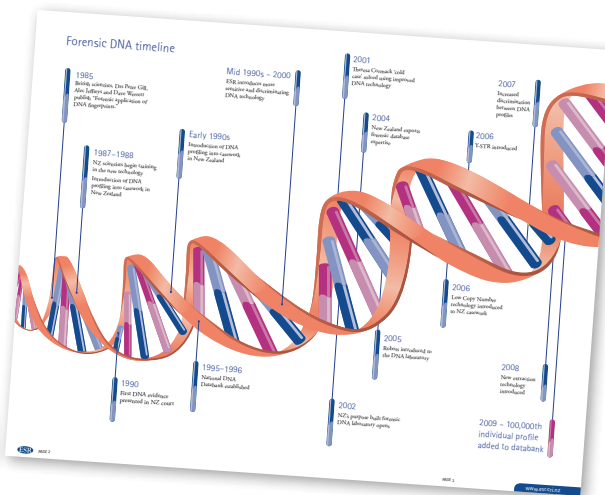
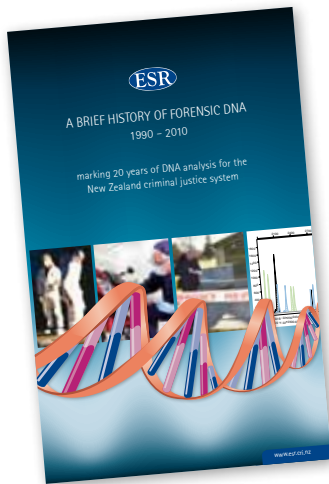


Briefing

Autumn 2010

20 years of DNA in the criminal justice system

It's hard to believe that just over two decades ago the use of DNA to fight crime was unheard of. The development of DNA 'fingerprinting' revolutionised forensic science and crime investigation around the world.



The first time that DNA evidence was presented in a New Zealand court was early 1990. Michael James Pengelly was accused of the murder of an elderly woman in her Auckland home. Bloodstains in the house were blood-typed and DNA tested. This showed that some of the bloodstains could not have been from the deceased and could have been from the accused – Pengelly was subsequently convicted of the murder.

In the early years, DNA profiling was mostly used to solve serious crimes. Now, it's routinely used to investigate crimes such as burglaries as well as homicides. Investigation of a major crime using DNA technology has often led to the solving of different – even completely unrelated – crimes. Many offenders plead guilty when confronted with DNA evidence, saving resources and money in criminal investigations and through the court system.

Forensic Programme Manager, Dr Jill Vintiner said the continual development and improvements in the use of forensic DNA technology has enabled some of New Zealand's most challenging cold cases to be solved.

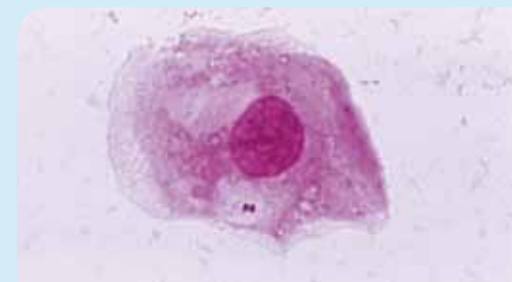
"It's an extremely important tool in exonerating the innocent. DNA can exclude suspects or change the focus of police investigations."

New Zealand has continually been at the forefront of developing and using forensic DNA technology. ESR forensic scientists have been instrumental in major technological advances, notably in the development of low copy number trace DNA and interpretation of DNA profiles.

New Zealand's hit rate linking individuals to crimes through the sample databank is one of the highest in the world. Our DNA expertise is globally recognised and our forensic systems and scientists are sought after by other jurisdictions – particularly in Australasia.

ESR has produced a booklet marking 20 years of DNA analysis for the New Zealand criminal justice system. *A brief history of forensic DNA 1990-2010* can be downloaded from www.esr.cri.nz or requested as a hard copy by emailing elizabeth.stewart@esr.cri.nz.

Fast-Start grant for meningitis research



Dr Joanna MacKichan has received a Fast-Start Marsden grant to identify specific molecular factors that determine meningococcal behaviour – enhancing understanding of what causes the disease.

The bacterium responsible for causing meningitis – *Neisseria meningitidis* (meningococcus) – usually inhabits the throat and causes no harm. How it turns into the form responsible for potentially fatal meningococcal disease is poorly understood, but certain environmental factors, such as other respiratory diseases, are known to increase the risk.

ESR meningococcal researcher Dr MacKichan has evidence that disease-associated meningococci can suppress the repair of damaged cells lining the airways.

"Once airway cells are damaged, bacteria capable of causing disease seem to develop a way to take advantage of them," she said. "This may explain why disease-associated bacteria can invade the body tissues of people with throat damage or inflammation."

Most store-bought fruit and vegetables test free of pathogens

A survey of fresh produce available from stores has found a low incidence of illness-causing bacteria.

Overseas outbreaks of food-borne illness have increasingly been associated with fresh produce. As a result, the New Zealand Food Safety Authority (NZFSA) commissioned ESR to run a microbiological survey of intact and fresh cut vegetables and fruits.

The survey looked at the levels and types of pathogens on nearly 900 imported and domestically grown fresh fruits and vegetables, purchased from a variety of retail outlets in Auckland and Christchurch over a 15-month period. Forty percent of the samples were conventionally grown in New Zealand, 35 percent were organically grown in New Zealand, and 25 percent were imported.

Microbiological quality was assessed using the New Zealand Ministry of Health microbiological reference criteria (1995) and the Food

Standards Australia New Zealand guidelines for Ready to Eat foods (2001).

“Only two of the 900 samples tested positive for a pathogen. Both those samples were lettuces from the same domestic grower – they were contaminated with Salmonella. A site visit suggested contamination by bird defecation, either directly by birds perched on hail netting, or indirectly by the netting being washed by irrigation or rain,” said Dr Stephen On, ESR Food Programme Manager. The survey found 95-97 percent of the produce was of satisfactory microbiological quality, based on indicator organisms (faecal coliforms and/or *E. coli*) levels. All the imported apples, capsicums, grapes, melons and strawberries were of satisfactory quality,” said Dr On.

While the results were good news for shoppers, it's important to note that only a limited number of pathogens were included in the survey. Other pathogens such as non-O157 STECs, *Listeria monocytogenes* and viruses, may be tested for in the future.



Cheers to smoke free

A new ESR service can identify whether wine – or food – has been contaminated by the taint of wood smoke.

It all began with bush fires in Australia. Extensive fires led to concern that vineyard wine had been contaminated by the smoke. Subsequent testing revealed that the wood smoke chemicals guaiacol and 4-methylguaiacol can adhere to grape skins – and wine produced from the contaminated grapes can have an offensive smoky taint.

That knowledge is now being applied to support New Zealand producers. “ESR recently worked for a local winery that was burned to the ground. The operators wanted to know whether they could salvage the wines still sealed in barrels,” explained ESR's Craig Houston.

“We tested multiple samples, and controls from previous batches, for guaiacol and 4-methylguaiacol. The testing showed that the barrelled wine had not been contaminated by the smoke.”

Testing quantifies what tasting may not be able to achieve. It's perfectly normal for wine to have low levels of guaiacol and 4-methylguaiacol as a result of barrels being charred or 'toasted' over a wood fire to help give additional taste. “We can quantify the exact level of normal oaky flavour - and what's smoke contamination,” he said.

Guaiacol is the main chemical causing the smoky flavour in all smoked food. So the new ESR test could easily be adapted beyond wine to any potentially smoke-damaged food, or liquid. Best results will be achieved by comparing suspect samples to control samples.

FIGHTING ANTIBIOTIC RESISTANCE

Antibiotic resistance continues to be an issue in New Zealand. As part of the response to this problem, the Ministry of Health (MoH) has contracted ESR to deliver a greater range of antibiotic resistance surveillance and laboratory testing services.

As a longstanding leader in the field, ESR has provided national antibiotic resistance surveillance and reference laboratory testing services since the 1970s. The New Zealand Food Safety Authority is also utilising ESR's specialist expertise in the first major national survey of antibiotic resistance in bacteria from food-producing animals. After gaining increased Government funding to combat antimicrobial resistance, the MoH is contracting ESR to deliver additional and enhanced surveillance and laboratory services.

Helen Heffernan, Senior Scientist at ESR, said that most of the new services will augment and enhance work already undertaken at ESR's national infectious disease reference laboratories.



“Our scientists provide specialist microbiological, virological and molecular testing. This work is integral to the surveillance of infectious diseases and understanding their epidemiology.”

The proposed extensions and enhancements to current services fall into the following three areas.



1 GREATER TEST CAPABILITY

The National Reference Laboratory already provides confirmatory and specialist reference testing for antibiotic resistance; and provides diagnostic laboratories with technical advice on test methods, appropriate control strains, and interpretation of results. The capability of the Reference Laboratory will be enhanced.

“In the past most antibiotic resistance was identifiable by well standardised antimicrobial susceptibility tests,” said Ms Heffernan. “But many newly emerging resistances cannot be identified by these standard tests. Detection of these types of resistance often requires special phenotypic tests, and then DNA-based methods – to confirm the presence of genes that mediate the resistance.”

The contract with MoH targets a 33 per cent increase in test volumes, enabling the National Reference Laboratory to better meet the high demand for the service. In addition, it will enable ESR to continue to provide a range of tests that have been introduced in the past three years. It will also enable a range of specialist ancillary tests to further characterise emerging resistances.

“All these services will be provided as a seamless extension to ESR's existing reference antimicrobial susceptibility testing services,” emphasised Ms Heffernan.



2 ENHANCED TYPING OF ANTIBIOTIC-RESISTANT ORGANISMS

When a hospital is investigating an outbreak of a resistant bacterium, typing the bacterial isolates to identify the strain is crucial to management and control. Identification makes it easier to track transmission, and identify and eliminate the source. Speed is imperative.

ESR's Nosocomial Infections Laboratory provides specialist typing services to identify outbreak strains of hospital-acquired pathogens. However, as outbreaks have become more common, demand has sky rocketed. ESR has often had to 'ration' typing services for hospital-acquired pathogens, and ask hospitals to limit the number of isolates they refer.

As part of the new contract, ESR is enhancing its typing capacity, and developing and applying different typing techniques. One goal is to increase ESR test volumes by 33 per cent. The other goal is to enhance the speed of getting a result, with the investigation of the application of MLVA typing for antibiotic-resistant *Escherichia coli* and *Klebsiella pneumoniae*. MLVA typing can have a turn-around-time of as little as 24 hours.

3 EXPANDED SURVEILLANCE

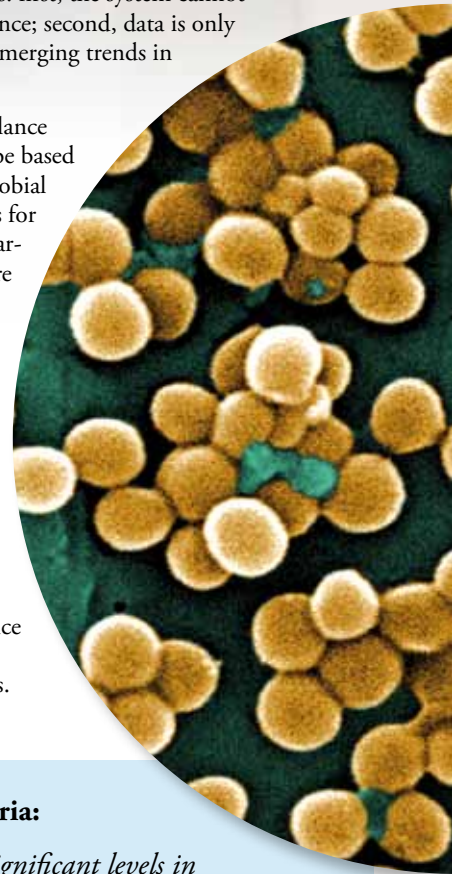
As part of routine diagnostic testing, hospital and community laboratories throughout New Zealand generate hundreds of antimicrobial susceptibility test results every day. These results potentially provide the most complete source of data for a comprehensive system for the surveillance of antimicrobial resistance.

Since the late 1980s, ESR has collected a limited amount of the resistance data generated from these tests and analysed the data to produce estimates of national rates of resistance. However, the current system has two major weaknesses: first, the system cannot provide information on the prevalence of multi-resistance; second, data is only collected once a year for the previous year, so rapidly emerging trends in resistance may not be immediately detected.

“There are clearly opportunities to improve the surveillance system,” said Ms Heffernan. “The improvements will be based on electronic capture of the results of routine antimicrobial susceptibility testing in diagnostic laboratories. Results for individual isolates will be collected and analysed in near-real-time. That means ESR will be able to provide more up-to-date and comprehensive information to clinical, infection control and scientific staff.”

Using the resistance data generated in hospital and community laboratories, ESR will produce regular reports and also issue alerts to key stakeholders whenever there is a significant change in resistance. In addition, existing analysis and reporting tools can be applied to provide enhanced reporting on the emergence and spread of resistant strains.

ESR and the MOH have extensive experience in developing information technology solutions to enhance infectious disease surveillance. Roll-out of the new system is expected to be phased over the next few years.



International attention often focuses on three particular types of resistant bacteria:

- **Methicillin-resistant *Staphylococcus aureus* (MRSA).** *MRSA first increased to significant levels in New Zealand in the late 1990s. While the national prevalence of MRSA has been relatively stable in recent years, the rates of MRSA vary markedly in different parts of New Zealand.*
- **Extended-spectrum b-lactamase (ESBL)-producing organisms.** *These bacteria are resistant to third and fourth generation cephalosporins. In recent years, New Zealand has experienced a significant increase in ESBL-producing organisms.*
- **Vancomycin-resistant enterococci (VRE).** *The first outbreaks of VRE in New Zealand occurred in Auckland hospitals in 2007 and 2008.*

DID YOU KNOW?

The new pandemic H1N1 is the result of four influenza viruses from swine, human and influenza species mixing.

This process is called reassortment, where influenza viruses swap genes when they infect the same host. Previous pandemics in 1957 and 1968 were thought to be caused by human and avian influenza viruses mixing when they infected pigs.

Pandemic influenza A(H1N1) 09 is a notifiable disease in New Zealand. Highest notification rates have been in the under-one-year age group. High notification and hospitalisation rates were also seen among Pacific Peoples and Māori ethnic groups.

Anti-viral drugs such as Tamiflu and Relenza are still effective against pandemic H1N1 influenza and provide an important therapeutic intervention. ESR's capability funded research showed all pandemic viruses were sensitive to antiviral drug Tamiflu. However all seasonal A(H1N1) viruses tested were resistant to Tamiflu.

Annual influenza immunisation is the primary method for reducing the impact of influenza in New Zealand. The recommended influenza vaccine formulation for New Zealand in 2010 is:

- A(H1N1) an A/California/7/2009 (H1N1) - like strain*
- A(H3N2) an A/Perth/16/2009 (H3N2) - like strain
- B a B/Brisbane/60/2008 - like strain

*Note: A/California/7/2009 is a pandemic A(H1N1) strain



Photo courtesy The Dominion Post

Pandemic influenza: what's our immunity?

A study is nearly complete investigating the level of New Zealanders' immunity to pandemic influenza (H1N1).

Blood samples from around 1500 New Zealanders are being analysed at ESR's National Influenza Centre (NIC), to see how many have been exposed to 'swine flu' and developed immunity to the virus. Knowing the percentage of the population with immunity will support effective planning for future pandemics, said NIC Head Dr Sue Huang. The Ministry of Health commissioned the study.

"Many New Zealanders have been exposed to the virus and developed immunity. A lot of them will have been sick as a result of the infection, but others will have been infected without realising it," Dr Huang said.

That was true of Wellington Phoenix Football Club, which took part in the study. Three of the 11 tested players returned positive results – showing they had developed immunity to the virus. Spokesperson John Mitchell said the results were unexpected as none of the players had shown signs of the illness. All the players had expected to test negative.

Most of the 1500 people were selected at random from participating general practices. Some special interest groups, including frequent travellers and health workers, were also included. Participants received their individual results.

Leading forensic technique will help solve cases

A new technique to identify the source of a DNA body tissue sample will support operational forensic work.

Scientists use DNA profiles to help identify people. Now ESR scientists have developed a technique to use RNA to find out more information from body samples. The new method will assist ESR scientists in about 30 percent of the cases they investigate, said ESR Science Leader Dr Sally-Ann Harbison.

RNA is the companion chemical to DNA. In different parts of the body, it turns the DNA's instruction into different proteins, which enables the tissue source of the DNA to be identified. The new method is a significant advance because until now, identifying the source of a DNA sample – hair, blood, saliva or skin – has been extremely difficult.

"Using RNA, scientists will be able to identify a greater range of body

tissue types. They won't just know the person the cells have come from – they'll know exactly where in the body those cells have come from," said Dr Harbison.

"As an example, the technique could determine whether the source of a DNA sample is likely to be menstrual blood or vaginal fluid, which existing methods can't do. The technique could allow scientists to return to cases where the bodily source of a DNA profile was crucial to the case, but was not determined. It could well help in piecing together crime scenarios," Dr Harbison said.

Several countries, including Switzerland and the United States, are also working on RNA testing. But New Zealand will lead the world in putting the new technique to use.



Superior testing of food & water

An LCMS, or liquid-chromatography mass spectrometer, is a big boost to analysing food and water samples at the Christchurch Science Centre.

“The new LCMS is close to being a universal detector,” said ESR Laboratory Manager Craig Houston. “It is a very sensitive piece of equipment. Combined with our expertise, it means a far greater range of compounds and elements can be analysed in a sample.”

“In a single analysis, the LCMS can filter out most interfering items, significantly reducing the time for sample extraction and cleanup. As well as the obvious advantages of greater sensitivity, turnaround times can be reduced,” he said.

Having contaminants in foodstuffs quickly identified is of critical importance to manufacturers and organisations responsible for food safety. With the new LCMS, analysis is up to six times faster than with other equipment.

“One of the key areas we are now working on is improving our ability to undertake allergen testing. We are currently developing methodology to use the LCMS to test specifically for the 31 most common allergen substances at once. Once operational this will enable us to rule out, for example, the presence of peanut allergens in a food sample.”

Rapidly tracking food pathogens

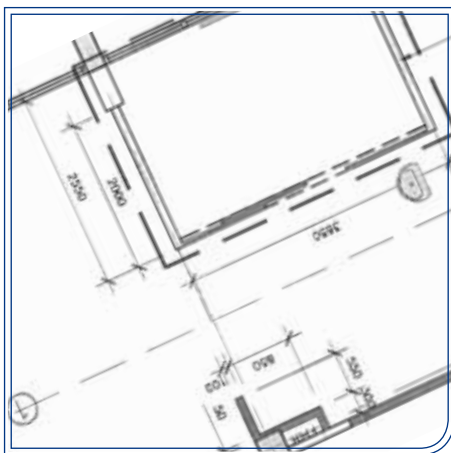
ESR Food Programme researchers have developed a simple method to rapidly track key pathogens through the food chain.

The new method involves P-BIT (PCR Binary Typing) which requires only basic molecular biology equipment. Data can be exchanged and compared using little more than standard email and spreadsheet programmes.

Utilising P-BIT for *Campylobacter jejuni*

showed more discrimination than existing methods such as serotyping, MLST and SmaI PFGE, noted Food Programme Manager, Dr Stephen On. The new method also showed potential for investigating longer-term clonal strain relationships.

“The method has been developed to try and quantify the potential risk of individual strains to human health. A P-BIT method for pathogenic *E. coli* is also in an advanced state of preparation,” Dr On said.



NEW LEASE OF LIFE FOR KENEPURU LABS

National communicable disease and reference laboratories at ESR's Kenepuru Science Centre are getting a major facelift.

The refurbishment project will ensure laboratories are up-to-date and continue to meet all user and accreditation requirements. It is the first major upgrade since the laboratories opened in 1982.

Completion of work is scheduled for October 2010. ESR's normal laboratory services will be maintained throughout the project. Users of ESR's laboratory and reference services include district health boards, community, hospital and commercial laboratories, and regional authorities. Services will continue as usual for all users.

When the refurbishment is complete, about 35 staff in ten laboratories will be housed in a single containment suite within the existing building. Alongside, there will be new office space for laboratory staff.

ESR leads European food-hazard project

As part of the European Commission-funded MoniQA Network of Excellence programme, ESR is leading a project related to the detection of chemical and microbial hazards in food.

The project aims to establish new universal guidelines for validating rapid tests in laboratories examining foods for pathogenic bacteria.

As a test case, the study will use PCR methods for *Campylobacter*, the most common bacterial cause of gastroenteritis worldwide. Seven laboratories from Finland, China, Italy, Spain, Bulgaria and Poland have agreed to participate.

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through science
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