Summer 2007

Briefing

The future of forensic science

Representatives from New Zealand's justice sector have recently been discussing what the criminal justice system is likely to need from forensic science in the near and long-term future.

A committee, chaired by Law Commissioner Warren Young, brought together New Zealand and overseas experts to look at the value forensic science provides to the criminal justice system and to investigate how more forensic research might be funded.

Mr Young said it was important to ensure that New Zealand had a robust and innovative forensic science research and development programme that underpinned forensic science delivery for the benefit of New Zealand.

Minister of Police Hon Annette King opened the summit saying she shared "commitment to the importance of making the best use we possibly can of rapidly-developing forensic science technologies".

The summit workshops discussed a number of aspects of forensic science including the social and organisational context in which forensic science is applied and the issue of ensuring integrated policy development underpinned by sound research.

Mr Young said one of the outcomes of the summit was the set up of a working committee to progress addressing these issues as a whole-of-justice-sector issue.

"A clear strategic focus and performance management policy will enhance the ways in which we apply forensic technology in this country."

Summit participants also discussed the issue of forensic research funding. ESR board Chair Ian Wilson has previously voiced frustration that there is no formal science or any other funding pool for criminal justice and forensic science research in New Zealand.

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Inside this issue

DNA solves more burglaries

Preliminary research shows New Zealand Police are clearing close to 100% of burglary cases where DNA crime scene evidence is processed, but samples are only submitted from 2% of burglaries.

Principal Forensic Scientist Dr John Buckleton said New Zealand's hit rates and clearance rates compare favourably to those of the United Kingdom, but the study highlights areas where improvements can be made.

Dr Buckleton presented results from preliminary research into burglaries and the use of DNA evidence at the forensic science summit in Wellington.

He told attendees that New Zealand's submission rate for processing DNA crime scene samples burglaries is about a quarter of that of the UK yet New Zealand's actual clearance rates are superior.

"It indicates that even a modest increase in the submission of crime scene samples here could have a huge impact on solving burglaries and other volume crimes".

Crime scene samples are sourced from blood and other evidence that is left at a crime scene and that may provide a DNA profile that can link to an offender.

"In New Zealand, samples from only 2% of volume crime scenes are submitted by police for processing. Of these an actual DNA profile is generated in about 64% of samples and a link to a potential offender is made in about 38% of these.

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The future of forensic science *continued*

"The funding agencies tell us that there are no stated priorities on forensic science investment or on research to mitigate the public hazards from crimes. To direct investment into this area we are told there needs to be a clear indication of priority.

"The New Zealand Police fund a small amount of operational research. However, their priority naturally lies in using their budget to solve current and historic serious crimes," Mr Wilson said.

Ms King told the summit that she was aware that formal funding pools existed in countries like the United States, where there is a large, nationally contestable, dedicated forensic science research funding pool administered by the National Institute of Justice.

"I will be interested to learn what longer-term and innovative funding solutions this summit comes up with, and where you believe the Government can best play its part in terms of its overall priorities in preventing and resolving crime, and making our communities safer places to live in.

"I certainly do not have to be convinced that crime scene investigation works. The sensitivity and discriminating power of forensic technologies help solve and reduce crime. CSI can provide fast resolution, saving precious police and courtroom time and resources. Forensic science enhances community security.

"I also do not need to be convinced that forensic science and the ongoing development of technology need to keep ahead of offenders; and that one of the best ways of achieving this is integrated policy development underpinned by sound research."

DNA solves more burglaries *continued*

In the UK, links are generated to a potential offender at a much higher rate, largely because of their much higher submission rate, but the actual clearance rate by the UK police is significantly lower that than of the New Zealand Police.

Dr Buckleton said that according to a British Home Office report, the UK had a year-on-year increase in DNA material collected (yield) from crime scenes - resulting in a 74% increase over five years.

"There was a 76% increase in DNA from crime scenes submitted to a forensic provider for processing over the same period. These rates are markedly above New Zealand's current levels.

"Evaluation in the UK has shown that the number of matches obtained from the database (and the likelihood of identifying the people who committed the crimes) is driven primarily by the number of crime scene profiles loaded on the database."

ESR and the New Zealand Police have begun a nationwide evaluation to identify best practices in the collection and processing of crime scene samples in New Zealand police districts.

"We need to identify what we are doing right so we can do more of it," Dr Buckleton said.

"While our research is a small-scale preliminary study it does seem to indicate that New Zealand could solve a lot more burglaries if more crime scene samples from volume crime scenes were processed. There is also great potential to reduce recidivist offending," he said.

Did you know?

- More than 50% of sex offenders in a US study had a previous conviction for property crimes, including burglaries.
- A prolific burglar in the US commits 243 burglaries a year.
- UK research indicates that on average each crime detected with DNA results in a further 0.8 crimes being detected and prevents 7.8 other crimes for each custodial sentence resulting from a DNA based conviction.
- DNA crime scene matches can help identify patterns of criminal behaviour.
- DNA has an important value in demonstrating that a person was NOT involved in a particular crime scene or crime.

Report shows 70% drop in 'flu deaths

The incidence of 'flu in the community has significantly decreased over the past decade, with a 70% drop in influenza-related deaths, according to an assessment by ESR's influenza experts.

However, influenza hospitalisations have increased over the same period, with more than 4400 people admitted to hospital.

Dr Sue Huang, ESR's Senior Influenza Scientist and head of the World Health Organization (WHO) Influenza Centre, said ESR looked at national influenza surveillance data collected from 1997 to 2006. The data included community disease burden, circulating virus strains, hospitalisations, mortality and immunisation coverage. This was compared with the previous ten-year period.

"We found that influenza-related deaths have reduced by over 70% since 1997 when the vaccination policy changed, resulting in a steady increase of vaccine uptake. There was a decrease in influenza mortality in the over-65-year age group, which correlated well with a substantial increase of influenza vaccine uptake," she said.

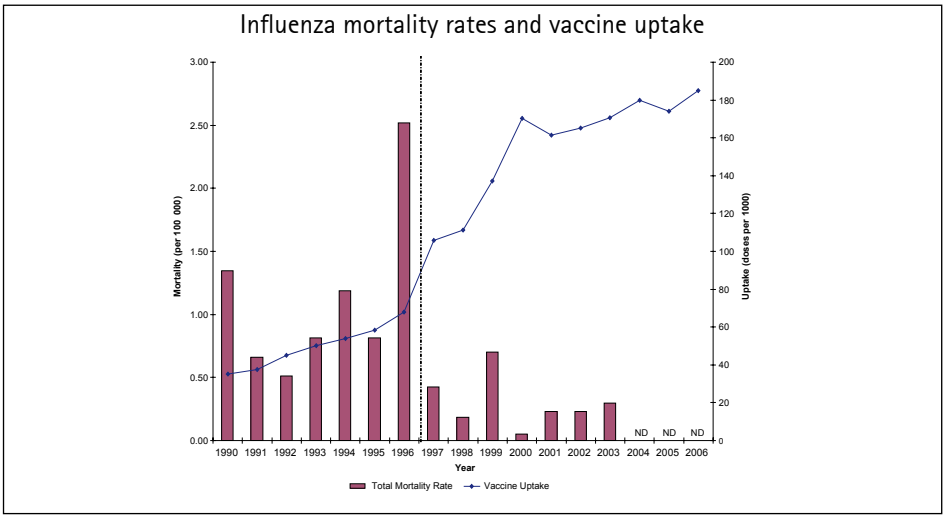
However, this group still has the highest mortality rates compared to other age groups (0-64 years). Therefore, vaccine uptake still needs to be increased in this age group, she said.

Dr Huang said the increasing trend of influenza hospitalisations required further analysis to understand whether it was due to improvements in coding, improvements in sensitivity of diagnostic tests, possible access problems to primary health care, changes in hospital admission criteria, demographics, or a true rise in influenza-like illness.

"Hospital surveillance indicates that children and young people 0-19 have had a significant increase in average hospitalisation rates compared with the previous ten years. High rates of hospital admissions among young children have also been reported in the US.

"We need to explore new measures to prevent influenza-related hospitalisation among young people," she said.

- Influenza A(H3N2) predominated for six seasons (1998, 99, 2002, 03, 04, 06). The A/Wisconsin/67/2005 (H3N2) like strain predominated in 2006, with the highest recorded hospitalisations.
- Influenza A(H1N1) predominated in 2000 and 2001.
- Influenza B predominated in 1997 and 2005. 2005 also saw the third highest recorded hospitalisations, particularly in children aged 5-19 when the B/Hong Kong/330/2001 like strain was around.



"Annual immunisation is the primary method for reducing the impact of influenza in New Zealand. Vaccines are recommended for people at risk of developing complications following infection because of their age or an underlying chronic condition."

Influenza rate this winter lowest since 2000

Influenza A was the predominant type circulating in New Zealand during the 2007 winter, according to ESR influenza surveillance data.

81% of all viruses identified through ESR's surveillance programme were Influenza A, with an increasing number of the subtype A(H1N1). Influenza A has two subtypes that are found in humans – H1N1 and H3N2. Nineteen per cent of the viruses identified were Influenza B.

Circulating 'flu viruses this winter were similar to those in other Southern Hemisphere countries. However, in Australia the influenza activity was moderate to severe with at least three deaths associated with influenza (H3N2). The A(H3N2) type is associated with severe disease and high death rates in high-risk groups.

Dr Huang represents New Zealand on the Australian Influenza vaccine committee which reccomends the annual influenza vaccine composition for New Zealand and Australia. The committee considers international surveillance by WHO, recent data from Australia, New Zealand, South Africa and Argentina on epidemiology and strain characterisation and virology before vaccine recommendations are made for each country.

"'Flu viruses constantly change and mutate, which makes the job of recommending vaccine composition challenging. Scientists call the constant changes in the virus antigenic drift. Each country or regional authority approves which specific strains will be included in its national annual influenza vaccine."

Did you know?

- An influenza strain is named after the area/region of the laboratory that first isolated the virus as a new strain. The name is not related to where the strain comes from - for example, the A/Brisbane/10/2007 was first formally identified as Influenza A subtype H3N2 in a Brisbane laboratory in 2007.
- ESR undertakes New Zealand's 'flu surveillance and operates the WHO National Influenza Centre. A national surveillance system was set up in 1991 as part of the WHO global programme for influenza surveillance.
- ESR's influenza team moves into new purpose-built laboratories at the National Centre for Biosecurity and Infectious Disease – Wallaceville, early in 2008.

Electronic disease notifications

From December 21 2007, the Epidemic Preparedness Act 2006 requires laboratories to notify Medical Officers of Health of positive laboratory tests for notifiable diseases. Previously only clinicians had to provide this notification.

Programme Manager Dr Bruce Adlam said ESR has been working with the Ministry of Health and representatives from clinical laboratories and the health sector to develop messaging standards and processes for the transfer of electronic notification messages.

"ESR is implementing the new standards in its own reference laboratory test results. It is also developing EpiSurv, the national notifiable disease database, to receive and process electronic notification messages." The new standards will enable laboratories, general practitioners and clinicians to send electronic notifications as required by the Act.

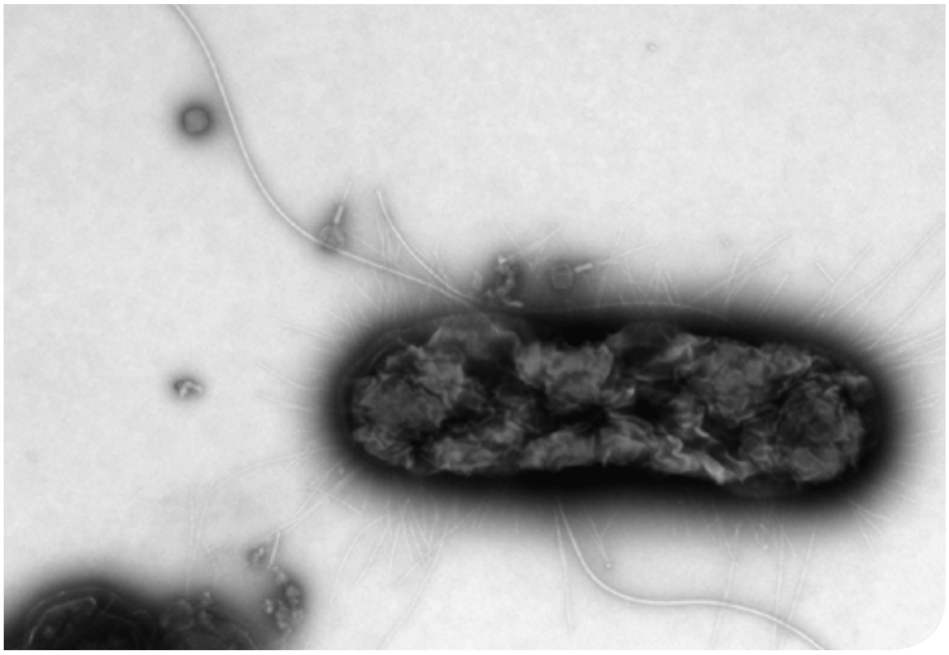
PulseNet helps protect beef trade status

Using microbiological capability and the PulseNet laboratory network, ESR was able to quell concerns that toxic bacteria *Escherichia coli O157* found in US meat processing plants may have come from New Zealand meat.

Earlier this year *E.coli O157* was found in two US meat processing plants. The one common link between the two plants was that both sourced some of their meat from New Zealand. *E.coli O157:H7* is a strain of bacteria that produces a powerful toxin that can cause severe illness in humans. Most infections in the US are caused by eating undercooked ground beef.

ESR and the New Zealand Food Safety Authority (NZFSA) received urgent requests from the US Centers for Disease Control and the US Food Safety and Inspection Services for information regarding a particular form of *E.coli O157*. The particular version of the bacteria had also been implicated in a cluster of illnesses in the US.

"We were able to demonstrate that the particular versions of the New Zealand and US bacteria implicated in the illness outbreaks were different and therefore there was no evidence to indicate that the *E.coli O157* in the processing plants had come from New Zealand meat."



IMPACT – ing on meat food safety

A collaboration between ESR, Massey University and AgResearch to improve the control of pathogens in meat and meat products has been funded by the Foundation for Research, Science and Technology (FRST).

IMPACT – IMproved PAthogen Control Technologies - is aimed at protecting public health in New Zealand and our international trade. FRST is providing $4.6 million over six years.

ESR's Food Safety Programme Leader, Dr Stephen On, is co-ordinating the project. It includes novel and environmentally friendly methods of eliminating and/or reducing important food poisoning organisms, with the focus on *Escherichia coli 0157*.

ESR Biocontrol Researcher, Dr Andrew Hudson, said the work would build on previous studies to provide a toolbox of interventions that can be undertaken at different points in the food chain to ensure the absence of the pathogen from meat.

"It will include using phage components and their bacteria-dissolving enzymes as well as disrupting cell-to-cell signalling of pathogens. Mathematical modelling will be used to optimise the efficacy of the methods."

Phages are naturally occurring viruses that infect and kill bacteria. The idea of using phages to treat bacterial infections in humans dates back to the early 20th century, when the first phages were isolated. When antibiotics were invented, interest in the commercial use of phages waned, as antibiotics proved easier to use. Recently, however, there has been renewed interest in the use of phages to kill disease-causing bacteria in food, reducing the need for the use of chemicals. ESR researchers have recently isolated and characterised several new phages for this purpose.

Local authorities use norovirus test

A number of local authorities and health boards in New Zealand have begun testing for norovirus and other disease-causing viruses in local shellfish and waterways.

This follows a FRST-funded study by ESR, which showed that many shellfish beds in New Zealand were sometimes contaminated with illness-causing viruses, making the shellfish unsafe to eat. Until recently, it was very difficult to find these viruses in shellfish and only bacterial testing had been occurring. However, improved testing methods developed at ESR have enabled these viruses to be identified.

Study leader Dr Gail Greening says she is very pleased that the research has provided important information that agencies are using to protect human health.

"Eating shellfish contaminated with viruses can cause illnesses such as gastroenteritis and hepatitis A; these can then be transmitted from person to person and spread through the whole community."

Oysters, mussels, cockles and pipis were collected from 28 sites in Northland, Hawke's Bay and Otago. Sixteen sites were sampled monthly or bi-monthly over the two years. Potential sources of faecal contamination were identified for each site.

The shellfish were sent to ESR's virology lab where they were processed and analysed for the presence of illness-causing viruses, adenovirus, enterovirus and norovirus and also indicator bacteria.

Bivalve shellfish such as oysters, mussels, pipis and cockles pose a particular risk because they are filter feeders. If the water in which they grow becomes contaminated with human sewerage, the shellfish concentrate the virus in their gut. While bacteria are expelled quickly, viruses may persist for long periods, even weeks.

The study found that 50% of shellfish samples were positive for one or more human enteric viruses. Only two sites had samples that did not show any viral contamination.

"Not surprisingly we found that viruses are most likely to be present in shellfish when they are in close proximity to sewage outfalls and following sewage spills and discharges," Dr Greening said.

"Repeated exposure to sewage led to ongoing virus contamination of shellfish. This was most obvious for shellfish samples in Dunedin taken adjacent to an outfall.

"Virus testing following spills is recommended so that further information can be obtained on the extent of contamination and the length of time the virus is persisting in nearby shellfish," she said.

The Bay of Islands results showed there was no clear seasonal pattern, but there were times during the study when viruses where more prevalent and in some cases these related to known sewage spill events. However, viruses did seem to be detected more frequently over wetter months (April – November) than in dryer months (December – March).

The results have led to other agencies and local authorities funding virus - studies of shellfish in their areas.

The NZFSA, Toi te Ora – Public Health, Environment Bay of Plenty, Tauranga City Council and Western Bay of Plenty District Council are funding monthly sampling of shellfish for the next year in the Bay of Plenty.

Shellfish virus testing is also now undertaken in the Canterbury region as part of Christchurch City Council's monitoring of potential sewage contaminants. Recent tests confirmed that local shellfish had become contaminated with norovirus.

Developing a new test

The NZFSA funded ESR to develop and validate a faster, more sensitive method for detecting norovirus in shellfish. By comparing and evaluating several published methods for their efficiency at detecting low levels of norovirus in different shellfish types, ESR was able to adapt the most appropriate methods and develop a specific test for use in New Zealand.

It has proved to be fast, sensitive and reproducible. It is now possible to obtain a result within eight hours, demonstrated by last year's Eden Park rugby test outbreak, where norovirus was detected in batches of imported Korean oysters within eight hours of receipt of samples. Using the new method, norovirus has also been identified in 20 shellfish samples associated with outbreaks and in ten non-commercial shellfish samples from environmental sites.

ESR has been awarded IANZ International Accreditation status (ISO 17025) for its method.

Collaboration on chemical genetics

ESR is collaborating with the Centre for Biodiscovery at Victoria University of Wellington to develop capability in the new and little known field of chemical genetics.

ESR scientist Penny Truman said that chemical genetics is a way of looking at networks of interacting genes and biochemical pathways rather than just individual genes or pathways.

"We are only just starting now to understand how genes interact. While we know there are many complex interactions, we are only at the very early stage of understanding how to interpret them," she said.

"In partnership with Professor Paul Atkinson we now have chemical genetics technology operational at Victoria University where it is being used to investigate the mode of action of natural products with possible pharmaceutical potential."

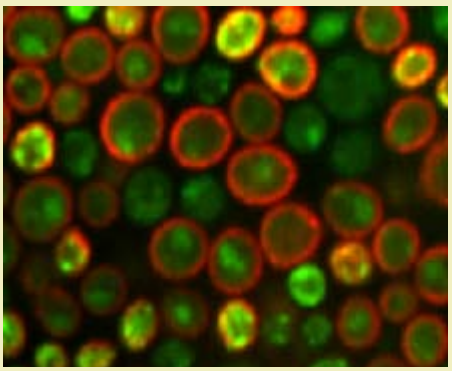
The technology is based on robotic high-throughput screening of living cells and is currently only available in about a dozen laboratories worldwide.

Overseas, chemical genetics is being used in the field of drug discovery. At ESR, it is likely to be applied to the field of microbial forensic investigation and could have useful applications in monitoring environmental pollution.

The scientists at ESR and Victoria are using yeast as a target organism for the chemical genetics research.

"The internal machinery of yeast is similar to that of a complex mammal, but yeasts are very easy and cheap to grow. The 5000 genes that make up a yeast cell have been sequenced, so the components that go to make up a yeast cell are well defined.

"We can use the yeast cell as a 'laboratory mouse' to find out what happens inside a cell when you do different things to it. Using a library of mutant yeasts we are able to test each individual gene separately to see what happens when we add, say, a chemical to it.



"If we can understand which genes affect the response of the yeast to that chemical, we can learn a lot about how that chemical is affecting the cells or, if we already know what the chemical does, about what is happening inside the cell as it responds to the chemical. We can choose whether we use the technology to help us understand the biological effects of the chemical or whether we use it to help us understand living organisms," she said.

"One of the current projects is looking at the biological activity of the toxins from *Karenia brevisulcata* responsible for the devastation of marine life in Wellington Harbour when those algae bloomed in 1998."

Preliminary results of drug-driving study

Preliminary results from a drug-driving study are showing that cannabis as well as alcohol may be a major factor in road fatalities.

In 2004 ESR and the New Zealand Police began a long-term study analysing blood samples from most driver fatalities within New Zealand. The aim is to assess which drugs, including alcohol, have been used by drivers killed in motor vehicle accidents.

The results so far show:

- 40% of the drivers killed on our roads between 2004 and 2006 used alcohol, cannabis or both prior to death.
- 30% of all drivers who use cannabis and are killed in motor vehicle accidents are likely to have smoked within three hours of driving. This puts them at high risk of being under the influence of the drug whilst operating the vehicle.
- Poly drug use is prevalent. Drivers are mixing prescription drugs with alcohol or illicit drugs. (Work internationally has shown that medicinal drugs can affect a person's ability to drive safely).

To ensure the role of drugs is not overstated, the study also uses the crash reports produced by the police.

The long-term research is set to continue for several more years with about 2000 driving deaths being studied.

Toxicologist and study leader Helen Poulsen said that samples from 85-90% of fatally injured drivers were analysed.

National Centre for Lifecourse Research

ESR is a partner in the newly formed National Centre for Lifecourse Research based at the University of Otago. Several New Zealand and international research groups are involved in the Centre, which is studying human health and development, families, relationships, and social outcomes over the lifecourse. www.lifecourse.ac.nz

Drug discovery centre

ESR is involved in a new virtual research centre for biology and drug discovery. The Bio-molecular Interaction Centre is a collaborative project between ESR, Crop and Food and Canterbury, Lincoln and Otago Universities. The Centre will focus on drug discovery, biotechnology and the development of new bio-nanomaterials.

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For further information about ESR visit
www.esr.cri.nz