the salt marshes of the estuary. Pollution levels increase markedly in wet weather, so much so that bathing waters can be given an official reprieve if they fail the EU Directive following severe weather.

**The present**

When the UK bathing water compliance data were published for 2007, The Times headline (23 May 2008) ran: "Dirty beaches treble after big increase in pollution caused by summer storms", suggesting that the success story was running out of steam. In fact, compliance
rough seas stir up sediments. Sediments, particularly those rich in silt, such as those in Morecambe Bay, contain ten times more faecal indicator bacteria than the overlying seawater. Once in the water column they detach from the particles and boost the faecal indicator count.

Temperature and light (particularly UVB) are the main bactericides in bathing waters. Faecal indicators die off much faster in warm water than in cold, e.g. faecal coliforms in sewage effluent survive in the dark for up to two weeks in Morecambe Bay seawater at 37 °C in comparison with seven weeks at 10 °C. In sunlight, survival is measured in hours and minutes, not weeks. At Lancaster latitudes, the 70° for E. coli in seawater in sunlight is only 30 minutes in June but is over eight hours in the winter months. Indeed, we showed that during the bathing season all three of Morecambe’s bathing waters failed the Bathing Water Quality Directive when sampled at 7am but passed at 7pm. The difference was attributed to the indicator bacteria surviving in the dark prior to the morning sampling and being killed by UVB during daylight prior to the evening sampling. We proposed that all bathing waters throughout the EU should be sampled in the early morning to allow for the worst case scenario.

Overall, failure to comply with the EU Bathing Water Quality Directive is more likely on cold, cloudy, windy and wet days sampled in the early morning compared to warm, sunny and still days sampled in the late afternoon.

Since the clean-up of coastal sewage discharges the proportion importance of diffuse pollution in bathing waters has increased. Although diffuse pollution is likely to be the cause of bathing water failures, proof is often difficult. For example, Morecambe South fails more than most, but nobody knows why. Morecambe South is further from Morecambe’s long sea outfall and the mouth of the Lune estuary than Heysham, and both Heysham and Morecambe North are more affected by flocks of wild birds.

At present, the bathing water clean-up can be deemed an aesthetic success, albeit an expensive one. I await with bated breath the first report showing a concomitant improvement in public health.

The future
After all the money and effort, the future ought to be rosy. However, a revised Bathing Water Directive (2006/7/EC) came into force in 2006, which includes a tightening of water quality standards. The revised Directive sets four new standards of water quality (excellent, good, sufficient and poor) and all bathing waters will be expected to achieve at least the sufficient classification by 2015.

Defra and the Environment Agency have tested the new Directive using data from English bathing waters from 2003 to 2006. The results show that 52 per cent would be classed as excellent, 27 per cent good, 13 per cent sufficient and 8 per cent poor. Several bathing waters in the north-west of England would be classed as poor, including Morecambe South and Heysham. Morecambe North was sufficient. Further details are provided on the Defra website: www.defra.gov.uk/environment/water/quality/bathing/default.htm.

In southern Europe, where bathing waters are warm and clear and exposed to intense sunlight, there will be few problems in meeting the microbial standards of the new Directive, but, in the north-west of England, where the water is cold and turbid and where there is much less sunshine, compliance will be more difficult and may not be possible. There is little scope for further improving sewage effluent quality, so the main effort will need to focus on preventing agricultural run-off or controlling flocks of wild birds. The latter will be difficult, and a return to the 1960s, when oystercatcher were cannon netted and culled in Morecambe Bay, are unlikely. Efforts are currently underway to help farmers prevent agricultural run-off, for example, by putting buffer strips round fields to catch run-off and by fencing off streams to prevent access by grazing livestock, but it remains to be seen whether this is effective on a large scale. In Morecambe Bay our main hope of compliance rests with climate change and in the words of Morecambe’s favourite son: ‘Bring me sunshine all the while’.

Further reading:
The Health Protection Agency’s Annual Conference took place at the University of Warwick from 15 to 17 September 2008 bringing together more than a thousand health and scientific professionals, including leading experts from across the Agency, and from partner organisations. It provided in-depth presentations on the latest work in key areas of health protection, including vaccine preventable disease, health protection in the global village, cutting edge microbiology and community care acquired infection.

Health Protection 2008

New modelling research presented to the conference confirms that vaccination against chickenpox would significantly decrease the burden of this disease but would lead to more shingles among the elderly.

Albert Jan van Hoek, who performed the research for the Agency, said; “Our models suggest that vaccination would reduce the burden of chickenpox in the young. However, it will lead to an increase in shingles in the medium term in adults because they will not get that ‘boosting’ effect from being in contact with cases of chickenpox.

“There are still uncertainties in the research and a lot more work needs to be done examining whether vaccination will be a benefit to all of the population. Also further work needs to be done on the cost effectiveness of any potential chickenpox vaccine before any policy conclusions can be reached.”

Varicella Zoster is a virus that causes two diseases: chickenpox (mostly among children) and shingles (mostly among elderly). The virus remains in the body after chickenpox and is able to reactivate as shingles later in life. In most cases, chickenpox is a mild illness and around 89 per cent of adults in the UK will develop immunity to the illness. Although a vaccine against the varicella virus (which causes chickenpox) is now licensed in the UK it is not part of UK’s routine childhood vaccination schedule.

Post-vaccination research from countries that routinely immunise their children against chickenpox, including the US, has found an increase in cases of shingles among non-vaccinated age groups.

The Department of Health has commissioned an expert sub-group of the Joint Committee on Vaccination and Immunisation (JCVI) to look at all the scientific and medical evidence on chickenpox vaccines which will provide its recommendation in due course.

The European Commission has funded a research project which aims to determine the feasibility of setting up a rapid alerting system for chemical incidents.

Delegates heard how establishing an EU-wide alerting system for chemical exposures using poisons centre data is a key step towards protecting the public from the accidental or deliberate release of toxic substances.

Following a chemical incident, the speed and effectiveness of the response is a critical factor in reducing any impact on public health. Once developed and implemented, the system would allow EU Member States to communicate with each other instantly about actual or possible chemical releases and, most importantly, to determine the actions needed.

The Health Protection Agency is managing the project in partnership with WHO-Geneva, the poisons centres in Germany, France and Lithuania, and the European Association of Poisons Centres and Clinical Toxicologists.

Warning and informing

Chickenpox vaccination = more shingles
A recent study, one of the first of its kind in Europe, has found that higher temperatures and increases in humidity are associated with an increase in cases of Legionnaires’ disease.

The study by the HPA looks at the association between humidity, temperature and the peak in Legionnaires’ cases over a period of several years including 2006, when there were unusually high numbers - 551 reported cases and 52 deaths, compared with 389 reported cases the previous year.

Kate Ricketts, a scientist specialising in Legionnaires’ disease at the Agency’s Centre for Infections, said: “In this study there appears to be an increase in cases following warm, humid periods; this was especially pronounced during the summer of 2006. The study suggests that the number of cases may be associated with the weather. It remains to be seen what impact the weather will have in the future.”

Temperature is important for the bacteria’s survival and multiplication, which occurs between 20 °C and 45 °C; an optimum temperature can cause a rapid increase in numbers of the organism. As transmission of the bacterium occurs by aerosol, humidity is an important factor in its survival. The longer cells remain viable in an aerosol, the greater the opportunity for susceptible individuals to inhale the bacteria.

The HPA plans further research on the possible effects on cases due to climate change. Studies are also being carried out in other European countries, highlighting the importance of the association between climatic factors and incidence of this disease.

Further information:
www.hpa.org.uk/infections/topics_az/legionella/menu.htm
www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1195733739018

Meningococcal vaccine moves closer

Scientists are moving into the final stages of evaluating a vaccine that could potentially protect against 80 per cent of meningococcal serogroup B strains.

Dr. Jamie Findlow, from the Vaccine Evaluation Unit at the HPA’s North West Regional Laboratory in Manchester, told delegates: “Phases I and II of the clinical trials have been successfully completed, proving that the vaccine is safe and that it stimulates the immune systems of infants when administered at 2, 4 and 6 months of age.”

The serogroup B strain accounts for around 90 per cent of the 1,800 cases of meningococcal infection that are recorded in Britain every year and is responsible for approximately 180 deaths annually.

The investigational vaccine, in development by pharmaceutical company Novartis Vaccines, has been evaluated by the Agency in partnership with the Department of Paediatrics at Oxford University and Gloucestershire Royal Hospital. If further trials achieve the expected results, the vaccine could be ready to be considered for inclusion in the childhood immunisation programme within two or three years.

The Agency’s North West Regional Laboratory also evaluated the successful vaccine that has cut meningococcal group C disease by 95 per cent and saved approximately 500 lives since its introduction in 1999.

Further information:
Information on meningococcal infection is available on:
www.hpa.org.uk/webw/HPAweb&Page&HPAwebAutoListName/Page/1191942172836?p=1191942172836

Reptile pets may pose salmonella risk

Families who keep reptiles as pets may inadvertently be putting young children in the household at risk of acquiring a rare form of salmonella infection.

Dr. Tansy Peters, an expert from the Agency’s Laboratory of Enteric Pathogens, said: “Salmonella arizona is commonly found in the gut of reptiles, with snakes being the largest reservoir of infection. Although it is comparatively rare in humans, a study of samples submitted to our laboratory for testing from January 1998 to December 2007 shows that there has been a significant increase in both numerical and percentage terms that may be a reflection of the increased popularity of reptiles as pets.”

In 1998, 30 human cases of S. arizona were recorded out of 23,134 non-typhoidal salmonellas in England and Wales (0.13 per cent) compared with 55 human cases of 11,943 non-typhoidal salmonellas (0.46 per cent) recorded in 2007.

Reptiles shed salmonella in their faeces and carry it on their skin and the public health implications of this inside the home should not be underestimated.

The Agency’s advice is:
• families with young children should be aware of the health risks associated with having a reptile as a family pet
• pet shop owners should advise their customers of potential risks associated with reptile ownership
• anyone handling a reptile or an object that has been in contact with a reptile should wash their hands thoroughly immediately afterwards
Radiation protection implications of the use of Cone-Beam CT systems in dental practice

In the absence of guidance, there is significant potential for dental cone-beam CT scanners to be used inappropriately exposing patients and dental practice staff to risks from ionising radiation. Andrew Gulson of the HPA’s Dental X-ray Protection Services describes plans to develop and publish guidance for the safe use of cone-beam CT scanners in general dental practice.

What is CBCT?
The Health Protection Agency’s Dental X-ray Protection Services (DXPS), which is based at the Leeds offices of the Radiation Protection Division, has provided radiation protection services to UK dentists for over 30 years. Recently, we have observed the emergence of a new form of X-ray imaging system that is being rapidly taken up by dental surgeons specialising in implant work. At the International Dental Trade Exhibition in Cologne in March 2007, no less than eleven manufacturers of dental X-ray equipment launched cone-beam computerised tomography (CBCT) systems on to the European market.

CBCT technology works in a similar way to the more familiar medical CT scanners, in which an array of X-ray tubes rotates around the patient, who is usually lying on a couch which slowly moves through the equipment. The images, which are essentially of adjacent ‘slices’ through the patient, are then combined using powerful software to recreate any two- or three-dimensional image of the exposed area of the patient that is required. CT scanners are therefore an extremely powerful tool and can provide information that is invaluable to effective diagnosis and treatment planning. Dental CBCT scanners use the same principle, but employ a single cone-shaped X-ray beam which scans the patient’s jaws and perhaps other areas of the head and neck in a single rotation (see the photos below). The patient is more usually seated, as in panoramic radiography, rather than prone. CT scanning technology and its imaging software continues to develop in capability and sophistication, and its use in the UK continues to increase. Of all diagnostic X-ray techniques, however, medical CT scans deliver some of the highest radiation doses to patients.

Doses, risks and how they are controlled
The radiation dose delivered to the patient during a CBCT scan can be significantly higher than from more common dental X-ray examinations, although much less than from multi-slice medical CT scanners. Typical radiation doses from various types of X-ray examinations of the head are shown in the table below.

To put the numbers into context, the average annual radiation dose to a member of the UK population is 2,700 microsieverts. The dose from an intra oral radiograph (1 microsievert) is equivalent to that which would be received from a few days’ exposure to natural background radiation, and carries an additional lifetime risk of cancer of one in a few million. The dose from a dental CBCT scan would equate to a few months’ natural background radiation, or an additional

<table>
<thead>
<tr>
<th>Examination</th>
<th>Typical effective radiation dose, microsieverts</th>
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<tbody>
<tr>
<td>Intra oral “bitewing” radiograph</td>
<td>1</td>
</tr>
<tr>
<td>Cephalometric radiograph</td>
<td>3</td>
</tr>
<tr>
<td>Panoramic radiograph</td>
<td>7</td>
</tr>
<tr>
<td>Dental cone-beam CT scan</td>
<td>100</td>
</tr>
<tr>
<td>Medical CT scan of the head</td>
<td>1000</td>
</tr>
</tbody>
</table>

Table: Typical radiation doses from various types of X-ray examinations of the head
lifetime risk of cancer of about one in a hundred thousand.

The risk to the health of a person exposed to X-rays, as with any other type of ionising radiation, is proportional to the size of the dose they receive and, even at very low doses, it is assumed that there is still a small risk. Because of this, one of the cornerstones of radiation protection is to always ensure that all exposures are justified. This applies as much to medical exposures as to any other. Another important principle is to make sure any radiation exposure is always limited to the smallest necessary for the intended objective; in radiation protection parlance this is referred to as the ALARP principle – keeping doses ‘as low as reasonably practicable’. In the case of diagnostic medical exposures, ALARP means a clinically justified exposure leading to a good quality image that provides a reliable basis for diagnosis, and therefore provides a benefit to the patient that outweighs the small detriment from the radiation exposure. Unfortunately, CBCT technology arrived here in the UK before any guidance was issued about the clinical circumstances under which its use is considered appropriate, or the best ways to use the equipment to keep patient doses ALARP.

Another important factor in the ALARP equation is the need to obtain the maximum diagnostic information from every CBCT scan that is performed. There are difficulties here too as the images obtained from CBCT scans are in a format that is novel to most dentists, implying a need for them to undertake training to be able to use the software to manipulate the image and extract the relevant diagnostic information. Furthermore, CBCT scans will often include anatomical regions and potentially, therefore, health conditions, that are outside the scope of a dentist’s normal undergraduate training, or common clinical experience. At the present time there is no recognised training standard for dentists wishing to use CBCT scanners, indicating a real risk that many patients will not receive the full benefit from their CBCT scans.

Testing of CBCT scanners

In order to achieve the maximum benefit for the patient with the minimum radiation dose, the equipment must, of course, work correctly. Any new item of diagnostic X-ray equipment must undergo a series of radiation safety tests designed to show that it is working as intended by the manufacturer and that it is safe to use for the patient and all other persons, including the operator. These tests must be done before the equipment is first used, and the results compared to the manufacturer’s specification, and any relevant national or international standards. While in regular use, further tests should also be carried out at intervals to ensure that the equipment continues to work correctly and safely, and some of these tests might need to be done by the user at weekly or monthly intervals. Once again, CBCT equipment has yet to be included in the relevant UK guidance. There are currently no recognised standards stating what the tests should comprise of, what the results are expected to be, or how frequently tests should be carried out. Manufacturers also often fail to provide some or even any performance specifications to compare the test results against. This situation is highly unsatisfactory as it is not often possible to state categorically whether or not a new CBCT scanner is performing adequately after installation. Again, this may have implications for the radiation dose received by patients undergoing examinations using the equipment.

Doses to dental practice staff

As already mentioned, the doses received by patients are somewhat higher than from more common types of dental X-ray equipment, and the potential doses to other persons in the practice are also proportionately higher. Current guidance on safe working with dental X-ray equipment, including the shielding requirements for X-ray rooms and many other radiation safety issues, is based on the radiation hazards associated with conventional dental X-ray sets. It follows that, in many cases, a dentist who equips his surgery and updates his working procedures in line with current guidance in readiness for the installation of a CBCT scanner, will not be doing enough to ensure adequate protection for himself and his staff. It is likely that doses to staff working in dental practices may also increase if sound radiation safety advice is not obtained prior to purchasing and installing these systems. As with all planned installations of X-ray equipment, the practice should consult its Radiation Protection Adviser (RPA) to obtain expert advice on the necessary precautions to be taken prior to, and after, installation. However, it is known that only a small minority of dentists with CBCT systems do this.

In conclusion

The current situation leaves a great deal to be desired. In the absence of guidance for dentists, there is significant potential for dental cone-beam CT scanners to be used inappropriately, without recognition of the principles of justification and optimisation of patient exposures. There are also concerns from an occupational safety point of view. These issues are recognised by many UK dental organisations and, of course, by the Radiation Protection Division of the Agency, which has a statutory duty to monitor national standards of radiation protection.

In response, the HPA CRCE Business Plan for 2008/09 sets targets specifically addressing the issues described in this article. DXPS will chair a working party of consultant dental radiologists, practising dentists and other stakeholders, with the objective of publishing guidance for the safe use of cone-beam CT scanners in general dental practice. It is planned that the working party will convene this autumn.

Any queries about the subject should be addressed to the DXPS Technical Manager, Andrew Gulson, at andrew.gulson@hpa.org.uk

Andrew Gulson is the Technical Manager of the Dental X-Ray Protection Service, and a certificated Radiation Protection Adviser. He has worked at the HPA’s Radiation Protection Division (formerly the NRPB) in Leeds for the past 19 years.
Expanding chemical sampling

Andrew Kibble and Toby Smith of the Health Protection Agency’s Chemical Hazards and Poisons Division in Birmingham describe new developments in taking environmental samples to test for risks to public health.

The collection of environmental monitoring data during and immediately following a major chemical incident can provide vital information on human exposure. Such data can allow Agency staff to assess the short and long-term health risks from chemical pollutants. This was clearly demonstrated during the fire at Buncefield oil depot in 2005 (see Figure 1) where data from surface soils and vegetation helped confirm the Agency’s assessment that the fire had not caused widespread environmental pollution (Kibble A J, Smith D J T, Fisher P A, 2006).

During the fire at Buncefield, environmental monitoring teams from the Agency’s Centre for Radiation, Chemical and Environmental Hazards (CRCE) were mobilised to collect surface soils and vegetation for subsequent laboratory analysis for a range of chemicals. Most of the sampling techniques used had been developed for radiation monitoring and were modified during the event to cover a limited range of chemicals. Following Buncefield, CRCE has begun to expand existing capabilities to cover a wider range of chemicals.

Over the past year, CRCE has been expanding its environmental monitoring capabilities with the aim to provide qualitative and quantitative data on pollutant fallout in surface soils and vegetation in the event of a major chemical incident. Six sets of soil and grass sampling kits have been purchased for CHaPD along with equipment to supplement existing facilities within the Radiation Protection Division (RPD) (see Figure 2).

Sampling protocols and operating procedures have also been developed, together with a comprehensive training package for scientific staff. As a result, this ‘standalone’ environmental sampling capability will allow the Agency to mobilise trained sample teams to collect valuable data on chemical contamination of surface soils and vegetation to inform human health risk assessments.

Sampling kit

In the event of a major chemical incident we will be required to collect reliable data quickly. The key principle behind the Agency’s strategy is to equip the responder with sufficient knowledge and equipment to, if necessary, undertake some simple but effective environmental monitoring that may provide information valuable the initial exposure assessment and for any further investigation.

Given existing limitations within the Agency in terms of prior knowledge, provision of training and the need for portable, robust and easy to use equipment, it was decided to focus on simple environmental grab sampling techniques that can allow samples to be then transported to laboratories for analysis and interpretation. A grab sample is a discrete sample taken from one specific sampling location at a specific point in time. For emergency field situations, grab sampling is a viable option as it can minimise the amount of time staff will spend in potentially hazardous situations and reduces the amount of specialised training required. Grab samples also have the added benefit of being easy and simple to collect, are low cost, require minimal resources and should be relatively easy to transport. Grab samples also identify contamination at a specific point or location that can be investigated later in more detail by a more specialist monitoring team.

Paramount in developing the toolkit was the need to provide, when possible, equipment that is easy to operate when wearing field safety or PPE kit, and which required minimal training. At no point will Agency staff be expected to enter hazardous environments such as hot zones as part of the risk assessment or field investigation process.

The collection of environmental samples requires staff to have a comprehensive understanding of the capabilities and limitations of

![Figure 1: Collection of soil samples](Photo: HPA)

![Figure 2: Soil Samplers](Photo: HPA)

![Figure 3: Augering of soil samples](Photo: HPA)
the sampling equipment, and of the criteria on which suitable locations for sampling are chosen. CRCE has been running theoretical and practical ‘hands-on’ training sessions that aim to ensure that staff understand the rules of good sampling practice, use the correct method to collect each type of sample, and understand the need for a clear audit trail.

The importance of good site selection is emphasised because an inappropriate sample will give unreliable data. For example, sample sites should be avoided that have a large amount of dead material, are waterlogged or flooded, have been trampled or heavily disturbed, are in close proximity to main roads or obvious sources of pollution, or are close to to tall sheltering vegetation or buildings. A sampling protocol has been written together with specific Standard Operating Procedures covering site selection, sample collection, storage, labelling and transport.

**Tools**

Sample collection and storage will broadly follow Defra guidance (Defra, 1999) together with methodologies developed by CHaPD and RPD for chemical and radiation monitoring of soil and herbage.

The sample kit includes a series of hand-held auger sets for each soil type, such as clay, sand, silt, peat, chalk and loam (see Figure 2, 3 and Box 1); this equipment can provide consistency with respect to soil sample depth and size. The kit also includes trowels, shears, measuring tapes, a portable global positioning system and a camera.

To ensure sample integrity, a variety of sample containers have been purchased including glass Kilner jars, plastic containers and bags. As a general rule, glass containers are appropriate for most samples of soil and water because they are chemically inert to most substances, although some metals may adhere to the sides of glass containers. However, since glass jars and containers can also present handling and transport problems, the kit also contains polyethylene and polypropylene plastic bottles. These are suitable for many substances, although not volatile organic compounds (VOCs), since plasticisers from the container may leach into the sample and VOCs may be absorbed from the sample onto the bottle. Both the glass and plastic containers have tight fitting, air tight, Teflon lined screw top lids to prevent the loss of VOCs and the ingress of ambient air that may, for example, oxidise the sampled pollutants.

Cool boxes will be used for storing samples on-site and during transport, since all samples must be kept cool on-site, during all transport and at base before transport to the laboratory. The samples will then be transferred to and stored in a refrigerator at base and the analytical laboratory within 48 hours of collection.

**Sample Collection**

The sampling protocol also includes guidance on sampling strategies. Sampling will target three main areas:

1. the predicted point of ground-level pollutant maxima using available plume dispersion models (such as ADMS, AERMOD or NAME)
2. areas with documented visible plume at ground level or where there is evidence of ground level pollution (soot, debris, etc)
3. visually assessed grounding of localised plume around the source. Particular emphasis will be placed on sampling at priority ‘sensitive’ sites such as schools, housing estates, parks, playing fields, nurseries and allotments.

**Conclusion**

The HPA can now respond to major chemical incidents by rapidly deploying scientists to gather key data on environmental contamination from a range of inorganic and organic chemicals. This capacity allows the Agency to have its own in-house environmental monitoring capacity. Procedures have been developed that provide sampling guidelines for our monitoring teams. These guidelines enable the teams to sample at the right locations, with the correct frequency to ensure the effective assessment of potential sites following major chemical incidents.

Andrew Kibble is head of CHaPD Birmingham which covers the North West and West Midlands Regions. He has worked in the field of Environmental Risk Assessment for over 15 years and has been a consultant to industry, Regulatory Bodies and both local and national government. He is also an Honorary Lecturer at the University of Birmingham.

On completing his PhD in Environmental Chemistry at the University of Birmingham, Toby Smith undertook postdoctoral research investigating the transmission of organic pollutants through the terrestrial and aquatic food chains. After working as an environmental consultant Toby joined the HPA and is currently Principal Environmental Scientist at CHaPD Birmingham. He is also an Honorary Postdoctoral Research Fellow at the University of Birmingham.

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Molecular diagnosis in clinical microbiology

Molecular diagnostics is the fastest growing area of the in-vitro diagnostic market, says Melvyn Smith, principal clinical scientist at HPA London. The future promises further exciting developments.

At the heart of molecular diagnostics lie techniques based on the central dogma of information flow in cell biology, from DNA to RNA to protein synthesis. As a consequence of the rapid developments and the vast amounts of information obtained, a necessary development in computer-based bioinformatics has followed. Molecular diagnostics is the fastest growing area of the in-vitro diagnostic market. In 2002, some 30-40 million molecular tests were carried out in the USA alone. Molecular biology techniques have already revolutionised clinical laboratory diagnosis (Read SJ, Burnett D, Fink CG, 2005).

One concern, particularly in virology, is the replacement of culture methods for isolating and detecting organisms by molecular tests. Thus, follow-up for public health purposes is limited because characterisation of the organism cannot be carried out without the viral isolate. From a purely diagnostic point of view, these concerns are largely unfounded. Virus culture suffers from poor turnaround times and poor negative predictive values. It is prone to contamination with non-target viruses, mycoplasma and fungi (Carman W, 2001).

Molecular methods are rapid, sensitive and can provide reliable results. With an accurate, early result, effective treatment can be planned, and with quantitative polymerase chain reaction (PCR) assays, the response to treatment monitored. Furthermore, with sequencing assays, e.g. HIV-1, resistance to a particular treatment can be monitored and a more appropriate one substituted.

The potential reduction in drug costs is an important consideration when the funding of molecular assays for the health service is being considered. And, where cell culture is impossible (e.g. HIV and hepatitis C virus), molecular tests are the only practical alternative. Another claim for viral culture is that it is a ‘catch-all’ technique, allowing novel viruses to be identified, assuming they will grow in culture. In fact, molecular techniques have been instrumental in finding new viruses. Representational difference analysis led to the discovery of a new human herpes virus (HHV8) associated with Kaposi’s sarcoma, and screening cDNA libraries made from diseased tissues led to the identification of hepatitis C and G viruses.

More recently a novel, random PCR approach has shown promise as a method for characterising virus isolates that test negative for all expected viruses (Stang A, Korn K, Wildner O, et al., 2005). Given that a third or more of patients with clinical symptoms of lower respiratory tract infections, an etiological agent cannot be identified, molecular methods will play an even more significant role in characterising the causative agents in the future.

Where are we now?

Fundamental to molecular diagnosis is the ability to detect nucleic acids from an infectious organism. While protein analysis plays a significant role in molecular techniques, and with the advent of the ‘proteomics era’, will play an even more significant role, the scope of this article does not permit a detailed description of all these methods. Therefore, a number of the most commonly used DNA/RNA-based techniques will be described, together with some newer and future developments.

Polymerase chain reaction

In terms of its impact on microbial diagnosis, one of the most significant developments has been the PCR. Early assays required amplification on solid block thermocyclers and analysis by agarose gel electrophoresis. With respect to assay specificity, analysis often incorporated hybridisation using a sequence-specific probe, with some form of detection system, radioactive or chemiluminescent. This is time consuming - around two days - and with the number of separate manipulations involved, prone to technical errors and contamination.

But recent developments in fluorescence monitoring of rapid DNA amplification have led to real-time PCR, which is now beginning to replace block-based systems. The PCR is carried out using the same basic reagents, but is monitored by fluorescent DNA-binding dyes or fluorescently labelled, sequence-specific probes. This, combined with much faster, computer-controlled thermocyclers that automatically analyse the reactions, produces results in less than 50 minutes.

The significant advantage with real-time PCR lies in the use of fluorescently labelled probes which monitor the PCR and confirm the target amplified in the same closed tube, minimising the risk of contamination. Numerous probe-type assays exist, including TaqMan, molecular beacons and adjacent hybridisation probes, all with their own advantages and disadvantages. TaqMan chemistry is arguably becoming the norm, because of its simplicity, just a short probe (ca. 20 nucleotides) with a fluorescent reporter dye at the 5’ end and a quencher at the 3’ end (Figure 1).

One drawback with TaqMan probes is that their design - the entire probe is degraded by the end of the PCR - prevents them from exploiting another very useful feature of real-time PCR, i.e. melt curve analysis. However, this can be achieved using other types of probes, for example, adjacent hybridisation probes. These consist of two oligonucleotides, which when hybridised, lie next to each other on their target strand, separated by approximately 3-5 DNA bases (Figure 2).
At the end of the PCR the reaction is cooled, allowing all the double stranded molecules to hybridise and fluorescence is at a maximum. The mixtures are slowly heated to 95 °C and at a specific temperature the level of fluorescence dramatically falls; characteristic of specific template-probe combinations (the melting temperature or Tm). This can be used to analyse mutations or identify subtypes of pathogens and is capable of detecting a one or two DNA base mismatch between probe and target.

During the PCR, fluorescence is proportional to the amount of DNA synthesised, which in turn is related to the amount of starting target nucleic acid. Reactions can be made quantitative by amplifying a range of external, log-diluted DNA standards to produce a standard curve. By comparing fluorescence levels in the original sample with the standard curve, the copy number can be calculated, useful in monitoring pathogen load in response to therapy.

**Development of in-house assays**

As PCR technology develops, more thermocyclers are becoming available, importantly with an increasing number of fluorescent channels. By using mixtures of primers for each target and specific probes with non- overlapping fluorescent dyes attached, multiplex assays can be developed, capable of detecting a greater number of pathogens in a single reaction.

There are a number of commercial kits available for numerous microbial pathogens, including varicella zoster virus, herpes simplex virus 1&2, Epstein-Barr virus, influenza A (including H5), Chlamydia trachomatis and Mycobacterium tuberculosis. The technology also lends itself to development of in-house assays, with a considerable financial saving and allows the user to trouble-shoot more easily if things go wrong.

Since the 1980s a number of companies have developed alternative amplification techniques for high throughput applications which do not rely on the PCR. The ligase chain reaction (Abbott Laboratories) uses a thermostable ligase to join two oligonucleotides together when they are hybridised to their target sequences. This can be exponential because each round of synthesis is capable of doubling the number of target molecules. Nucleic Acid Sequence Based Amplification (NASBA), developed by Organon Teknika, is an isothermal process without the need for thermal cycling and is particularly suited to detecting RNA viruses because it removes the need to produce a cDNA intermediary by using RNA polymerase for direct amplification. Signal amplification techniques, such as the Versant HIV-1 viral load assay (Siemens), rely on amplifying the signal generated by the probe binding to its target, rather than amplifying the target itself. This works by having a number of target probes which bind to different regions of the HIV-1 pol gene, to which numerous amplifier probes bind, forming a branched DNA complex, detected by chemiluminescence.

However, none of these techniques exhibit the specificity and simplicity of the PCR. Significantly, Roche’s foundational PCR process patents expired in the US in March 2005 (one year later in the rest of the world). This is likely to ensure PCR’s importance in the molecular diagnostics market.

**DNA sequencing**

Sequencing is proving to be an invaluable diagnostic tool. The ability to ‘read’ the nucleic acid sequence of a pathogen is considered by many to be the diagnostic gold standard. Not only is the pathogen’s presence demonstrated, but drug resistance mutations and epidemiological data are also provided. Drawbacks have been the high cost of equipment and the time taken in training staff to carry out sequencing assays. However, recent developments leading to various degrees of automation with plate and capillary sequencers, together with kit-based reactions have significantly reduced these difficulties. A number of laboratories now run routine drug resistance screening for HIV-1 infections and further commercial developments will undoubtedly follow. Nevertheless, even with the fastest automated capillary sequencers, it can take up to 24 hours to analyse 96 samples. Pyrosequencing is an interesting recent development.
Despite the complexity of the enzymatic reactions, pyrosequencing is easier to perform than previous methods, because there is no need for gels, dyes and template clean-up steps. Pyrosequencing is faster than conventional methods, capable of ‘reading through’ regions of difficult secondary structure and is particularly suited to short read lengths, such as single nucleotide polymorphisms (SNPs) and Tag sequencing. In Tag sequencing, a sequence length of approximately 30 bases (the ‘Tag’) is all that is required to unequivocally identify a gene derived from a complex organism.

Using high throughput pyrosequencing it is possible to analyse a microtitre plate of 96 such samples in around one hour, potentially a very useful diagnostic technique. At the moment, pyrosequencing is limited to short read lengths, however, through the development of new enzyme and buffer systems, it will be capable of reaching 2000 bases in a single reaction.

**Microarrays**

Perhaps the single most important molecular development has been the dramatic increase in the use of microarray or chip technology. This can be applied to both nucleic acid and protein screening, and it has the major advantage of allowing large scale sequence interrogation, only limited by the number of probes immobilised on the chip. Early work on genetic screening has also seen a rapid extension of this technology into other applications relevant to molecular diagnostics (Stevens J, Blixt O, Glaser L et al., 2006).

Microarrays typically consist of a number of DNA spots or probes, bound to a solid substrate, such as glass. The spots represent fragments of the different genes under investigation. Each gene spot in the array matrix contains millions of identical copies of the same sequence, at a known location. Nucleic acid from the sample is amplified, or in the case of RNA, reverse-transcribed into complementary DNA (cDNA) and labelled for subsequent detection, typically by fluorescent dyes. The labelled target is hybridised to the array and any complementary sequences bind to the immobilised probe(s) on the slide. Because the location and identity of each probe is known, the target can be identified. Expression arrays are screened with cDNA from a sample, and the level of fluorescent signal will give an indication of up (or down) regulation. This could be important in distinguishing between new infection, carriage and reactivation, and therefore crucial in determining a course (or progress) of therapy and also identifying potential therapeutic targets.

In exploiting the parallel capabilities of the technology, arrays can be made containing both pathogen and host sequences, allowing interactions to be monitored. As the various associated aspects of the technology have developed, whole genome arrays are now available, allowing an enormous amount of expression and DNA analysis data to be generated from a single experiment. The technology is also very applicable to high throughput automation, making it ideal for diagnostic use; indeed a number of commercial and academic collaborative studies are working toward rapid, point of care array testing.

Some aspects of nucleic acid expression array technology may itself be replaced by protein expression arrays, which enable gene actions to be studied directly. Currently there are still some difficulties in arraying functional, correctly folded proteins and much of the technology is at proof of concept stage. However, the diagnostic value is shown in a recent publication describing a glycan microarray analysis of haemagglutinins from modern and pandemic influenza viruses and their receptor specificities (Stevens J, Blixt O, Glaser L et al., 2006). The results showed that with the array, changes in receptor specificity could be quickly monitored and correlated with mutations in receptor binding sites to aid in prediction of new pandemics or epidemics.

Array technology has also been applied to DNA sequencing. Sequencing by hybridisation exploits the degree - and hence signal strength detected - to which different oligonucleotide probes bind their target DNA, with such specificity that a single base difference can be detected. The technology has developed to such an extent that it is now possible to sequence whole genomes in a single experiment. Conventional sequencing strategies are expensive in cost, time and labour, with array-based sequencing, a single operator can resequence up to 300kb of a genome within 48 hours, with minimal amplification of the genomic target sequence.

This next generation of assays is moving toward single molecule sequencing, removing the need to amplify/prepare DNA prior to sequencing. One method is based on engineering both polymerases and dNTPs to act as molecular sensors of DNA base identity in a real-time format. This is a commercial development that, once established will, it is claimed, make it possible to read one million bases per second per machine (Bonetta L, 2006).

The mass and charge properties of nucleic acids are being exploited in nanosequencing. As a DNA strand passes through a tiny pore (the nanopore), different base pairs obstruct the pore to varying degrees, causing measurable variations in the pore’s electrical conductance. This produces a unique electronic signature for each base as it passes through the detection pore enabling the sequence to be determined.

**Comprehensive molecular diagnosis**

Ultimately proteins do all the work of the cell and it is their interactions that dictate all its biological processes. Once the role that these proteins play in the intricate pathways developed during an infection is understood, new clinical opportunities will be created, because these pathways will also indicate drug targets. There is no doubt that in the future these developments will have a profound impact on the way microbiology laboratories are organised, with the traditional virology, bacteriology and fungal specialties being merged into one diagnostic service. Furthermore, array technology will allow the development of ‘point of care’ chips that can identify, very specifically, not only the infecting pathogen and its strain, but also its drug sensitivity profile and the patient’s prognosis. It is this combination of speed, sensitivity and specificity that array technology can offer that may well bring about the era of true patient-tailored therapy.

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**References**


Melyn Smith is principal clinical scientist at HPA London, based at King’s College Hospital Foundation Trust. He obtained his PhD at King’s College, University of London, in molecular biology, working on the laccase enzymes of the commercial mushroom Agaricus bisporus. His current work focuses on developing rapid diagnostic tests for diagnosing infectious diseases using a combination of real-time PCR and sequencing. Further interest is centred on gene-expression in the development of infectious diseases, particularly in Epstein-Barr virus-driven post transplant lymphoproliferative disease and invasive pulmonary aspergillosis.
The tidal stretch of the River Thames has long had an iconic status in British culture. It connected the royal palaces of Whitehall and Hampton Court; it flows back and forth before the mother of Parliaments; it links the United Kingdom’s seat of government with its focus of wealth creation in the City of London.

While the river may now have lost most of its formerly teeming commercial traffic, its recreational use has never been greater. Traditionally that recreation has always been competitive rowing, and the best known surviving example is ‘The Boat Race’. Why two quite far off universities decided in 1829 to have an annual race on the Tideway is not known, but the contest continues to attract a worldwide following, and has served to encourage year round participation in the sport on the Thames. Along the 9 km stretch above Chelsea Bridge there are now 26 rowing clubs with about 1500 active members; several times more people exercise less formally on that part of the Tideway, whether boating, fishing, or simply living on barges on the river.

The question the HPA, in collaboration with the City of London, as the London Port Health Authority, has recently set is what, if any, disease risks these river users run, bearing in mind that the river serves other functions possibly inimical to recreation. The physical hazard of collision between racing boats and commercial or passenger river traffic is probably less than it formerly was. Not so, though, the risk of contamination from sewage treatment and other outfalls, which is constant. The 9 km of river being studied by the Agency has seven combined sewer outfalls - whence excess rainfall causes intermittent discharges - and 3 km further upstream there is at Mogden a major sewage treatment works. The latter continually releases treated effluent into the river. Because of the flux of water up and down stream with the tide, clearance is not as constant as it would be in the case of an inland river.

Weekly water sampling
Regular monitoring of the microbiological quality of Thames water has in fact been in place for many years and continues to be done by the HPA. In the “Thames Recreational Users Study”, however, extra weekly water sampling took place from January 2005 to March 2006. To determine if human enteric viruses were present ten litre samples were concentrated to 10 millilitres which were then mixed with BGM cells in agarose. Any virus plaques present were analysed using polymerase chain technology.

The results of those investigations may be summarised by saying that except during two periods in March and October 2005 that coincided with episodes of heavy rainfall, bacterial and virus isolates were within expected limits for this type of river at all of the three sampling points - Kew, Barnes and Putney bridges. Nevertheless, concentrations of microbiological indicator organisms exceed the World Health Organization (WHO) recommended levels for recreational use at these sampling points. During the two periods of unusually high rainfall an up to tenfold increase in concentration of enteric bacteria and viruses was noted.

The question that remains to be answered is what if any significance for humans these findings have. To attempt to answer that question, members of rowing clubs have been asked to keep ‘illness’ diaries and to relate these to their use of the river. The analysis is not yet complete and will have to be seen against the background community incidence of gastrointestinal and other illness in the same age group.

Reassuringly, the investigations found that, as has been found in comparable surveys of river water sports elsewhere, any risk is modest and can largely be removed by simple precautions, e.g. ‘don’t swallow river or splash water’; ‘don’t eat or drink on the vessel’; ‘avoid, if possible, total immersion’.

It therefore seems that the time-honoured custom of the winning Boat Race crew throwing their cox into the river should be reassessed.

Analysis of the data from this study is complete and a report has been produced and will in due course be submitted for publication in a scientific journal. Jane Sellwood, Suzanne Surman-Lee and Chris Lane are to be thanked for this opportunity to preview their work.
Close to eradication

Communicable diseases claim more than 15 million lives a year with over 80 per cent of these deaths occurring in developing countries. Reversing communicable disease epidemics is one of the Millennium Development Goals, and progress is being made.

Ask anyone in which country the world’s last victim of smallpox died and they are unlikely to choose England.

But 30 years ago a medical photographer died in Birmingham, weeks after being infected with the virus. She had been working in a room above the smallpox laboratory at the University Medical School, which had been earmarked for closure within months because of safety concerns. The incident claimed a second life - the head of smallpox research committed suicide. Thousands of people in Birmingham were immunised as a precaution. It was an unexpected reminder of a deadly and ancient scourge.

The disease provided the stimulus for one of the great advances in medicine - it was the subject of the first ever vaccine. In 1796 Edward Jenner, a doctor in Gloucestershire, discovered that immunity to smallpox could be produced by inoculation with the mild related infection of cowpox. He was testing the theory that since milkmaids rarely got smallpox, perhaps cowpox gave them some protection.

It took nearly 200 years for the disease to be finally eradicated. In 1980, the World Health Organization declared that the planet was free of smallpox. After the success of smallpox eradication global health officials were confident other diseases would follow. Like smallpox, polio and measles do not infect animals, so once they are wiped out in humans the viruses related infection in Nigeria and three other countries - in part due to opposition to immunisation.

There is some good news on the horizon. Guinea-worm disease - a parasitic infection looks close to eradication. This will not be the result of vaccination but through filtering the infected fleas out of drinking water.

Guinea-worm disease is a debilitating and painful infection caused by a large nematode (roundworm), Dracunculus medinensis.

The disease is transmitted exclusively by drinking stagnant water contaminated with tiny water fleas that carry infective guinea-worm larvae. Inside the body, the larvae mature into worms, growing up to one metre in length. Since the peak transmission period often coincides with the agricultural season, fields are left untended and food production levels fall. In Mali, guinea-worm disease is called “The disease of the empty granary”

At the beginning of the 20th century, guinea-worm disease was widespread in many countries in Africa and Asia with an estimated 50 million cases in the 1950s. Due to concentrated efforts by the international community and endemic countries, the number of cases was reduced to about 96,000 by 1999 when it was prevalent in only 13 countries in Africa.

Specific interventions include: health education, case containment, community-based surveillance systems, provision of safe water, including use of filtering devices and treatment of ponds with a pesticide that kills the water fleas and health education on disease prevention. Health education about the disease is a key responsibility of village volunteers. They convince infected people to stay away from drinking water sources until worms are fully extracted, and explain how to use cloth filters to make drinking water safer. There remain now five African countries with endemic disease.

MMR vaccine

A study conducted by the Health Protection Agency has confirmed that the measles component of the MMR vaccine is highly effective in preventing measles infection.

Analysis of laboratory confirmed cases of measles estimated that one dose of MMR vaccine provides over 95 per cent protection against measles, whereas two doses provide almost 100 per cent protection. This confirms that the current UK policy is highly effective and that the main reason for the recent increase in measles is failure to vaccinate, rather than vaccine failure.

The study looked at surveillance of laboratory confirmed cases of measles between 2002 and 2007. During this time there were 1,794 laboratory confirmed cases of measles reported in children eligible for MMR vaccine. Cases from communities where vaccine uptake is known to be low were excluded as they are not representative of the general population. Of the remaining 786 reported cases of measles, 730 (93 per cent) of those affected had received no MMR vaccine at all, 50 (6 per cent) had received one dose, and only six cases (1 per cent) had received two doses of the vaccine.

In January to March 2008, uptake of the MMR vaccine in the UK reached 84 per cent for the first dose but was only 76 per cent for the second dose. This study reinforces the need for children to receive both doses of MMR vaccine to ensure optimal protection against measles infection. It confirms that the effectiveness of the measles component of the MMR vaccine is similar to that shown in the early clinical trials of measles vaccine.

MMR vaccine was introduced in 1988 to protect children against measles, mumps and rubella. Measles is highly infectious; in community settings such as schools and colleges, the infection can spread easily. The 2007 total of 990 laboratory confirmed cases was the highest recorded since the current method of monitoring began in 1995.
More antibiotic development needed

The Health Protection Agency is warning about the need for new antibiotics to be developed to ensure the range of treatment options for some infections does not run out.

Alongside new development, other crucial factors in tackling so-called ‘superbugs’ include more careful prescribing, better infection control, and general awareness among the health profession and public about appropriate antibiotic use.

The news about antibiotic resistance is a mixed picture. The good news is that there are more treatment options available for what are called Gram-positive bacteria, for example with MRSA there are several antibiotics to choose from and a number of new options in the advance stages of development.

Gram-negative bacteria

The picture is not so good, however, with another group called Gram-negative bacteria. For example with acinetobacter there is sometimes only one treatment option available to doctors and in some rare situations Gram-negative bacteria can cause infections that are untreatable. These multi-resistant Gram-negative bacteria often cause infection in particular patient groups who are very sick such as those in intensive care units or those with chronic lung infections. This is a particular problem with pseudomonas and burkholderia in cystic fibrosis patients.

The fight against drug resistance is an ongoing battle because many bacteria constantly mutate, gaining resistance to current antibiotics in the process. This is what has been happening in recent years to the likes of E. coli, which can cause a range of symptoms from mild diarrhoea to abdominal cramps and kidney damage. HPA data show that there are about 20,000 bloodstream infections of E. coli each year - although the true level of infections would be much higher if urinary tract infections were taken into account. Of these, 12 per cent show signs of resistance - up from about 4 per cent at the turn of the century.

The infections are mostly not yet resistant to all forms of antibiotics but doctors have to use back up drugs, which tend to have more side effects and raise the prospect of the widespread emergence of a new strain which is totally antibiotic resistant.

Precious resource

Dr David Livermore of the HPA said: “Antibiotics are a precious resource in fighting infections and one that we must do everything possible to preserve. This is why we need to ensure there is a constant range of options under development. Health professionals also have a key part to play in ensuring the antibiotics we currently have are put to best use. Sensible prescribing is critical in keeping resistance at bay, and this is of particular relevance where a wide range of antibiotics are used in hospitals to protect vulnerable patients against infection. Patients can also play their part by being aware of the problem of resistance and not expecting antibiotics as treatment for themselves or their relatives if doctors do not recommend them.

“Over the last ten years the pharmaceutical industry has significantly invested in antibiotic treatments for bacteria such as Staphylococcus aureus, including MRSA. There is however a big public health threat posed today by multi-resistant Gram-negative bacteria and there is an urgent need for the pharmaceutical industry to work towards developing new treatment options to tackle infections caused by these bacteria, in the same way as they did for bacteria like MRSA.

“"It is a fact of life that bacteria will always try to find a way to survive and develop resistance. Resistance is also part of the price we pay for advances in medical technology and being able to keep sick patients alive for longer. We can try to minimise this problem by ensuring antibiotics are used sparingly and that a range of new treatment options is in development.”

Professor Peter Borriello, Director of the Agency’s Centre for Infections, said: “Our monitoring of antibiotic resistance patterns is enabling us to tackle the problem head on, giving us advance sight of the issues that are likely to emerge in the future. This is vital, alongside the continued research and development into new treatments for infections and initiatives to raise awareness among health professionals and the public about appropriate use of antibiotics.”

The problem of antibiotic resistance is likely to remain with us for the foreseeable future. Efforts to control the problem will be long and complex but these efforts are already underway.

Further information: For further information about antibiotic resistance view the Agency’s latest report on this topic at: www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1216798080755
DIARRHOEA AND VOMITING – a comedy illness?

Sarah J O’Brien, Professor of Health Sciences and Epidemiology at the University of Manchester, argues that viral gastroenteritis is no joking matter.

It is tempting to write off diarrhoea and vomiting (D&V) as a ‘comedy illness’. After all, to use that hackneyed phrase, “There’s a lot of it about”, and the commonly held view seems to be that it is at worst unpleasant or inconvenient, and that it does not kill people.

Wrong! Diarrhoeal disease ranks third among the leading causes of mortality from infectious diseases worldwide, and is the second biggest killer of children globally (WHO 2002). Furthermore, its perception as a trivial illness poses perhaps the greatest challenge in seeking to develop a robust estimate of the total disease burden (O’Brien, 2008).

Is there really a lot of it about?
In the United Kingdom in the winter of 2007/08 norovirus infection, probably the leading cause of acute D&V, hit the headlines in a big way. Estimates of the numbers of people affected over Christmas 2007 reached 3 million (Smith, 2008).

So what is it that prompts us to play down the importance of D&V in general, and of viral gastroenteritis in particular?

One reason is that our current methods of surveillance militate against a proper understanding of the population burden of norovirus. The laboratory-based surveillance of gastrointestinal pathogens, which works fairly well for understanding the burden of bacterial gastroenteritis when combined with the assessment of under-ascertainment derived from the Infectious Intestinal Diseases (IID) Study (Wheeler et al., 1999), sheds a distorted light on the community burden of norovirus infection. Norovirus manifests itself most clearly as outbreaks, whereas the IID Study emphasised sporadic cases of gastrointestinal infection not outbreak-related cases.

Furthermore, the IID sampling frame did not include settings in which norovirus was likely to be most burdensome. Estimates from the IID Study in England suggested that for every case reported to national surveillance, there were over 1,500 in community outbreaks, and working out the community burden of norovirus is not as simple as multiplying laboratory surveillance data by an estimated under-ascertainment based mostly on sporadic cases.

The importance of norovirus has been better shown in a recently completed study that examined the diagnostic gap in the IID Study through the use of molecular methods (Amar et al., 2007). Thirty six per cent of the samples from cases were positive for norovirus; but so were 16 per cent of the control samples!

Winter vomiting: summer too!
Like its respiratory cousin, influenza, seasonal norovirus activity is highest during the winter, and new virus variants spread extremely rapidly (Lopman et al., 2008). Unlike influenza, however, norovirus does not necessarily disappear during summer (Lopman et al., 2003a). It is ironic that at the time of year when everyone becomes frantic about whether or not influenza might lead to hospital wards being shut, norovirus outbreaks are leading to hospital ward closures. In an active surveillance study of 227 outbreaks in south-west England, (Lopman et al., 2004) showed that gastroenteritis outbreaks cost the NHS about £115 million.

The blame game
Norovirus outbreaks tend to cause the greatest disruption in closed and semi-closed settings like hospitals and nursing homes. And what is our response? We play the hospital-community blame game. We argue endlessly about which side is at fault, the arguments running something like this: “This hospital outbreak would not have happened if we had not admitted a case from the community” versus “Our nursing home outbreak would not have happened if we had not accepted this patient from the hospital”.

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The importance of norovirus has been better shown in a recently completed study that examined the diagnostic gap in the IID Study through the use of molecular methods (Amar et al., 2007). Thirty six per cent of the samples from cases were positive for norovirus; but so were 16 per cent of the control samples!

Winter vomiting: summer too!
Like its respiratory cousin, influenza, seasonal norovirus activity is highest during the winter, and new virus variants spread extremely rapidly (Lopman et al., 2008). Unlike influenza, however, norovirus does not necessarily disappear during summer (Lopman et al., 2003a). It is ironic that at the time of year when everyone becomes frantic about whether or not influenza might lead to hospital wards being shut, norovirus outbreaks are leading to hospital ward closures. In an active surveillance study of 227 outbreaks in south-west England, (Lopman et al., 2004) showed that gastroenteritis outbreaks cost the NHS about £115 million.

The blame game
Norovirus outbreaks tend to cause the greatest disruption in closed and semi-closed settings like hospitals and nursing homes. And what is our response? We play the hospital-community blame game. We argue endlessly about which side is at fault, the arguments running something like this: “This hospital outbreak would not have happened if we had not admitted a case from the community” versus “Our nursing home outbreak would not have happened if we had not accepted this patient from the hospital”.

Sarah J O’Brien, Professor of Health Sciences and Epidemiology at the University of Manchester, argues that viral gastroenteritis is no joking matter.
To play this game of ping-pong is to miss the point. Genotypes of norovirus causing outbreaks in hospitals seem to be different from those in the general community, suggesting that nosocomial outbreaks are not simply an amplification of a pre-existing community infection (Koopmans et al., 2000; Lopman et al., 2003a; Callimone et al., 2005).

Moreover, the supposition that multiple outbreaks within the same institution are linked is not necessarily borne out by the evidence when transmission patterns are examined systematically using molecular epidemiological tools (Lopman et al., 2006). Hospital design and intensity, and diversity of use appear to militate against containment of norovirus infection; and rates of gastroenteritis outbreaks are higher in larger care units and those with higher throughput (Lopman et al., 2004).

How do we stop spread?
This is the crux of the problem with D&V, and many of the control measures are generic. “Wash your hands after going to the toilet and before preparing/eating food” is hardly the sexiest prevention message; yet it is a measure that works (Ejemot et al., 2008). What is becoming clear, though, is that the ways we promote hand hygiene as an intervention lack conviction (Mah et al., 2008).

Tackling the environmental and person-to-person transmissions associated with norovirus outbreaks is challenging. Lopman and colleagues (2004) showed that norovirus outbreaks were contained much faster when units were swiftly closed to new admissions. It would be interesting to know how many hospital infection control teams have been able to use their knowledge of this to influence managers at the start of an outbreak. Martin and colleagues (2007) have shown that when rapid, enhanced, infection prevention and control measures are implemented to reduce the effects of norovirus outbreaks it has the additional benefit of reducing Clostridium difficile infection.

Action in the community
Control of spread in settings outside hospitals is also possible. In a randomised controlled trial of multifactorial interventions, including the use of hand sanitisers and surface disinfectants, Sandora and colleagues (2008) demonstrated a significant reduction in absenteeism in schoolchildren due to gastrointestinal infection. Norovirus was found less frequently on surfaces in intervention classrooms compared with control classrooms (9 per cent vs. 29 per cent).

Similarly, rigorous handwashing, environmental disinfection and temporarily restricting food handlers’ food preparation activities are needed to prevent outbreaks on board cruise ships (Laurence, 2004). Widespread norovirus outbreaks can occur on cruise ships even with appropriate environmental control programmes, but passengers who washed their hands before meals were protected from becoming cases of norovirus infection during a cruise in Alaska (Chimonas et al., 2008).

A vaccine against norovirus?
The prospects for a vaccine might seem like a long way off, but developments with plant-based vaccines are starting to look promising (Tacket, 2007; Santi et al., 2008). In the meantime, applying what we already know to control norovirus infection would be a great start. The remedy is to some extent in our own hands!

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BMC Infect Dis. 6: 108.
Radon, tobacco and lung cancer – the significance of smoking cessation programmes

To assess whether smoking cessation campaigns make significant contributions to radon risk reduction on their own, preliminary assessment has been carried out amongst clients of the smoking cessation services in Northamptonshire, with the risks of individuals developing lung cancer being assessed from knowledge of their age, gender and smoking habits, together with the radon levels in their homes.
Domestic radon levels in parts of the UK are sufficiently high to increase the risk of lung cancer among the residents of affected homes. In Northamptonshire, a designated radon Affected Area with 6.3 per cent of homes having annual average radon levels exceeding the UK Action Level of 200 Bq m$^{-3}$, campaigns to encourage householders to test for radon, and then to carry out remediation in their homes, have been only partially successful.

Although some 40 per cent of Northamptonshire houses have been tested to date, only 15 per cent of those householders finding raised levels have proceeded to remediate their homes. Of those who have remediated, only 9 per cent were smokers, compared to a countywide average of 28.8 per cent. During 2004/05, the NHS smoking cessation services in Northamptonshire assisted 2,808 smokers to quit to the 4-week stage, with some 30 per cent of 4-week quitters continuing to abstain after one year.

Initial assessment suggests that, overall, smoking cessation programmes appear to have significant added value in radon affected areas, and potentially contribute a greater health benefit, in terms of life-years lost to lung cancer, than reducing radon levels in the smokers’ homes whilst they remain smokers. A questionnaire-based study of 12-month quitters, addressing their reasons for seeking help in quitting smoking, has confirmed that knowledge of radon risks plays a minor role in influencing this decision, the direct health risk of smoking playing a much more significant role.

**Tobacco and lung cancer**

Although medical evidence of the harm done by smoking has been accumulating for more than two centuries, it was only the recognition in the mid 20th century of the correlation between cigarette (rather than pipe) smoking and lung cancer incidence that led to the commencement of serious studies (Doll R et al., 2004). Epidemiological evidence indicates that the tobacco-induced excess lung cancer risk is determined principally by the extent of exposure to mainstream smoke, increasing with tobacco consumption and duration of smoking, and these two parameters underpin most predictive models for lung cancer. A smaller excess risk has been confirmed for exposure to environmental smoke or ‘second-hand smoking’. For confirmed ex-smokers, excess lung cancer risk declines with duration of abstinence, although it may take several decades of abstinence for this risk to approach that of a non-smoker.

**Radon and lung cancer**

The discovery of the link between radon and lung cancer possibly pre-dates the discovery of the link between cigarettes and lung cancer. High mortality rates from respiratory disease among underground metal miners have been known since the Middle Ages, and by the early 20th century this malignancy had been identified as primary carcinoma of the lung - lung cancer. A hypothetical link with the presence of radon gas was developed in the 1920s, but only in the early 1950s was a mechanism involving radon’s short-lived decay products identified and confirmed. The first sets of indoor measurements in homes date from 1956, but by the 1970s, large-scale surveys were underway in homes in several countries.

Radon, a gaseous radioactive decay product of uranium occurring in a wide range of rocks, soils and building materials incorporating or manufactured from these, is insidious in that it is all-pervasive, invisible and odourless, and consequently difficult to eliminate from everyday environmental exposure. Of the three naturally occurring isotopes, $^{222}$Rn, derived from $^{238}$Ra in the $^{238}$U decay series, is relatively long-lived, its half-life of 3.8 days enabling it to migrate significant distances within the geological environment. Although radon dissipates rapidly in outdoor air, it can concentrate in houses, where it contributes 50 per cent of the average background radiation dose received by the UK population.

Ionising radiation has well-known adverse health effects. Radon itself is radioactive, decaying by $\alpha$-emission successively to polonium isotopes $^{218}$Po and $^{214}$Po, both themselves $\alpha$-emitters, with two intervening Beta emitters, $^{214}$Pb and $^{214}$Bi. All of these decay products (progeny) are toxic heavy metals, solid rather than gaseous, and therefore readily adsorbed onto atmospheric particulates, their half-lives ensuring that they decay before clearance from the lung. Inhalation of gaseous radon and its progeny provides the majority of the radioactive dose to the human respiratory system (BEIR VI, 1999), damaging the sensitive inner lining of the lung and increasing the risk of lung cancer.

The 2000 report from the United Nations Scientific Committee on the Effects of Atomic Radiation provided estimates of mean radon concentrations in dwellings for 29 European countries, with a population weighted average of 59 Bq$m^{-3}$ (UNSCEAR, 2000). If this is approximately correct, and if the excess risk of lung cancer is about 16 per cent per 100 Bq$m^{-3}$ throughout a wide range of exposure levels (Darby S et al., 2005), then radon in homes currently accounts for about 9 per cent of the deaths from lung cancer and 2 per cent of all cancer deaths in Europe. In most countries residential radon concentrations vary widely, with levels in most homes well below the national average but levels in a minority of homes several times higher than the national average.

**Radon-tobacco interaction**

As Lubin et al. (1995) commented: "Because smoking is the most significant cause of lung cancer, the joint effects of radon progeny and smoking have important risk evaluation implications. If the relative risks (RRs) for smoking and radon exposure are multiplicative, the RR for radon exposure is the same in smokers, ex-smokers and never-smokers and, because the lung cancer rate is higher in smokers, the absolute increase in radon-attributable lung cancer rate is substantially greater in smokers. Conversely, if RRs for smoking and radon exposure are additive, the absolute increase in radon-attributable lung cancer rate is constant in smokers and never-smokers and, therefore, proportionally less in smokers".

Extensive pooled epidemiological studies in the UK and the USA confirm that a sub-multiplicative association between smoking and radon exposure is most consistent with the data (Lubin J H et al., 1995) and that radon consequently:

"poses a much greater absolute hazard to current smokers and recent ex-smokers, than to lifelong non-smokers" (BEIR VI, 1999).

Our own extensive studies in Northamptonshire (Denman A R et al., 2004) have confirmed that completed radon remediation programmes in radon Affected Areas are cost-effective compared to other approved health interventions, e.g. breast screening, and, as recently confirmed by HPA research (Chow Y et al., 2007), have demonstrated that the relatively low uptake of remediation in practice reduces the value of such programmes. Our studies have further shown the radon-associated lung cancer risk for smokers living in areas with appreciable levels of domestic radon gas to...
be some four times greater than that for non-smokers and have confirmed that the smoking status of the individual is the most significant factor in determining the reduction in individual risk when radon levels are reduced.

The much more detailed underlying database provides indication of the radon potential of an individual property based on its address, and this is now the official criterion for assessing the need, or otherwise, for protective measures. More details can be found on the dedicated HPA/BGS website (www.ukradon.org).

Do householders take action to reduce radon risk?
Despite the well-publicised nature of the health risks associated with radon, residents of Radon Affected Areas appear to remain unconvincing of the need for action. In Northamptonshire, designated a Radon Affected Area in 1992, only 80,100 out of 268,000 homes - 29.9 per cent - had been tested ten years later (Green B M R et al., 2002). Nationally, only 15 per cent of householders finding elevated radon levels in their homes have actually proceeded to remediation and our previous studies (Denman A R et al., 2004) indicated that it is generally those less at risk, principally the elderly, non-smokers and families without young children, who take remedial action, suggesting that socio-economic influences feature strongly. This trend has recently been confirmed by HPA in a larger sample of homes (Chow Y et al., 2007). The true significance of these figures lies in the fact that while the annualised cost of a single averted lung cancer arising from a completed radon remediation programme in Northamptonshire has been estimated (Denman A et al., 2005) to be in the range £K 65 - 82, the comparable figure for the relatively incomplete (10 per cent remediation as of 2005) Northamptonshire programme is in the range £K 884 - 1304.

Smoking in a radon affected area
The lung cancer effects of radon and tobacco smoking are intrinsically interactive. With current models suggesting that the excess lung cancer risk for smokers in radon-affected homes is four times the risk for non-smokers, it is interesting to consider whether it is more cost-effective, in terms of attributable life-years lost, to prioritise smoking cessation or radon remediation. We have recently commenced pilot studies in Northamptonshire aiming to quantify the relative effects of radon and smoking among the population, and to identify patterns in attitudes and risk perception, directed towards defining cost-effective intervention models to guide public health actions.

The 1998 White Paper Smoking Kills outlined a comprehensive smoking cessation service for the NHS in England, with counselling and support for smokers wanting to quit complementing the prescription cessation aids, Nicotine Replacement Therapy, Bupropion and Varenicline. In Northamptonshire, the smoking cessation programme is offered through General Practitioners, Pharmacists and Stop-Smoking groups. The criterion for quitting is Carbon Monoxide (CO) validation at four weeks, the current success rate being 60 per cent, above the national average. Patient follow-up at 12 months is less reliable, as response rate is low and not CO-validated.
Radon exposure of smokers in Northamptonshire

To characterise the radon environment inhabited by Northamptonshire smokers, and to quantify life-years saved by radon remediation and smoking cessation programmes, individual and population-average lung-cancer risks of 432 confirmed 12-month quitters have been modelled using the European Community Radon Software (ECRS) tool developed in France by CEPN with input from the HPA. This encapsulates the quantitative results of extensive research on tobacco and radon-induced lung cancer, providing individual and population-average risk and mortality factors as functions of age, gender, duration and level of radon exposure, and duration (but not level) of smoking.

Due to the nature of the study, it was not possible within the available timescale or resources to determine radon concentrations in the homes of individual subjects. To overcome this limitation, the HPA arithmetic mean radon concentration for the postcode sector of residence of each individual subject was used as surrogate for the radon exposure of that individual. Although it is appreciated that this approach may lead to a measure of bias in the outcomes, a separate analysis has shown that Monte-Carlo-like allocation of radon concentration levels to individual homes within a single postcode sector, on the basis of an assumed lognormal distribution in conjunction with the published geometrical mean and standard deviation for that sector, yields demographic results comparable with those for the county as a whole.

Table 1 summarises the modelled effects of smoking and radon, separately and in conjuction, on the Whole-Life Lung-Cancer Mortality and Age at Death, averaged for the study population.

For non-smokers, exposure to radon increases whole life lung cancer mortality by just 0.19 per cent, and by 0.65 per cent and 1.43 per cent respectively for ex-smokers and smokers. For the study population of 432 12-month radon-exposed quitters, this represents 0.8 additional radon-induced lung cancers within the population life-span for non-smokers, 2.8 for ex-smokers and 6.2 for smokers. Alternatively, encouraging just 29 per cent (0.19/0.65) of smokers in a high radon area to stop smoking, or deterring 13 per cent (0.19/1.43) of potential smokers from ever commencing to smoke, will generate the same reduction in lung cancer burden as complete eradication of radon exposure. The relative scales of the potential enhanced life expectancy expected from successful smoking cessation and radon remediation campaigns can be seen from the related figures for loss of average individual and population total life expectancy resulting from radon and smoking exposure considered individually (Table 2).

ECRS makes no provision for calculation of a joint effect, but it is evident that if all 432 quitters abstain permanently, more than 1000 life-years will be saved, while if their homes were remediated and they continued to smoke, the saving would be around 150 life-years. We believe that this is the first use of ECRS to model impact of smoking cessation intervention in a real population.

Factors leading smokers to quit in Northamptonshire

The prevalence of smoking in adults in Northamptonshire in 2006/07 was approximately 25 per cent (Timson K et al., 2007). Of those smokers taking advantage of the smoking cessation services in the county, approximately 60 per cent remain quit at four weeks, with some 30 per cent of these remaining tobacco-free after 52 weeks. These figures are broadly in line with national UK trends. To clarify understanding of the population’s knowledge of and attitude to domestic radon risks, a questionnaire survey was undertaken amongst a cohort of quitters counselled by the Northamptonshire smoking cessation services. This questionnaire

Table 1: Population mean whole-life lung cancer mortality and age at death for non-smokers, ex-smokers and smokers under zero and ‘postcode sector mean’ residential radon exposure conditions

<table>
<thead>
<tr>
<th>NON-SMOKER</th>
<th>EX-SMOKER</th>
<th>SMOKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>No exposure</td>
<td>Radon only</td>
<td>No exposure</td>
</tr>
<tr>
<td>Mean</td>
<td>1.18</td>
<td>1.37</td>
</tr>
<tr>
<td>95% CI</td>
<td>0.03</td>
<td>0.04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGE AT DEATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
</tr>
</tbody>
</table>

Table 2: Loss of life expectancy (years) for individuals and total population under zero and ‘postcode sector mean’ residential radon exposure conditions

<table>
<thead>
<tr>
<th>RADON</th>
<th>SMOKING</th>
<th>SMOKING + RADON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual average</td>
<td>Cohort total</td>
<td>Individual average</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>0.03</td>
<td>12.09</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>0.10</td>
<td>43.68</td>
</tr>
<tr>
<td>Smoker</td>
<td>0.21</td>
<td>92.35</td>
</tr>
<tr>
<td>Total</td>
<td>148.12</td>
<td>1015.68</td>
</tr>
</tbody>
</table>
was sent, with their consent, to all patients counselled within the period July to September 2006, following their 12-month review contact in autumn 2007.

In addition to collecting anonymised demographic data, the questionnaire explored factors influencing the decision to stop smoking and, investigates awareness of the risk from radon in the home. Some 103 clients responded, of whom 66 remain abstinent at 12 months. Initial inspection suggests that few respondents regarded radon as a significant decision factor, consistent with the empirical assessment of the relative risks associated with smoking and radon exposure that emerged through the ECRS modelling. Direct health concerns as a result of smoking were much more significant as factors affecting decision to quit.

Conclusions

Extensive studies in Northamptonshire over a number of years have repeatedly confirmed firstly, that the incidence of smoking is broadly in line with the national UK average, and secondly, that radon remediation campaigns are not apparently reaching those most at risk from lung cancer, namely the committed smokers. It is therefore imperative that alternative approaches to public health education on the causes, and the means of reduction, of the burden of lung cancer be explored. However, while the known interaction between radon and smoking promotes the suggestion that smoking cessation campaigns might offer an alternative route to reach these people, initial studies indicate that, even in a high-radon area, knowledge of the health risks of radon ranks very low among factors influencing individuals’ decisions to stop smoking.

In addressing radon-induced lung cancer, the most significant factor is the risk to the individual from the radiation dose. This risk is demonstrably much higher for smokers than for non-smokers, yet it is the smokers who are relatively uninfuenced by current radon remediation campaigns.

Smoking cessation programmes have quantifiable added value in radon affected areas, and an untested research question is whether better understanding of radon and its health risks could offer a more urgent stimulus to smokers who might consider quitting.

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Young people disproportionately affected by STIs

Sexually transmitted infections (STIs), including HIV, remain one of the most important causes of illness due to infectious disease among young people aged between 16 and 24 years old according to the HPA 2008 Report: Sexually transmitted infections and young people in the UK.

Young people represent only one in eight of the population but accounted for nearly half of all STIs diagnosed in genitourinary medicine clinics across the UK in 2007 - 65 per cent of all chlamydia (79,557 of 121,986), 55 per cent of all genital warts (49,250 of 89,838) and 50 per cent of gonorrhoea (9,410 of 18,710).

Many STIs, if left untreated, can lead to long-term fertility problems, e.g. from chlamydia or gonorrhoea. Infection with HIV or the strains of human papillomavirus (HPV) that cause cervical cancer can lead to long-term illness and possible death. The excessive morbidity among young people due to STIs, a consequence of both increased sexual activity and possible susceptibility to infection, highlights the importance of well-targeted interventions in this population.

Key findings
- The most common sexually transmitted infection in young people is genital chlamydia. The National Chlamydia Screening Programme in England performed 270,729 screens in under 25 year olds in 2007; a further 79,557 diagnoses of genital chlamydia infection were made among young people in genitourinary medicine clinics in the UK in 2007, (a rate of 1,102 per 100,000 16-24 year olds), a rise of 7 per cent on 2006.
- Genital warts were the second most commonly diagnosed sexually transmitted infection among young people in genitourinary medicine clinics, with 49,250 cases diagnosed in 2007 (682 per 100,000), a rise of 8 per cent on 2006.
- In 2007, 702 young people were diagnosed with HIV, representing 11 per cent of all new HIV diagnoses. Young men who have sex with men remain the group of young people most at risk of acquiring HIV in the UK.
- Increases in diagnoses reflect greater ascertainment of cases through more testing and improved diagnostic methods, as well as indicating increased unsafe sexual behaviour among young people.

New diagnoses of STI
Genital chlamydia infection is the most commonly diagnosed STI among young people attending genitourinary medicine clinics in the UK. In 2007, 79,557 diagnoses of genital chlamydia were made among young people in genitourinary medicine clinics (1,102 per 100,000 population aged 16-24 years). High rates were also reported for genital warts (682 per 100,000), genital herpes (156 per 100,000) and gonorrhoea (130 per 100,000), although rates were much lower for HIV (10 per 100,000) and syphilis (6 per 100,000).

Since 1998, diagnosis rates of almost all STIs among young people attending genitourinary medicine clinics have risen in the UK. The rate of chlamydia diagnoses has more than doubled, from 447 per 100,000 in 1998 to 1,102 per 100,000 in 2007. Although rates of gonorrhoea have declined in recent years from the peak in 2002 (186 per 100,000), to 130 per 100,000 in 2007, rates are still a third higher than in 1998 (96 per 100,000).

The number of new HIV diagnoses in young people in the UK remains relatively low compared to older age groups. In 2007,
there were 702 new diagnoses of HIV among young people (10 per 100,000), which is still nearly three times the number reported in 1998 (258). Nearly all young people diagnosed with HIV in 2007 were infected through either heterosexual contact (48 per cent), of whom the largest group were Black-Africans who have probably been infected abroad, and sex between men (48 per cent), of whom the majority were white and have probably been infected in the UK.

**Chlamydia screening**
For infections such as chlamydia, genital herpes and HIV, these rates are an underestimate as asymptomatic infections can remain undiagnosed. In addition, many young people may be diagnosed outside of genitourinary medicine clinics, by their general practitioner or as part of the National Chlamydia Screening Programme.

The National Chlamydia Screening Programme in England offers sexually active young people screening for chlamydia and other sexual health promotion activities, mainly in community settings. In 2007, over 270,729 screens were performed, a 93 per cent increase on the 140,157 performed in 2006; 5 per cent of females and 8.4 per cent of males were positive for chlamydia.

Among females, the highest rates were found in 16-19-year-olds. Chlamydia positivity was higher among those who reported two or more sexual partners in the last 12 months (11.8 per cent) compared to those who did not (7.8 per cent).

**Young men who have sex with men**
There have been worrying increases in the number of younger men diagnosed with STIs in the past decade, with more than a doubling of diagnoses of HIV (from 128 in 1998 to 281 in 2007) and a threefold increase of gonorrhoea (339 to 1001) – increases similar to that observed in older men who have sex with men. The prevalence of undiagnosed HIV infection appears to have decreased among young men who have sex with men in London (from 4.0 per cent in 2002 to 2.5 per cent in 2006), but increased among those outside of London (from 0.8 per cent in 2002 to 1.8 per cent in 2006).

**Young ethnic minorities**
Rates of diagnosed STIs vary among young people of different ethnic groups. Data from the National Chlamydia Screening Programme in England show that in 2007 chlamydia positivity rates of >10 per cent are found among young Black-Caribbeans (12.9 per cent), Black-Other (10.1 per cent) and those of mixed origin (11.2 per cent), while rates among young White Caucasians are 9.3 per cent and <5 per cent among young Asians (4.4 per cent). Data from the Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP), which operates in England and Wales, indicate that young Black-Caribbeans are disproportionately affected by gonorrhoea, accounting for 21 per cent of the samples collected in 2006.

Current data for 2007 show that of the 46,114 young people attending sentinel genitourinary medicine clinics in England, Wales and Northern Ireland, nearly all (92 per cent) accepted voluntary confidential testing for HIV, with little difference by sex or sexual orientation.

**Human papillomavirus immunisation programme**
A national human papillomavirus immunisation programme will begin throughout the UK in autumn 2008. This programme aims to prevent cervical cancer in females and will routinely offer all girls
aged 12-13 years immunisation with a vaccine that protects against the two types of HPV virus that cause ~70 per cent of cervical cancers (HPV 16 and HPV 18). There will also be a catch-up campaign for girls aged up to 18 years: in England this will be a two-year campaign starting in autumn 2009.

**Behaviour change and sexual health promotion**
There are a number of national and local media campaigns that aim to inform young people of their choices about safer sex, to improve their sexual health and promote condom use. The ‘Condom Essential Wear’ media campaign, comprising advertising through traditional and digital media, aims to normalise condom use and is targeted at sexually active young people.

Given that in 2000 over a quarter of young people reported having had sex before the age of 16, the effective delivery of high quality personal, relationship and sexual health education remains of paramount importance. It is essential that interventions are multi-level, so that they are delivered not only to young people themselves, but also to their parents and the wider community.

**Recommendations**
- There should be easy access for young people to sexual health services that can provide advice, screening and treatment of STIs including HIV.
- Interventions to promote sexual health among young people should be designed from a strong evidence base and evaluated for their continuing effectiveness.
- The delivery of high quality personal, relationship and sexual health education, which should include sexuality among its themes, is essential in providing young people with the necessary information and skills to be able to negotiate and engage in safer sexual behaviour.
- Information from the new improved STI surveillance will enable primary care organisations to better target future prevention efforts, especially in vulnerable populations such as men who have sex with men and ethnic minority communities with the highest rates of STIs.

**Messages to be used with young people**
All those interested in the sexual health of sexually active young people should use their particular communication skills to relay the following key messages for the prevention of STIs:
- Have fewer sexual partners and avoid overlapping sexual relationships.
- Use a condom when having sex with a new partner and continue to do so until both have been screened.
- Get screened for chlamydia every year and whenever you have a new partner.
- If you are a man who has sex with men, then always use a condom and have an annual sexual health screen, including an HIV test.

**Prevention and control**
As with other infectious diseases, the prevention and control of STIs (including HIV) is based on reducing the duration of infection by early testing and treatment, reducing the number of susceptible individuals (e.g. HPV vaccination) and reducing transmission of infection (e.g. change in sexual behaviour including regular condom use).
Nanotoxicology

The Health Protection Agency has set up a new centre to study the possible health effects of human exposure to nanoparticles.

The National Nanotoxicology Research Centre (NNRC) is being developed at the Agency’s Centre for Radiation, Chemical and Environmental Hazards (CRCE) at Chilton in Oxfordshire. The Agency is collaborating with the Universities of Birmingham, Cardiff, Edinburgh, Imperial College and King’s College London and the MRC Toxicology Unit in Leicester.

The Agency’s Chairman Sir William Stewart said: “The application of nanotechnology is an exciting development with many potential benefits. However, it is very new technology and some element of precaution is required. More research should be carried out into any possible health effects from the use of nanoparticles, and that is the primary task of the new centre.”

Nanotechnology uses materials of dimensions measured in nanometers (1 x 10^-9 metres or 0.0000001 millimetres). Such materials can have unusual physicochemical properties which make them useful in applications including medicine, electronics, optical-electronic systems and imaging. They are also used in cosmetic and food products.

Knowledge of the possible interactions between nanomaterials and the body is developing rapidly. The Agency is adapting its aerosol inhalation facility at CRCE Chilton to allow a programme of experimental work on nanomaterials, spending over £300,000 to refurbish and re-equip the existing facility.

NNRC will focus, initially, on the behaviour of nanomaterials that enter the body via the lung and skin. The transportation of nanomaterials in the body will be studied and special emphasis will be placed on investigating the bio-kinetics of nanoparticles. This will involve studies of their entry into the body, their distribution within and their removal from the body.

Call for wider HIV testing

New guidelines from the British HIV Association (BHIVA), the British Association for Sexual Health and HIV (BASHH), and the British Infection Society (BIS) aiming to increase the offer of HIV testing to ensure fewer people go undiagnosed have been welcomed by the Health Protection Agency (HPA).

The guidelines recommend that wider HIV testing should be considered in those areas of the country where the numbers of undiagnosed infections are likely to be greatest. To assist planning, the Agency is releasing information from its HIV surveillance systems showing those places where undiagnosed infections are concentrated.

Professor Peter Borriello, Director of the Agency’s Centre for Infections, said: “We estimate around 73,000 people are infected with HIV in the UK, and a third of these don’t know they have the infection. The trouble with so many people being unaware of their infection is that onward transmission is more likely and late diagnosis is associated with more serious HIV disease.”

A universal offer of HIV testing is estimated to be cost-effective where the HIV diagnosis rate is greater than one per 1,000 tests. However, the evidence on the cost effectiveness of expanding HIV testing in the population of England is sparse. Therefore, local innovations to expand HIV testing should be the subject of formally designed service evaluations and be sufficiently large so as to better inform the implementation of the guidelines and the development of national policy.

Further information:
To view the guidelines visit www.bhiva.org

MRSA bloodstream infections continue to fall

MRSA bloodstream infections fell by 30 per cent in 2007/08, 4,438 reported cases compared to 6,383 in 2006/07. This is the fourth annual decrease in such bloodstream infection cases and the most marked.

The latest quarterly figures on MRSA (methicillin-resistant Staphylococcus aureus) from the Agency’s mandatory surveillance of MRSA bloodstream infections show that there were 836 cases reported in England during the April to June quarter of 2008, this represents a 14 per cent decrease on the previous quarter (January to March 2008) when 969 reports were received, and a 36 per cent reduction in the corresponding quarter of 2007 (April to June).

Professor Peter Borriello, Director of the Agency’s Centre for Infections, said: “The reduction of healthcare associated infections is a big challenge throughout the world and the falls we are seeing in cases of MRSA bloodstream infections demonstrate the huge efforts being made by NHS staff to tackle these infections.

“The next challenge for the NHS will be to ensure that the downward trend continues and that we move to a position of zero tolerance.

“Of course, not all cases are preventable but if the fight against healthcare associated infections is to be won, it is vital that the measures which have achieved this significant success remain in place and that both the public and healthcare workers recognise the importance of these measures.”

Further information:
Reports of MRSA bloodstream infections for individual Trusts are available at www.hpa.org.uk/webw/HPAweb&Page&HPNews&AutoListName/Page/1191942126522?p=1
**News**

**Action to reduce risk of measles epidemic**

The Health Protection Agency welcomes the Chief Medical Officer’s (CMO) MMR catch up programme, which urges Primary Care Trusts and GPs to identify individuals not up to date with their MMR and offer catch-up immunisation to reduce the risk of a measles epidemic.

Latest modelling research carried out by the Agency, examining the potential for measles transmission in England, suggests that there is now a real risk of a large measles outbreak of between approximately 30,000 to 100,000 cases - the majority in London.

Professor Elizabeth Miller, Head of Immunisation at the Health Protection Agency, said: “Public confidence in the MMR vaccine is now high with more than eight out of ten children receiving one dose of MMR by their second birthday. However, low vaccine uptake over the past decade means there is now a large group of children who either haven’t been vaccinated or who have received just one dose. These children are susceptible to not only measles but to mumps and rubella as well.

“2007 saw the highest number of measles cases recorded in England and Wales since the current method of monitoring the disease was introduced in 1995. Measles is a very serious infection as it can lead to pneumonia and encephalitis. It is not possible to tell who will be seriously affected by measles. This is why it’s incredibly important to continue to remind parents about the benefits of having their child vaccinated with two doses of MMR for optimum protection. It is never too late to get vaccinated.”

The Agency has reported year on year increases in cases of measles due to outbreaks in areas of the country where MMR uptake has dipped or been low for longer periods of time with some children becoming seriously ill. In June the Agency reported the second death from measles in the last two years.

**Consultation on ICRP’s recommendations**

The Board of the Health Protection Agency is consulting stakeholders on its response to the latest recommendations of the International Commission on Radiological Protection (ICRP).

The Agency has an important role in advising on protection standards against ionising radiation. Its advice on the application of these new international recommendations will assist the future development of radiation protection in the UK, at a time of renewed interest in nuclear power.

For many years ICRP’s recommendations have formed the basis for radiological protection standards in most parts of the world, including the UK. In 2007 ICRP issued new recommendations for a system of radiological protection.

Much new information has accumulated on the health effects of ionising radiation since ICRP’s previous recommendations. Following an extensive review of all the evidence, no change in the overall estimate of ionising radiation risk is made by ICRP. It has however taken the opportunity to simplify the system of protection and to strengthen its advice in some areas.

This consultation document provides the Agency’s proposed response to the 2007 ICRP Recommendations. The consultation is directed principally towards radiological protection professionals and to those in government and non-government bodies with specific responsibility in this area.

**Key recommendations in this consultation document from the HPA include:**
- the linear no threshold model remains the basis for setting radiological protection standards and criteria, because it represents the scientific consensus
- no changes are made to the dose limits in the UK
- a maximum dose constraint for the public of 0.15 mSv per year for new nuclear power stations and is consulting on whether this constraint should be extended to the design of all new sources

The consultation period will last three months. Following consideration of the comments received during the consultation, the Agency will issue formal advice and recommendations.

**Further information:**

The Consultation Document is available on the HPA website at: [www.hpa.org.uk/webw/HFweb&Page&HFAwebAutoListName/Page/1204186217717?p=1204186217717]

**Six per cent increase in STIs**

The Health Protection Agency has reported a 6 per cent increase in the total number of new sexually transmitted infections (STIs) diagnosed in 2007 compared to 2006. Across all age groups 397,990 new STIs were diagnosed in UK genitourinary medicine (GUM) clinics in 2007 - an increase from 375,843 in 2006.

Professor Peter Borriello, Director of the Agency’s Centre for Infections, said: “The number of people being tested for STIs has risen considerably over the past five years, giving us a better insight into the sexual health of the nation. More than one million sexual health clinics were carried out in 2007 – a 10 per cent increase on the previous year and one of the reasons why we have seen an increase in the number of diagnoses.

“This increase in testing, together with the decrease we have seen in waiting times for GUM services, ensuring prompt treatment of infections, will help to reduce risk of transmission and the development of complications. If sustained this could have a significant impact on the control of sexually transmitted infections.

“However, we cannot rely on prompt diagnosis and treatment alone – a shift in behaviour is the only way that we will bring down this continued increase in infections. Substantial numbers of young people remain undiagnosed, untreated and unaware of the risk they pose both to their own health and that of their sexual partner.

“It is crucial that young people continue to be exposed to messages about safe sex, including condom wearing, and the importance of getting check out at their nearest GUM clinic if they have had unprotected sex with a new partner.”
Design of laboratories for samples from Mars

The European Space Agency has appointed the SEA (Group) Ltd to lead a team of experts, including the Health Protection Agency, to define the requirements and initial concept for a Biocontainment Facility to safely handle any samples which may be brought back from Mars.

The Mars sample return mission is a goal of the European Space Agency and under international treaty it is mandatory that samples from Mars or other planets are sealed off from the terrestrial environment until they have been tested for the presence of life or fossil life-forms. It is also important that any samples returned are not contaminated by the earth’s environment.

The Agency has over 50 years experience in dealing safely with a range of dangerous microbes in high containment laboratories, including new diseases or previously unknown organisms. In addition, it manufactures a number of pharmaceutical products in specialist clean rooms. This means the Agency is ideally placed to recommend appropriate control measures to ensure safe handling of any samples that are brought back from Mars and to assist in the design because of its experience in safely containing microbes, as well as protecting sterile products from environmental contamination.

Welcoming the announcement of the contract, Justin McCracken, Chief Executive of the HPA said: "This programme will develop new concepts and explore new ways of working. The knowledge gained from this will in turn enable us to improve and enhance our own containment strategies in relation to rather less exotic but equally sensitive materials in the future."

Together the consortium members - SEA (Group) Ltd, the Health Protection Agency, Bovis Lend Lease UK, Gravatom Engineering System Ltd and the Natural History Museum - will be able to combine their individual expertise to design and develop a cutting edge concept for future construction, with the Agency receiving up to 200,000 Euros from the total 500,000 Euros for the entire contract.

eHealth - Online learning for healthcare professionals

The Health Protection Agency has launched eHealth, a new online education and training service for healthcare professionals, exclusively for the National Health Service.

The Continuing Professional Development (CPD) accredited online training is funded by the Department of Health (DH) and covers the management of chemical, biological, radiological and nuclear (CBRN) injuries and incidents. eHealth will help a wide range of healthcare professionals’ prepare their response to a deliberate or accidental CBRN incident.

The eHealth e-learning modules have been designed to reflect the shift towards online learning and to move away from the traditional static linear approach. Modules include scenarios that help to engage the user and engender an interactive approach to learning. Following the complete roll-out of eHealth, healthcare professionals will be able to access courses that comprise:

- Generic incident management
- Biological incidents: smallpox
- Radiological incidents
- Burns and blasts
- Chemical incidents

eHealth also allows users to register their attendance online for HPA designed face-to-face CBRN and emergency planning courses.

Further information: eHealth is accessible via the HPA website - www.hpa.org.uk/ehealth

‘Surveillance of Healthcare Associated Infections 2008’


It shows significant decreases in rates of surgical site infections (SSIs) in the main orthopaedic categories and that English rates of surgical site infection are comparable to those elsewhere in Europe.

There has been growing participation in SSI surveillance since 2003, with 224 hospitals collecting data in 2007 on 83,444 surgical procedures across ten categories of surgery.

898 SSIs were identified with rates of SSIs ranging from 0.5 to 0.75 infections per 1,000 post-operative days. Rates were found to be highest in surgery where the likelihood of microbial contamination at the surgical site is high, e.g. bowel surgery.

Work in progress

The report identifies work in progress, such as outbreak surveillance and areas warranting further attention, like surveillance of particularly vulnerable groups of patients, for instance those in critical care units.

Professor Peter Borriello, Director of the Agency’s Centre for Infections, said: “It is worth remembering that not all healthcare-associated infections are preventable. However, this shouldn’t lead to complacency around tackling the infections that are preventable and engaging in the battle to continually drive down rates of healthcare associated infections. These figures show that there can be, and have been, significant reductions.”

Further information: ‘Surveillance of Healthcare Associated Infections 2008’ is available to download from the Agency’s website.
Sustainable Communities – the right paradigm!

A new way of thinking about public health is long overdue, and ‘Sustainable Communities’ offers a brilliant solution, giving sharp focus to the practice of health protection; to quote ‘Securing the Future’:

“No community, here or overseas, wants to be faced with problems which lead to them becoming caught in a cycle of degradation and poverty, with a consequent lack of community pride in their area, poor environmental quality and health, high crime and unemployment levels, and multiple inequalities. Our aim is to create sustainable communities – places where people want to live and work, now and in the future …

A sustainable model
But the concept of ‘Sustainable Communities’ is not really new. Public health was born out of the clearly unsustainable urban explosive of disease following uncontrolled industrialisation. The rapid movement of rural people to unprepared towns created cesspools of deprivation and squalor, and a fall in life expectancy. Champions of public health emerged such as Edwin Chadwick, but it wasn’t until the resources of local communities were really engaged following the 1871 Public Health Act and the 1872 Local Government Act that mortality substantially improved.

One major factor that helped tip the balance against vested interests in ‘muck’ was the impact of William Farr’s timely and eloquent surveillance reports on disease and deaths: statistics about people in places compared in meaningful ways, and the preventable burden clearly expounded. His reports to the City Fathers were published verbatim in the columns of the Times and read right across the nation. Farr introduced the concept of “Healthy Districts” and calculated how many lives could be saved if the worst districts were brought to the levels of the best. The message was tirelessly presented, year after year. Farr lived in no ivory tower. His weekly return was no archive for stale data but with this facile pen became a literary weapon for effective change.

A second element was the appointment of local leaders and advocates for health - the Medical Officers of Health (MOH) - to overcome the “laissez-faire” culture. But of course, focussing on localities has the danger of recreating a postcode lottery of services.

In some places the MOH has been blamed for delaying immunisation, neglecting nutrition and failing to investigate threats to local health (Welshman, 1997). Without decisive national action local advocacy may have little impact. Take for example bovine tuberculosis. Forty years after McFadyean proved the effectness of pasteurisation of milk there were still 1600 deaths and 7-8000 new cases a year in 1947.

So what is the lesson of history for successful health protection? Strong, national evidence based leadership and timely health surveillance effectively linked to local leadership, and the mobilisation of community resources. The HPA is brilliantly placed to enable this goal to be achieved.

The challenge today
The experiences of HIV/AIDS, re-emergence of TB in USA when investment in services declined, epidemic cholera in South America due to collapsing sanitary infrastructure, and the rapid fall in life expectancy in Russia and Eastern Europe following major social change (10 years drop in life expectancy in men within a decade), and the failure of public health after Hurricane Katrina all caution us against complacency. New threats from climate change, together with continuing impact of social exclusion, poverty and inequalities threaten sustainability of communities.

In 2008 the EU added: “There is also evidence that factors such as particle matter in the air, noise and ground level ozone damage the health of thousands of people every year, environmental pollutants, including pesticides, endocrine disruptors, dioxin and PCBs persist in the environment, accumulating over time and we do not know enough about their long term effect on health.”

So what must we do?

Work with communities: we should adopt the Sustainable Communities paradigm for health protection, focussing on people in places and making a full contribution to the local partnerships essential to enabling people to make healthy choices in health settings. This is a key role for every Health Protection Unit (HPU).

Link to national evidence and standards: we need to sustain and develop surveillance, tracking and research in the face of vested interests, using the latest technology to bring meaningful and timely evidence to local and national policy and practice.

Re-emphasise the importance of epidemiology: epidemiology as a new scientific discipline played a key part in the public health revolution and continues to be the core science of health protection. We must ensure that the epidemiological function is well defined and executed to the highest possible standards, utilising powerful new techniques and linked to academic centres of excellence. We are now in an age of having to prove ‘no risk’ and therefore more and bigger epidemiology is needed.

Build public trust: working with communities, and engaging communities in risk assessment and control, will be increasingly demanded and should be welcomed. Only through openness and transparency will public trust be won and kept, and only then will our advice be acted on.

Focus on future generations: sustainable development is about this generation not compromising the next. Life course epidemiology has shown that prenatal and antenatal factors can have life long effects on health. The impact of infections and chemical exposures in young women and in pregnancy must surely be the top priority for health protection services.