ACT Government
Health

ACT Population Health Bulletin

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Contents

Upcoming Events

- **27.07.17** - The Menzies Centre for Health Policy is inviting abstracts for its annual Emerging Health Policy Research Conference at the University of Sydney - https://wordvine.sydney.edu.au/files/1736/16250/
- **16.11.17** – 6th Annual NHMRC Symposium on Research Translation -https://www.nhmrc.gov.au/media/events/2017/6th-annual-nhmrc-symposium-research-translation-co-hosted-lowitja-institute?utm_medium=email&utm_campaign=NHMRC%20Research%20Tracker24%20March%202017&utm_content=NHMRC%20Research%20Tracker24%20March%202017+CID_184

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Introduction

A message from the Chief Health Officer

This is the 20th Issue of the ACT Population Health Bulletin, an event worthy of celebration and reflection. The Bulletin started with an idea, then moved to a relatively small first Issue written almost entirely by one author within the then Population Health Division. Over the last five years, the Bulletin has grown in size, presentation, diversity of content, and circulation. Now 230 individuals and 32 organisations throughout the ACT and nationally receive the quarterly Bulletin and each Issue has a targeted distribution based on the key stakeholders for the particular theme. Copies of the Bulletin are also held in the ACT Heritage Library and the National Library of Australia. True to its mission, the Bulletin has covered the breadth and depth of Population Health practice in the ACT. In this Issue, there is a call for readers and contributors to provide feedback on the Bulletin to allow us to plan for the future and I encourage all of you to participate in the survey.

In that spirit of looking back and looking forward, this Issue of the Bulletin highlights the historical underpinnings of the ways in which health protection, prevention and promotion are practised today. It is important that we reflect on where we have come from, not so that we remain wedded to concepts or techniques which are now out-dated, but rather to learn from the past so as not to repeat previous mistakes. Additionally, we need to recognise that many of the disease threats from the past have not disappeared and it is only through constant monitoring and maintaining sufficient capacity to respond that we are able to adequately protect the health of ACT residents.

Similarly, we need to look to the future so as to recognise emerging threats and opportunities for response. Here is where Population Health needs to consider 'big picture' issues as important health determinants, which include demographic (population growth, movement and ageing), environmental (global climate change and local exposure to environmental toxins), behavioural (diet and physical exercise, as well as ingestion or exposure to harmful substances such as tobacco, alcohol and other drugs) and technological (including antimicrobial resistance) domains.

The traditional disciplines which underpin population health monitoring, prevention and response such as epidemiology, demography, laboratory science, health promotion, quarantine, sanitation and immunisation remain as pertinent today as they have ever been. Furthermore, there are new disciplines that have the scope to radically change the landscape, including genomics for microbiological diagnosis, precision public health in the form of individual risk assessment and treatment as well as internet-based surveillance methods, real time reporting and sophisticated modelling techniques for decision analysis and health service planning. As evidenced by the expertise and knowledge of the staff who have contributed to this Issue, the ACT is well placed to take advantage of national and international developments in these areas. A special thanks especially to the guest editor, Dr Marlena Kaczmarek, for compiling such an interesting Issue.

Dr Paul Kelly
ACT Chief Health Officer
May 2017

Breaking News

Celebrating five years of the ACT Population Health Bulletin

This edition marks five years since first publication of the ACT Population Health Bulletin. When the Bulletin was published in 2012 we noted that each issue would have a theme and highlight a particular body of work, a key function, or an emerging topic of interest in population health in the ACT. In addition, "hot topics" would be highlighted and upcoming events related to population health in the ACT would be outlined. The twenty issues that have since been published have certainly fulfilled that purpose, as well as raising the profile of the interesting and varied work being conducted throughout the Population Health Protection and Prevention Division of ACT Health.

In case you missed previous issues, here are the topics covered:

- Volume 1 Issue 1 - Emergency Management
- Volume 1 Issue 2 - Preparation for summer
- Volume 2 Issue 1 - Population health data and monitoring
- Volume 2 Issue 2 - Healthy Workers
- Volume 2 Issue 3 - Air Quality in the ACT
- Volume 2 Issue 4 - Obesity in the ACT
- Volume 3 Issue 1 - Population health research and evaluation
- Volume 3 Issue 2 - Food safety in the ACT
- Volume 3 Issue 3 - Sexual health and blood borne virus
- Volume 3 Issue 4 - Tobacco Control in the ACT
- Volume 4 Issue 1 – ACT Health Promotion Grants Program
- Volume 4 Issue 2 – Emerging Infectious Diseases
- Volume 4 Issue 3 – Food and Nutrition
- Volume 4 Issue 4 - Pharmacy Regulation
- Volume 5, Issue 1 - Environmental Hazards
- Volume 5, Issue 2 - Emerging issues in population health
- Volume 5, Issue 3 - Immunisation
- Volume 5, Issue 4 - Population Health Data
- Volume 6, Issue 1 - Healthy Ageing in the ACT

All of these can be found at http://www.health.act.gov.au/healthy-living/population-health

We hope you have found the Bulletin useful in your professional and academic workplaces. We are constantly striving towards quality improvement; to this end, you will find a link below to a brief survey about your experience of reading and/or contributing to the Bulletin and about how we may improve future issues.

Please take five minutes to tell us what you think at: https://www.surveymonkey.com/r/T798YJM

We look forward to reporting back on the findings in the August 2017 issue of the ACT Population Health Bulletin.

Preventative Health Forum

On 10 April 2017, the Minister for Health, Meegan Fitzharris, MLA, hosted a Preventative Health Forum. The Forum represents the first step in an ongoing process to engage with the community in relation to the development of a comprehensive preventative health strategy.

In attendance at the Forum were two eminent international public health experts – Dr Ruediger Krech, Director of Health Systems and Innovation at the World Health Organization and Professor Rob Moodie, Professor of Public Health from the University of Melbourne and the University of Malawi.

The Forum highlighted the importance of prevention, and the wide ranging impact that preventative health activities have on the community as a whole. Effective preventative health activities/interventions often have significant co-benefit to other key policy areas of government and the community.

Prevention is better than cure, and the evidence shows that by focussing on prevention, significant improvements to the quality of life of individuals are achieved, which in turn reduces pressure on an already highly pressured hospital/health system.

The Forum was attended by approximately 65 people, including a very broad range of stakeholders, including:

- Politicians and key advisers;
- Non-government organisations;
- Business owners;
- Peak representative bodies;
- Consumer representatives;
- Clinicians; and
- Government representatives.

Image: Preventative Health Forum. ACT Health

For more information contact PHD@act.gov.au.

Breaking News

Gift of Life DonateLife Walk

On 1 March 2017, Minister for Health Meegan Fitzharris, MLA participated in the annual DonateLife Walk around Lake Burley Griffin. Now in its eleventh year, the Gift of Life DonateLife Walk provides an opportunity to recognise those touched by organ and tissue donation, including donor families and recipients. The free community event is also a perfect time to start conversations with family and friends about becoming an organ and tissue donor by registering through the Australian Organ Donor Register. The 2017 Walk attracted almost 4,500 people.

Minister Fitzharris acknowledged the generosity of the 20 ACT organ donors and their families in 2016, who enabled 59 people to receive life saving organ transplants. In the latest Organ Donation and Transplantation Outcomes Report 2016, the ACT recorded the highest donation rate per million population (dpmp) of 32.3, a result that was well above the national rate of 20.8 dpmp.

Minister Fitzharris also announced that the ACT Government has committed $150,000 to Gift of Life over three years to continue raising awareness of organ and tissue donation.

For more details on the Gift of Life DonateLife Walk visit: www.giftoflife.asn.au, or to learn more about organ and tissue donation phone DonateLife ACT on 6174 5625 or visit www.donatelife.gov.au.

Images: DonateLife Walk 2017. Gift of Life

Acronyms and Resources

Acronyms

AAQ	Ambient Air Quality
ACT	Australian Capital Territory
AMR	Antimicrobial resistance
BAM	Beta Attenuation Monitors
CDC	Centers for Disease Control and Prevention
DDT	Dichlorodiphenyltrichloroethane
DIP	Diabetes in pregnancy
DNA	Deoxyribonucleic acid
ECDC	European Centre for Disease Prevention and Control
EPA	Environment Protection Authority
FDA	Food and Drug Administration
FSANZ	Food Standards Australia New Zealand
GC	Gas chromatography
LMWQCC	Lower Molonglo Water Quality Control Centre
MALDI -TOF	Matrix Assisted Laser Desorption/Ionization - Time of Flight
MLST	Multilocus sequence typing
MLVA	Multiple locus variable number tandem repeat analysis
MROs	Multi-drug resistant bacterial organisms
MS	Mass spectrometer
NATA	National Australian Testing Authorities
NCQ	Non-communicable disease
NEPM	National Environment Protection Measure
NPS	Novel psychoactive substances
PCR	Polymerase Chain Reaction
PFAS	Perfluoroalkylated substances
PFGE	Pulse field gel electrophoresis
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PHPP	Population Health Protection & Prevention
PM	Particulate matter
TBX	Tryptone Bile X-Glucuronide
TEOM	Tapered Element Oscillating Microbalances
TSP	Total Suspended Particulates
UN	United Nations
USSR	Union of Soviet Socialist Republics
WGS	Whole genome sequencing
WHO	World Health Organization

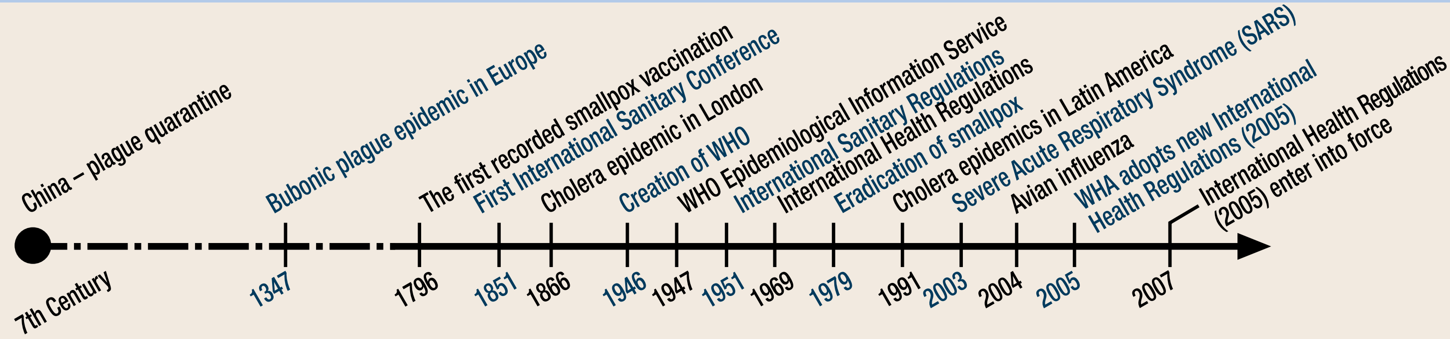
Resources

- Healthy Canberra: ACT Chief Health Officer's report - http://www.health.act.gov.au/datapublications/reports/chief-health-officers-report-2016
- Towards Zero Growth: Healthy Weight Action Plan - http://www.act.gov.au/healthyliving
- Smoke free in the ACT - http://www.health.act.gov.au/public-information/public-health/tobacco-and-smoke-free
- Smoking in Pregnancy project - http://www.health.act.gov.au/healthy-living/smoking
- Food Safety - http://www.health.act.gov.au/public-information/businesses/food-safety-regulation
- Perfluoroalkylated substances - http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas.htm
- Gift of life - www.giftoflife.asn.au

Snap shot

Timeline of significant events in public health

World Health Organization (WHO) timeline of significant events



Source: World Health Organization

A timeline of key dates in the Victorian campaign for sanitary reform, United Kingdom

1832	A severe outbreak of cholera affects many British towns and cities and prompts investigation on the part of the medical community.
1833	Dr. Robert Baker submits his *Report to the Leeds Board of Health* outlining his investigation into the cholera outbreak in Leeds.
1841	The periodical *Punch* is launched.
1842	Edwin Chadwick publishes his *Report into the Sanitary Conditions of the Labouring Population of Great Britain.*
1844	The Health of Towns Association is established to put pressure on the government to bring about sanitary reform.
1848	The Public Health Act is passed by Robert Peel's government, establishing a Central Board of Health as well as corporate boroughs with responsibility for drainage and water supply to different areas.
1849	The Metropolitan Sanitary Association is established to campaign for adequate public health provision for London (not covered by the Public Health Act of 1848).
1849	John Snow publishes *On the Mode of Communication of Cholera*. A second edition is published in 1855, this time including findings from the case of the Broad Street pump.
1849	The Morning Chronicle begins a series of letters and articles looking at the issue of sanitary reform. These are published daily until the end of 1850.
1849	Britain suffers another outbreak of cholera. 10,000 people die in three months in London alone.
1850	The Metropolitan Sanitary Association publishes its first report.
1850	Charles Dickens begins to publish his journal *Household Words*.
1854	The outbreak of cholera documented by John Snow in the second edition of *On the Mode of Communication of Cholera* begins.
1858	A revised Public Health Act is passed, abolishing the Central Board of Health and creating local boards responsible for preventative action and reform.
1866	Parliament passes the Sanitary Act making local authorities responsible for the removal of 'nuisances' to public health and for the removal or improvement of slum dwellings.

Source: British Library

A history of public health in NSW, Australia

The arrival of Captain Arthur Phillip and the First Fleet in Sydney Cove, Port Jackson in 1788, and the subsequent establishment of the colony of New South Wales, began the history of the NSW public hospital system. Several medical staff arrived with the First Fleet, among them Dr John White, Ship's Surgeon. The Colonial Medical Service was soon established to provide basic medical care for the convicts and others. A temporary hospital was constructed at Sydney Cove, with many convicts being housed in tents in the hospital grounds. The arrival of the Second Fleet showed the inadequacy of this arrangement, as the extremely harsh conditions exacted a high death toll. Construction soon began on more permanent convict hospitals, at Windsor, Bathurst, Liverpool and Goulburn in the early 1800's. Sydney Hospital was finally opened in 1816. These convict hospitals were progressively handed over to civilian control, as the transportation of convicts to NSW ceased in 1841. Some financial assistance was given by the government, although little control was exercised over their operations.

It wasn't until the 1850s that public health administration commenced in NSW. The main concerns at this time were infectious diseases and sanitation - two issues still of great importance to public health today. In 1881, the first NSW Board of Health was established as a response to the smallpox epidemic under the provisions of the *Infectious Diseases Supervision Act*. The aim was to provide a "Board of Advice to assist in preventing the spread of small pox". It was decided that the Board of Health would comprise of at least six members, appointed by the Governor.

The first *Public Health Act* was introduced in NSW in 1896 and was responsible for increasing and clarifying the powers of the Board. The revised *Public Health Act of 1902* consolidated existing Acts and made provision for an increase in the number of Board of Health members from six to ten, four of which had to be legally qualified medical practitioners. Whilst the Board of Health was a statutory body, local authorities were required to provide quarterly written reports detailing both public health and the administration of the Public Health Act within their district. In April 1904, a Department of Public Health was established, with the Board of Health and the Health Officer of Port Jackson being brought under the control of the Colonial Secretary's Department.

Subsequent amending Acts to the *Public Health Act of 1902* further strengthened the powers of the Board. The Board became responsible for the supervision of the various public health acts, including the *Abattoir Act of 1850, Quarantine Acts, Infectious Diseases Supervision Act of 1881, Dairies Supervision Act of 1886, the Leprosy Act of 1890, the Noxious Trades and Cattle Slaughtering Act of 1894, the Pure Food Act of 1908, the Private Hospitals Act of 1908* and the *Diseased Animals and Meat Act of 1902*.

Source: NSW Health

Snap shot

Demographics over the last century

Alexandra Raulli, Epidemiology Section, Population Health Protection & Prevention

The Australian population has profoundly changed over the past 100 years. Today Australians are older, live longer, more likely to live in capital cities, have fewer children and are more likely to be born overseas in countries outside of the British Isles.[1]

Compared with 100 years ago, Australia's population is now older and has an even distribution of males and females. At the turn of the 20th century, the population was influenced by male dominated immigration with men outnumbering women by around 110 to 100, the median age of the population was 22 years with only 4 percent of the population was aged 65 years and over.[1] In 2015, the ratio of males: females was 99:100; the median age of the population was 37.4 years, with 13.6 percent of the population aged 65 years and over.[2]

In 1916, 41 percent of Australia's population lived in capital cities,[1] by 2016, 67 percent of the Australian population lived in capital cities.[3] This is expected to increase in the next fifty years, with Australian Bureau of Statistics projections estimating that by 2053 72 percent of the Australian population will live in a capital city and of those capital city residents, 89 percent will live in the four largest capital cities (Figure 1).[4]

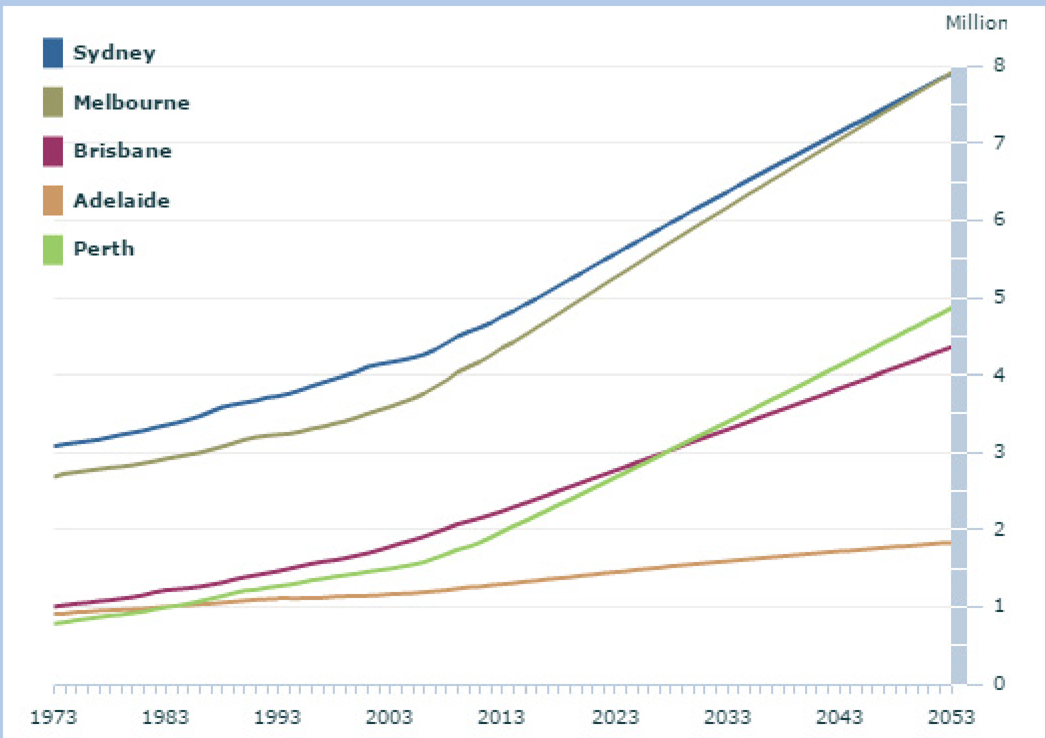


Figure 1: Estimated and projected population, larger Greater Capital Cities - 1973 to 2053. Source(s): Regional Population Growth, Australia (cat. no. 3218.0), Population Projections, Australia, 2012 (base) to 2101 (cat. no. 3222.0)

Life expectancy at the turn of the century (1901-1910) was 55.2 years for males and 58.8 years for females. Today life expectancy at birth is 80.4 years for males and 84.5 for females.[5] The improvements in life expectancy over the century are due to falling rates of child mortality, maternal mortality and later in the century a reduction in deaths from heart disease.[6]

Fertility rates have fluctuated over the century but overall there was a drop in Australia's total fertility rate from an average of 3.1 babies per women of child bearing age in 1921 to 1.9 babies in 2011.[1] We now have smaller families and women are becoming mothers later in life.[1]

Since Federation, immigrants from Britain and Ireland made up three quarters of all Australia's overseas born population, however following World War II immigrants were coming from other European countries such as Italy, Germany and Greece.[1] After the dismantling of the White Australia policy in 1973, migrants from all parts of the world, notably from Asia have been arriving in Australia.[1] In 2016, after the British Isles and New Zealand, immigrants from China (2.2 percent of Australian population) and India (1.9 percent of Australian population) are the largest groups of overseas born Australians.[7]

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Sanitation from ancient civilisations to the present

Radomir Krsteski, Environmental Health, Population Health Protection & Prevention

Sanitation: don't mess it up

Early sanitation systems date back more than five thousand years. Sanitation developments were driven by the necessities to make efficient use of natural resources, to make civilizations more resilient and improve the standards of life. Improvements in sanitation practices have not been a continuous journey but riddled with a series of discontinuities and regressions. The Dark Ages was a notorious period for poor sanitation and in large parts of the world this has continued through to the present, with more than 946 million people still defecating in the open. Canberra as a modern, planned city did not have to go through the growing pains of Australia's colonial unsanitary past. Before the Australian Parliament's first sitting at Parliament House in Canberra, the government of the day made sure that a state of the art sewage treatment works in Weston Creek was operational. Canberrans are very lucky and should not take sanitation for granted, given how important sanitation is to the health and well being of our community.

Sanitation: a not so new concept

Effluent sanitation systems, commonly known as sewage systems, are not a modern invention. It is well documented that most of the technological developments relevant to water supply and wastewater are not the achievements of present-day engineers, but date back more than five thousand years.[1] These developments were largely driven through necessity: it was essential to make efficient use of natural resources, ensure civilizations were resistant to destructive forces of nature, and improve living standards in growing cities. Evidence of sanitation systems have been discovered as far back as the Bronze Age (ca. 3200–1100 BC) in Crete (Minoan), Aegean islands, and Indus Valley civilizations.[1] Sanskrit writings from as early as 2000 BC illustrate how to purify foul water by boiling and filtering.[2] Ancient civilisations realised that good sanitation was essential for prosperity and growth.

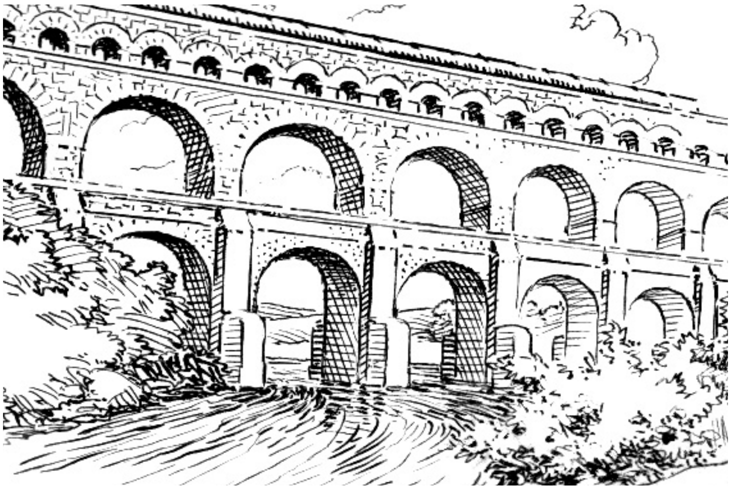

Image: Roman aqueduct. Wikicommons

These civilisations developed and engineered many technological marvels such as aqueducts, cisterns, filtering systems, sedimentation basins, rainfall-harvesting systems, terracotta pipes for water supply and sewerage, as well as sewerage and drainage systems. An example of these early achievements was in Mohenjo-Daro, an early Bronze Age City 400 km north of present-day Karachi, Pakistan.[1] This planned city received water from at least 700 wells, had bathrooms in houses, sewers in streets, as well as thermal baths. The ancient Romans and Greeks inherited these technologies, with the Romans developing these further in scale and application. These advancements are not only of significant cultural heritage, but underpin modern applications in water engineering and management practices. Ancient civilisations such as the Minoan had flushing toilets equipped with seats resembling present-day toilets and drained by sewers, with some of these systems still operating to this day.[1,2] Clearly, the notion that quality of life is directly related to sanitation standards is not a recent development.

However, improvements in sanitation practices have not been a continuous journey but instead have been riddled with a series of discontinuities and regressions.[1] These regressions most notably occurred during the Dark Ages, but still occur through to the present day. Globally, there are currently more than 946 million people still defecating in street gutters, behind bushes or into open bodies of water.[3]

Sanitation in Early Australia

In the early period of Australian colonisation, water supply systems, proper roads and sewerage systems were viewed as not necessary and too costly.[4] Methods of sewage disposal in early Australia can be categorised into two groups: the dry method and the water-carriage method. The dry sewage disposal method consisted of designated cesspits that were fixed or movable. Effluent from houses would be dumped in these cesspits that would be later cleared by horse and cart. The water carriage method consisted of open and closed drains where sewage from houses would be dumped and mixed with stormwater which generally carried untreated waste into creeks, rivers or the ocean.[2,4] In rural areas, toilets were simply holes that were covered over when full or pails that were emptied into holes. This approach to sanitation was rather crude and a regressive step in comparison to our ancestors.

Image: Cesspit. Wikicommons

Colonial sanitation management was not sustainable. As cities grew, poor sanitation management hampered economic growth and quality of life, and this was the case in Britain and other parts of the world. In 1858, the NSW Government surveyed sanitation in Sydney and found that the ad hoc approach to sanitation resulted in inadequate drainage of sewage and removal of filthy matter, resulting in foul drainage running down the back or front walls of the houses where it would accumulate, soaking down into foundations, or sometimes even running in through doorways. Besides being unsightly and offensive, poor sanitation can drastically affect the health and economic growth of a community.[4] Poor sanitation can spread disease and contaminate drinking water supply as well as agricultural crops. The cholera epidemic in Britain during 1831-32 was attributed to poor sanitation.[4,5]

One of the first (although incidental) environmental movements of the nineteenth century sweeping the Commonwealth was the social and moral reformers. These reformers argued that the state of sanitation shaped the moral character of the individual. This renewed concern on sanitation and led to the passing of the *Public Health Act of 1848*. Social reformers of the time, led by Edwin Chadwick, demonstrated that the health of the working class was linked to economy performance.[4,5] Money spent on improving public health was cost effective because it had an economic benefit and would save money in the long run.[5]

Sanitation from ancient civilisations to the present *(continued)*

The fundamental requirement for a satisfactory sanitation system was the supply of water to each home. Chadwick considered that the most important steps to improve the health of the public were: improved drainage systems and the provision of sewers; the removal of all refuse from houses, streets and roads; and the supply of clean drinking water to each home and business.[5] The *Public Health Act of 1848* and work performed by Chadwick was fundamental in changing practices in Australia as all laws and statutes in force in England applied to colonial Australia.

What has always underpinned a good sanitation system was the supply of water to each home, which allowed adequate flow rates to be achieved in sewers and drains. Good design of drains and sewers ensured that sewers didn't block and drinking water was not contaminated. During the nineteenth and early twentieth century, environmental movements pushing for better sanitation were occurring in Australia and across the world, leading to the resurgence of sanitation innovators such as Thomas Crapper, who brought flushing toilets to the masses (hence the famous saying 'sitting on the crapper').[6] These movements were fundamental in bringing about sanitation management and the subsequent prevention of disease in early Australia.

Canberra, the Lucky City

The city of Canberra was fortunate from its very beginning. The city, and the Australian Capital Territory, was developed with the knowledge that it would house the Australian seat of Government. As such, Canberra did not have to go through the growing pains of Australia's other major cities. Before our first sewage treatment plant was operational in 1927, drainage and sewerage was very basic but had already been planned. The ACT's early sewerage system consisted of three temporary, self-contained sewerage works with separate septic tanks, built so they could be connected to a future permanent sewer main.[7,8]

Work began on the Main Outfall Sewer in 1915, which connected the city to the proposed Weston Creek Sewage Treatment Plant. This work was stopped in 1917 due to various reasons, including the lack of resources as a result of World War I.[7] Work recommenced in 1922, after Parliament's decision to move from Melbourne to Canberra. Construction of four more additional intersecting sewer lines also commenced, which connected the majority of the city to the main sewer lines. Canberra's first sewage treatment plant began operating in 1927 at Weston Creek, just before the first sitting of Parliament in Canberra.[7]

By this time, technology had significantly improved and the Weston Creek Sewage Treatment Plant released high quality water into Weston Creek which flowed into the Molonglo River, and on into the Murrumbidgee River.[7,8] The treatment process consisted of screening to remove detritus, grit settlement tanks to remove gravel and sand, primary treatment using sedimentation tanks to settle out organic material, and secondary treatment using trickling filters (Figure 1) to further reduce organic material before water being released.[7,8] Trickling filters were a significant advancement in sanitation; they comprised of huge a bed of generally crushed rock (or other coarse media) roughly two metres deep and up to 60 metres in diameter.[9] Primary treated sewage is gently sprayed over the surface and purified as it trickles downward through the rock bed, coming in contact with layers of microorganisms (biofilm) attached to the course media. The microorganisms absorb the organic matter in the sewage by stabilising it through aerobic metabolism.[9] This process removes the majority of organic pollutants from sewage and is still used around the world today.

The ACT sewerage system is a complex network of pipes to every home and business. Sewage from households and businesses is fed through this network to sewerage mains which flow into pump stations, trunk sewers and then to treatment plants. Most of Canberra's network is still designed to use gravity. Sewage flows down to sewerage pump stations, is collected in large wells, and when the sewage level gets high enough it starts the pump automatically. The pump stops when most of this sewage is pumped away to the pump station or treatment plant itself.[8]

Figure 1: Weston Creek Sewage Treatment Trickle Filters.[10]

As Canberra grew, the Weston Creek Treatment Plant could no longer meet the demands of Canberra's sewage alone. As a result, the Belconnen Water Pollution Control Centre and Fyshwick Sewage Treatment Works were built to treat sewage that could not easily be dealt with at Weston Creek. The Lower Molonglo Water Quality Control Centre (LMWQCC) became operational in 1978. It was the ideal solution to service the needs of Canberra's rapid population growth, and was able to increase its capacity to match future population growth. In 2017, the Control Centre treats 109 million litres of Canberra's wastewater daily.

Underpinning a good sanitation system is the continuous monitoring of its performance and potential environmental impact. Released treated sewage water is extensively monitored to ensure both high water quality and minimal ecological impact downstream. Ecological surveys of fish, small crustaceans and insects provide essential information on the river's health. The treated water from LMWQCC also plays an important role in ensuring adequate environmental flows that contribute to the Murray-Darling Basin river system, especially during dry periods.[7]

Sanitation from Ancient Civilisations to the Present *(continued)*

Why we shouldn't take effluent for granted

The World Health Organization (WHO) highlights the fact that 2.4 billion people around the world do not have access to adequate sanitation systems, such as toilets or latrines, with 946 million people still defecating in the open, in street gutters, behind bushes or directly into open bodies of water. In addition, at least 10 percent of the world's population is thought to consume food irrigated by untreated wastewater.[8] Crops irrigated with sewage contaminated water can lead to outbreaks of cholera, hepatitis and typhoid. Untreated sewage should not be used to irrigate food crops. Outbreaks of disease attributed to poor sanitation are still a major cause of death in the world today. The WHO estimates that poor sanitation contributes to 280,000 diarrhoeal deaths annually as well as tropical diseases, intestinal worms, schistosomiasis, and trachoma.[3] These illnesses are also a significant cause of malnutrition in developing countries.[3,12]

To put things in perspective and highlight how important sanitation is, following the earthquake that struck Haiti in 2010, poor sanitation practices of UN peace keepers created a much larger humanitarian disaster than the earthquake itself. UN peace keepers camped alongside the Meille River and discharged sewage and wastewater directly into the river. This resulted in one of the largest cholera outbreaks that affected at least 770,000 Haitians and claimed more than 9,200 lives.[11]

Image: Water testing in Haiti. Public Health Image Library

So the next time you flush a toilet, take a moment to consider how lucky we are that we live in Canberra and how important sanitation is to the health and well being of our community.

Image: Toilet. Freedigitalphotos.net

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Article

Evolution of Environmental Health Regulation and Emerging Environmental Toxins: A New Precautionary Approach

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Throughout the world there are various examples of the evolutionary journey that environmental health regulation has taken. That evolution shifted public and regulatory focus away from primarily economic concerns such as adulteration and substitution to ones of safety. Environmental health protection has always played catch-up to emerging contaminants that pose health and environmental risks. Emerging toxins such as perfluoroalkylated substances commonly known as PFAS that caused growing concern globally and locally regarding the potential health and environmental effects associated with their use. The ongoing uncertainty about the impacts of chemicals such as PFAS illustrates why environmental regulation has taken a precautionary approach.

Environmental Health: a New Frontier

Throughout the world there are various examples of the evolutionary journey that environmental health regulation has taken. In the United States what is now known as the *Food, Drug, and Cosmetic Act* evolved from important events marked by legislative changes in 1906, 1938, and 1962. That evolution shifted public and regulatory focus away from primarily economic concerns such as adulteration and substitution to ones of safety. The steps taken in that evolution were often marked by specific events which dramatically influenced regulation.[1]

At the same time developments in the environmental regulatory sphere were also occurring, capturing physical and chemical agents found in the workplace and in the general community environment. There was a growing concern about air pollution and water pollution, ionising radiation, industrial and commercial chemical products, hazards in the industrial workplace, and the disposition of industrial chemical wastes and the potential impact on human health.[1,2]

The publication in 1962 of Rachel Carson's "Silent Spring" generated widespread public concern over the dangers of improper pesticide use, notably Dichlorodiphenyltrichloroethane (DDT), and the need for better pesticide controls.[1,2] This was also later emphasised during the Vietnam war and with the use of Agent Orange. The ecological effects of pollution and the integrity of the environment have historically been, and are currently, raised as concerns, but the human health impacts have been the main rallying point for political action with the environment generally being a secondary beneficiary.[1] This has historically been played out on a number of occasions, for example, acute air pollution events such as Donora, Pennsylvania in 1948 and the great smog of London, England in 1952.[1,3] The latter spurred Sir Winston Churchill, the then Prime Minister, to introduce the *Clean Air Act of 1956*, which restricted the burning of coal in urban areas and authorised local councils to set up smoke-free zones.[3]

Emerging Modern Threats

This approach is still evident today where health outcomes still take a lead role in environmental protection. Environmental health protection efforts have always played catch-up to emerging contaminants that pose health and environmental risk. However, evolution has seen that the current approach is not reactive to events that result in the loss of life; regulatory action is now taking a risk based approach. It can be difficult to assess the safety of any new compound or chemical, and predict any potential undesirable effects, particularly if a compound/chemical does not show an immediate toxic effect. Undesirable effects such as bioaccumulation may take decades to manifest.[2] Therefore it is essential that regulatory systems are flexible, adaptive and responsive even in the absence of the proverbial "smoking gun". Perfluoroalkylated substances (PFAS) are one such group of chemicals of increasing concern, globally and locally. The concerns relate to the potential health and environmental effects associated it's use. PFAS are a group of manufactured chemicals that have been continually in use since the 1950s.[4,5,6,7,8]

PFAS were revolutionary compounds when first introduced, due to their ability to repel water, oil and combined with their high thermal stability, they provided a number of useful industrial applications such as:

- fire fighting foams;
- carpets;
- scotch guard and stain resistance;
- leather, textiles and upholstery;
- paper and packaging;
- make up and personal care products;
- coatings and coating additives such in non-stick pans;
- industrial and household cleaning products;
- pesticides and insecticides;
- photographic industry;
- hydraulic fluids; and
- metal plating.[4,5,6,7,8]

Image: Firefighting. Wikicommons

The three main PFAS types of public health concern are perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexane sulfonate (PFHxS). The same reason that these chemicals were found to be useful is the same reason that these chemicals are now creating a concern.[6,7] They are inert, stable and thermally resistant which allows these chemicals to persist in the environment for a long time.[4, 5,11,12] These properties and widespread use over 60 years means that many types of PFAS are now ubiquitous global contaminants. The biggest concern with these substances is bioaccumulation, meaning the concentration of these chemicals increases over time in animals and humans.[4,5,11,12] At high concentrations, certain PFAS have been linked to adverse health effects in laboratory animals.[4,5,9,11,12,16] Continued exposure to these chemicals and the potential for bio-magnification/concentration through the food chain can result in excessive accumulation in the body.[12] Notwithstanding this, studies have shown that there is a limit to how much bioaccumulation can occur and that serum concentrations of PFAS can reach steady state despite continued exposure and a long half-life.[9,15]

Evidence suggests that long chain PFAS (PFOS, PFOA and PFHxS) are of greater concern because of the time is takes for humans or animals to naturally rid their bodies of those componants.[4,5,11,12]

Evolution of Environmental Health Regulation and Emerging Environmental Toxins: A New Precautionary Approach *(continued)*

Luckily in Australia, food surveys by Food Standards Australia New Zealand indicate that levels of PFAS in the general food supply are low.[14] While short chain PFAS chemicals still persist in the environment they are much more readily expelled by animals and humans and do not have the same bioaccumulation properties as long chains PFAS. As such, these may be viable replacements for the long-chain PFAS.[8]

A New Approach

Due to the potential for accumulation, coupled with the uncertainty around the risk of PFAS to cause adverse health effects, it is prudent to take a precautionary approach in dealing with PFAS and PFAS contamination. Many countries have phased out, or are in the process of phasing out, the use of PFAS. In Australia, most contamination sites have been associated with the use of fire fighting foams.[5,6]

In humans it is not conclusively demonstrated that PFAS are related to specific illnesses, even under high occupational exposure.[9,15,16] Recent studies have shown possible associations to some health problems, but there is no evidence that humans are routinely more sensitive than animals.[12,15,16] More research is required before definitive statements can be made about causality or risk related to PFAS exposure. This highlights that there is ongoing uncertainty in relation to the impacts of PFAS contamination and the need for further research globally and locally. There also needs to be an understanding that due to this uncertainty, scientific guidance will continue to evolve and in turn the regulatory framework for dealing with environmental toxin such as PFAS will also evolve.[13,15,16]

Providing guidance and tolerable dietary intake recommendations for PFAS, complimented by the need for environmental investigations as well as taking all reasonable steps to mitigate potential harm, shows another evolutionary step in environmental regulation[13,15,16] This measured precautionary approach demonstrates that regulators are now more adaptive and responsive to emerging environmental threats.

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Antimicrobial resistance: are we facing a return to the pre-antibiotic era?

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Antibiotics radically changed the course of modern medicine, by dramatically decreasing mortality caused by bacterial infections. But the dramatic rise of antimicrobial resistance globally means we are now facing a future that is more like the past, where effective antibiotics were not a treatment option. It is only through the prudent use of existing drugs, surveillance and control of the spread of resistance, and the introduction of new and effective antibiotics that this phenomenon will be slowed and that we can continue to treat bacterial infections as effectively as we have done for decades gone by.

The era of antibiotics

Antibiotics revolutionised the practice of modern medicine and have enabled incredible progress across the spectrum of clinical medicine, including safer child birth and surgical procedures, organ transplantation and immune suppressing chemotherapy regimes.

Before the era of antibiotics, there were no effective treatments for common infections such as pneumonia, gonorrhoea or rheumatic fever. These and other infections were managed with treatments of varying efficacy, including bloodletting, chemical compounds (mercury, iodine, bromine etc.), herbal remedies, and surgery.[1] One longstanding treatment for tuberculosis was a combination of clean air, rest, and posture.[2] Hospitals admitted patients with septicaemia (blood poisoning) contracted from a simple cut or a scratch, and doctors could do little more but wait and hope.[3]

It has long been known that antibiotics are compounds produced by bacteria and fungi that are capable of killing, or inhibiting, competing microbial species. This may explain why the ancient Egyptians promoted the application of a poultice of mouldy bread to infected wounds.[4] However; it was not until 1928 that penicillin, the first true antibiotic, was discovered by Alexander Fleming, Professor of Bacteriology at St. Mary's Hospital in London. Later, Howard Florey (an Australian pharmacologist and pathologist) and Ernest Chain developed the protocol for the purification of penicillin quantities sufficient for clinical testing. This eventually led to penicillin mass production and distribution in 1945 and heralded the dawn of the antibiotic age.[4] Subsequently, infections that had previously been death sentences could be cured in a matter of days by this antibiotic and others to come. All three were awarded the Nobel Prize in 1945 for their contribution to the field of medicine.

Notably, Fleming was among the first to signal the potential for resistance to penicillin to develop if used in too small doses or for a too short a period during treatment.[4] Accepting the 1945 Nobel Prize in Medicine, he said:

"It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to concentrations not sufficient to kill them… There is the danger that the ignorant man may easily underdose himself and by exposing his microbes to non-lethal quantities of the drug make them resistant."

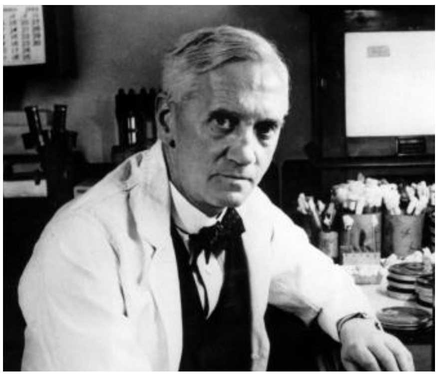

Image: Sir Alexander Fleming. Wikicommons

Fleming, a biologist, knew that antimicrobial resistance is to a certain extent a naturally occurring phenomenon. For example, bacterial replication cycles provide the opportunity for mutations in DNA to occur, allowing for the emergence of genetic factors that contribute to resistance to antibiotics.[5] But what Fleming was cautioning against was the acceleration of antimicrobial resistance (AMR) through inappropriate use of these highly effective drugs.[4]

Fast forward to the 21st century and Fleming's prediction has proven correct. AMR has become a global public health issue, and the most powerful contributor to resistance is the global unrestrained misuse of antibiotics in both human and animal health, and in agriculture.[5]

Antibiotic resistance

AMR is the resistance of pathogenic infections against anti-bacterial, anti-viral and other medicines. In recent years AMR has attracted significant attention internationally and has been identified as a threat to global health security.[6]

In May 2015, the World Health Assembly adopted a global action plan on AMR with the aim of ensuring treatment and prevention of infectious diseases with quality-assured, safe and effective medicines remains achievable into the future.[7] In September 2016, the United Nations (UN) General Assembly held a high level meeting on AMR; only the fourth occasion that a health issue has been taken up by the UN General Assembly.

The most striking examples of resistance, in terms of morbidity and mortality, concern bacteria. Multi-drug resistant bacteria or so-called 'Superbugs' are bacteria with enhanced virulence due to high levels of resistance to multiple antibiotics specifically recommended for their treatment.[5] Today, multi-drug resistant bacterial organisms (MROs) are associated with significant morbidly and mortality, as therapeutic options for these organisms are reduced, and periods of hospital care are extended and more costly.[8,9] Recent estimates suggest at least 700,000 people die each year directly from drug resistant pathogens. If the current situation is left unchecked, this toll will exceed 10 million annually by 2050 and cost the global economy, in total, over 100 trillion USD in lost productivity.[8]

AMR is not isolated to specific geographical areas; high rates of resistance have been observed in all WHO regions in bacteria that cause common health-care associated and community-acquired infections.[10] The extent of resistance varies across different countries and regions of the world; unsurprisingly, this variation strongly correlates with the extent of antibiotic use in different areas.[4] Travel, trade, and poor infection prevention and control practices contribute to the spread of drug resistant organisms both within and between geographical regions.

While MROs in Australia continue to be predominantly associated with hospital settings, over the last decade these infections have started to emerge as an issue in long-term care facilities (e.g. aged care) and in the community. For example, while methicillin resistant *Staphylococcus aureus* (so-called "golden staph) began as a hospital-acquired infection, in some regions it has become a major community-acquired pathogen, and may cause infections in people who are otherwise healthy.[11]

Antimicrobial resistance: are we facing a return to the pre-antibiotic era? *(continued)*

Imagining a post-antibiotic future

It is a reality today that some bacteria are now so resistant that the infections they cause are virtually untreatable with any of the currently available antibiotics.[12] In the face of escalating antimicrobial resistance, there are real concerns that we are facing a future that is more like the past, when antibiotics were not part of our armoury of treatment options.

Without the protection offered by antibiotics, entire categories of medical practice will be impacted. Treatments that require suppressing the immune system, to help destroy cancer or to keep a transplanted organ viable, make people unusually vulnerable to infection. Antibiotics reduce the threat; without them, chemotherapy or radiation treatment could possibly be as dangerous as the cancers they aim to cure. Antibiotics are routinely administered to patients before invasive procedures and surgeries that carry a high risk of infection – including Caesarean sections, open-heart and abdominal surgery. Without effective antibiotics the infection risks posed by these procedures will radically increase.

In 2016 a landmark 'Review on Antimicrobial Resistance', commissioned in 2014 by the United Kingdom government, underscored that tackling AMR is key to the long term economic development of nations and to population health.[8] Recognising the threats to the health system and to public health more broadly, governments around the world are moving to slow the development of AMR through national strategies and programs and international collaboration. These focus broadly on the four core actions that are known to prevent antibiotic resistance:[12]

- Preventing infections in the first place - through immunisation, safe food preparation, hand washing, and using antibiotics as directed and only when necessary;
- Surveillance of antibiotic-resistant infections - critical to understanding the magnitude, distribution and impact of AMR and to evaluate interventions to combat the problem;
- Antimicrobial stewardship – a collective set of strategies to improve the appropriateness and minimise the adverse effects of antibiotic misuse, including resistance; and
- Developing new antibiotics and rapid diagnostic tests.

In June 2015, the Australian Government released its first National Antimicrobial Resistance Strategy. This strategy affirms that at all levels of government a coordinated and multi-disciplinary approach is required to address AMR and sets the framework for Australia's national response to this public health issue.[13] The Strategy acknowledges that minimising the development of resistance in livestock and companion animals is an essential component of Australia's response and has adopted a 'One Health' approach. This approach recognises that human, animal and ecosystem health are inextricably linked and that actions need to occur across all sectors where antimicrobials are used.[13]

Conclusion

AMR is a massive challenge but it is one where the human and economic costs compel us to act to avoid the prospect of a post-antibiotic era. It will take commitment and investment from governments at all levels, and across human and animal health and agricultural portfolios. While historically, MROs have been largely confined to the hospital setting, we know that this pattern is changing. Practitioners right across the health sector, from population and community health to acute and residential care, need to engage with this issue, from both prevention and control standpoints. Public health professionals, with specific expertise in surveillance and outbreak management, leveraging partnerships and developing evidence-based guidelines and policy, are key stakeholders in this endeavour.

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Case Study

Whole Genome Sequencing (WGS) for public health surveillance: A focus on *Listeria monocytogenes*

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Laboratory methods to subtype foodborne disease pathogens are commonly undertaken to assist with public health surveillance. Subtyping strains that cause human infection can help to monitor disease trends, detect clusters of illness, investigate outbreaks, and distinguish between outbreak-associated infections and sporadic infections.[1-3]

The bacterium *Listeria monocytogenes* is one that is routinely subtyped for surveillance. *L. monocytogenes* causes listeriosis, a serious infection transmitted through contaminated food.[4] It is most likely to affect pregnant women and their newborns, people with weakened immune systems, and people aged 65 years or older.[4] The symptoms of listeriosis can vary and include fever, diarrhoea, flu-like symptoms, headache, loss of balance, and convulsions.[5] Listeriosis infection can have severe outcomes, leading to miscarriage, stillbirth, premature delivery, or life-threatening infection of the newborn in pregnant women and encephalitis, meningitis, and/or septicaemia in others.[5,6] Detecting outbreaks of listeriosis is important to identifying sources of infection, implementing control measures, and preventing further illness.

A national enhanced *Listeria* surveillance scheme has been implemented in Australia to improve national surveillance.[7,8] This scheme ensures that when *L. monocytogenes* is cultured from a person's specimen, the isolate will be referred to a reference laboratory to undergo a number of standardised rapid subtyping techniques including serotyping, binary typing, multilocus sequence typing (MLST), multiple locus variable number tandem repeat analysis (MLVA), and previously, pulse field gel electrophoresis (PFGE).[7,9] These conventional typing methods are useful to differentiate cases with different strains of listeriosis for public health surveillance and they have shown significant economic and public health benefits.[10]

For example, following the implementation of the national enhanced *Listeria* surveillance scheme in 2010, a multi-jurisdictional outbreak was detected after the OzFoodNet network recorded an increase in a common strain of *L. monocytogenes* (serogroup 12b, 3b, 7, binary type 158 and PFGE 121:119:1).[7,11] This resulted in an immediate public health investigation, which identified nine cases from three states associated with the outbreak. Epidemiological evidence and microbiological evidence from food samples implicated melons as the likely source of illness.[11] The availability of subtyping data of *L. monocytogenes* isolates from humans and food sources at a national level helped to identify the outbreak early, and helped to link a food source to illness, resulting in effective mitigation strategies to prevent further contamination.[7,11]

Whole genome sequencing (WGS), the process of reading an organism's genome,[12] has recently emerged as an alternative to conventional typing methods. As WGS uses all of the genetic information of an organism, it offers a highly discriminatory typing method for differentiating closely related isolates and assists in tracking trends and identifying sources of infection.[13]

In the US, a number of organisations, including the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA), began to prospectively perform WGS from September 2013 on all available *L. monocytogenes* isolates from patients, food, and food processing environments in order to enhance listeriosis surveillance and control.[14] They found that implementing WGS for *L. monocytogenes* has transformed listeriosis outbreak surveillance and response by detecting more clusters, linking cases to a likely source of infection, identifying unrecognised sources of *L. monocytogenes*, and stopping *L. monocytogenes* outbreaks while they are still small.[14,15] In addition, there are several examples in the literature from the US and Europe that demonstrate how the high discriminatory power of WGS has helped to investigate listeriosis clusters and outbreaks, link sporadic cases to food sources, and recognise low-intensity, extended time-period outbreaks that are linked to food products, establishments, or production facilities.[16-20] WGS has redefined what a typical listeriosis outbreak looks like, with fewer cases per outbreak and cases potentially spanning longer periods of time.

Image: Laboratory testing. ACT Government

In Australia, the *Listeria* reference laboratory (Microbiological Diagnostic Unit – Public Health Laboratory) began to prospectively sequence *L. monocytogenes* isolates from 2014.[21] The laboratory found that WGS offered increased resolution to existing typing methods, facilitated interlaboratory comparison better than PFGE, and was less expensive and less labour intensive than conventional typing methods.[21] In addition, serotype, binary type, and MLST can be predicted from WGS data with high concordance.[21]

Case Study

Whole Genome Sequencing (WGS) for public health surveillance: A focus on *Listeria monocytogenes* (continued)

The high discriminatory power of WGS has demonstrated its potential to be an important tool for the public health surveillance of foodborne disease pathogens. Internationally, the use of WGS for foodborne disease pathogens has continued to increase, with the US CDC expanding their WGS program to include other foodborne disease pathogens, Public Health England routinely sequences *Salmonella* isolates, and the European Centre for Disease Prevention and Control (ECDC) is committing to using WGS as the choice method for typing microbial pathogens over the next five years.[22-24] As Australia transitions to WGS for prospective and routine typing of more and high-throughput pathogens, defining when to rule isolates in or out of an outbreak, how data is reported, and timeliness are some challenges that need to be addressed.[21] It will be important for epidemiologists, microbiologists, and bioinformaticians to work together more closely than ever before for the effective implementation of WGS for the public health surveillance of foodborne disease pathogens.

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Article

The journey of food safety

Cathy Watson, Environmental Health Policy and Projects, Population Health Protection & Prevention

Australia now has some of the lowest rates of foodborne illness in the world, however historically food adulteration was common and highly hazardous to health. Australian food legislation developed in an ad-hoc manner, with no harmonisation between states and territories until 2000 when consistent food safety standards were agreed across Australia and New Zealand. A risk-based regulatory approach combined with a consultative decision-making process now supports Australia to deliver the greatest benefit to the community.

Food safety issues continue to emerge. While the incidence of foodborne gastroenteritis in Australia is dropping overall, illness caused by Salmonella and Campylobacter is increasing. Authorities are working with producers to reduce the level of contamination during production and processing stages. However education of consumers about safe storage, transport, and preparation of high risk foods is also essential to reduce the incidence of foodborne illness.

History of food safety

Along with other Western countries, Australia has some of the lowest rates of foodborne illness in the world.[1] This wasn't always the case.

There are many historical practices described in Britain that were likely to have been used by settlers in Australia. By 1850, it is believed that up to half the food consumed in cities was adulterated in one way or another,[2] and many of the additives posed a significant health hazard.

Milk was regularly watered down (often with dirty water) and treated with sodium bicarbonate to disguise souring. In the 1890s, boric acid or formaldehyde were added to milk as a preservative. It is believed that adulterated milk caused significant infant deaths from diarrhoea.[2]

There were descriptions of diseased meat being dressed with fat from healthy animals to make it look healthier and hams being brushed with a mix of borax, creosote and red tar dye so that they looked smoked.[2]

Used tea-leaves were collected from hotels and coffee houses, mixed with gum and black lead and sold as fresh tea, while cocoa regularly had fine earth and butter fat added to it.[2]

Bread, the staple food for most people, was also the most commonly adulterated food with chalk, bone meal or aluminium salts (alum) added to flour to make the bread look whiter. It is likely that long term intake of alum may have contributed to rickets in children.[3]

By 1900, colouring compounds including lead, arsenic, coal tar and mercury were widely used in the food industry.[2] These are all highly toxic to humans[4,5] and the use of arsenic in beer brewing caused 70 deaths in England in 1900.[2]

From the 1880s, understanding developed about the role played by bacteria in food contamination. Concerns arose over the adulteration of food and led to the introduction of laws regulating food in Australia. The New South Wales (NSW) government passed the *Adulteration of Bread Act* in 1838 and the *Victorian Public Health Act* of 1854 empowered the Board of Health to inspect, seize and destroy unwholesome food. This was followed by the NSW *Adulteration of food prevention Act* of 1879. Unfortunately these Acts were described as being ineffectual.[6]

THE USE OF ADULTERATION.

Little Girl. "IF YOU PLEASE, SIR, MOTHER SAYS, WILL YOU LET HER HAVE A QUARTER OF A POUND OF YOUR BEST TEA TO KILL THE RATS WITH, AND A OUNCE OF CHOCOLATE AS WOULD GET RID OF THE BLACK BEADLES!"

Image: Cartoon. Punch. 4 August 1855

Food safety gradually increased but Australian food legislation continued to develop in an adhoc manner and state and territory legislation did not keep pace with the changes in food processing, new foods or changes in diet over time. There were also increasing challenges for food businesses working across jurisdictions with different regulatory requirements in each state and territory.[7] Between 1910 and the 1980s, a number of attempts were made to introduce uniform standards for food in Australia but they were only partially successful.[6]

Risk-based regulation

In August 2000, consistent food safety standards were agreed across Australia and New Zealand, and all states and territories then amended their food acts to underpin these standards.[8] In the ACT, the standards were adopted by the *Food Regulation Act 2002*.

Food Standards Australia New Zealand (FSANZ) sets, develops and maintains the Australia New Zealand Food Standards Code (the Food Standards Code). FSANZ's objectives are to protect public health and safety, provide adequate information about food so that people can make informed choices, and prevent misleading or deceptive conduct.[9]

FSANZ uses a risk analysis approach to develop or revise food standards, monitor and investigate activities, assess food technology practices and to consider emerging food safety issues.[9]

The journey of food safety *(continued)*

The Food Standards Code covers a raft of requirements for matters such as labelling, additives, contaminants and microbiological limits. New foods (i.e. foods, or components of foods that have not been traditionally consumed in Australia or that are produced by a process not previously applied to food) are assessed to establish their safety before they are included in the Food Standards Code and added to the food supply. As an example, hemp seeds were recently approved as a food and are being added to the Food Standards Code with their sale permitted from November 2017.[10]

The food standards support importers, producers, food businesses and retailers to follow a risk-based, preventative approach to providing safe and suitable food to consumers. The food safety standards are based on the principle that food safety is best ensured by implementing food hygiene controls at each stage of food handling and implementing additional risk management tools, such as food safety programs, for high-risk food industry sectors.[11]

Challenges in food safety

There are always emerging issues in food safety. In 2015, frozen berries contaminated with hepatitis A were imported to Australia from China and 33 people contracted the virus. Swift action was taken to recall the berries and inspect and test all imported berries. FSANZ has now issued guidance on inactivation of the virus in berries and the Department of Agriculture requires importers to demonstrate that imported berries have been handled using good agricultural and hygienic practices.[12] Fortunately incidents like this are rare and levels of hepatitis A are steadily falling in Australia, including the ACT (See Figure 1).

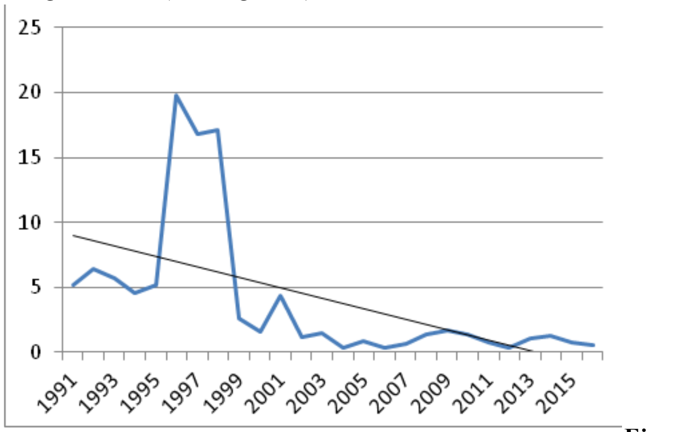

Figure 1: Rate of hepatitis A notifications per 100,000 population in the ACT 1991-2016

While the incidence of foodborne gastroenteritis in Australia is dropping overall, illness caused by Salmonella and Campylobacter is increasing[13] and these trends are reflected in the ACT[14] (see Figures 2 and 3).

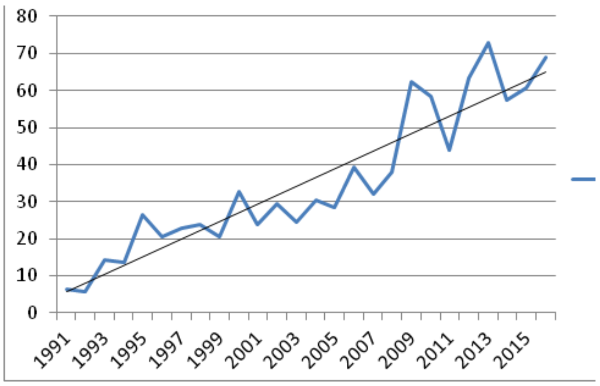

Figure 2: Rate of salmonellosis notifications per 100,000 population in the ACT 1991-2016

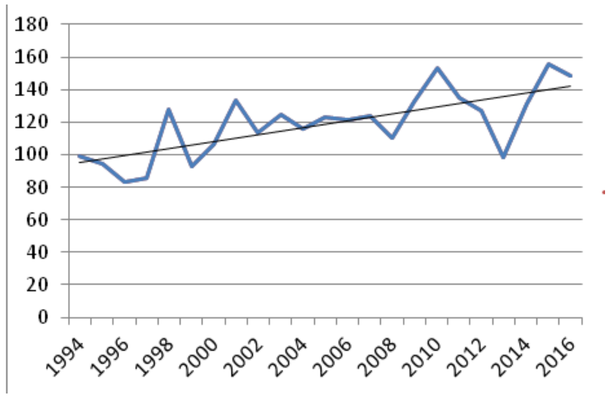

Figure 3: Rate of campylobacteriosis notifications per 100,000 population in the ACT 1994-2016

Most *Salmonella* illnesses are associated with egg or poultry consumption.[15] Poorly cooked or stored poultry are also the primary source of exposure to Campylobacter. Children aged less than four are most at risk of illness but people over 70 are also increasingly vulnerable to Campylobacter. Interestingly, men have a higher incidence of Campylobacter infection as do young adults.[16]

Some reasons for the increasing rates of illness from Salmonella and Campylobacter infection include the increasing age of our population, inadequate safety practices and poor knowledge about high risk foods and foodborne infection.[17] While there is always significant publicity about food outbreaks in food businesses, most incidents of foodborne illness occur after eating home cooked food and are rarely reported.[12]

Australians are also eating more of the foods that carry the highest risk for Salmonella and Campylobacter infection; between 2009 and 2016 the rate of chicken meat consumption rose by 50 percent[18] and the per-capita consumption of eggs increased by 15 percent.[19]

New Zealand has the highest incidence of Campylobacter infection in the developed world, however in 2007-2008, the number of cases declined by 54 percent following the introduction of a range of voluntary and regulatory interventions to reduce contamination of poultry in primary production and processing.[20] Australia followed suit in 2012, introducing a national Primary Production and Processing Standard for Poultry Meat. This Standard requires businesses that process poultry to control their food safety hazards, be able to trace their products and demonstrate compliance with the Standard.

The incidence of Campylobacter infection dropped significantly in Australia in 2013, including the ACT (see Figure 3), but then rose again over the following two years. Rates of Salmonella infection continue to rise in Australia[10], including in the ACT (Figure 2). In response to this, FSANZ and state and territory food regulatory agencies have been developing guidance for producers so that they can check the effectiveness of their controls for the production and processing of poultry.[21]

The high rates of Salmonella and Campylobacter illness in Australia can be mitigated by reducing the level of contamination in products sold to consumers and properly handling (including storing, cooking and serving) such food products at home. Ongoing education of consumers about safe storage, transport, and preparation conditions for high risk foods is very important.

The journey of food safety *(continued)*

Despite these challenges, Australia now has one of the safest food supplies in the world. A risk-based regulatory approach combined with a consultative decision-making process supports Australia to deliver the greatest net benefit to the community whilst providing appropriate protections.[9]

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Article

Safe public spaces – tobacco and smoke-free policy

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Australia has made great strides in reducing smoking rates, moving from 49 percent of people smoking in 1945 down to 13.3 percent of people older than 13 smoking daily in 2013.

The public health policy response to the harm associated with second hand smoke has been incremental with people protected under some circumstances in some states and territories, but remaining exposed in others.

The ACT was a leader in smoke-free legislation in Australia in the 1990s, however the introduction of the *Smoke Free Public Places Act 2003* unintentionally slowed this progress. The Act had to be amended to allow a new smoke free area, which was a complicated and lengthy process. In 2016, amendments were made to allow the Minister to establish new smoke-free public places and events by declaration. This is now supporting faster introduction of new smoke-free areas.

Anti-smoking sentiment is increasing worldwide and this is reflected strongly amongst the ACT population. The ACT is reviewing a range of options to reduce people's exposure to second hand smoke.

Image: Anti-smoking poster. American Lung Association 1977

History of smoking in Australia

Tobacco smoking was introduced to Australia in the early 1700s by Indonesian fishermen visiting Aboriginal and Torres Strait Islander communities.[1] British patterns of tobacco use were transported to Australia in 1788 and by the early 19th century tobacco was routinely issued to servants, prisoners and conditionally released convicts as an inducement to work.[2]

By 1945, 49 percent of people (72 percent of men and 26 percent of women) were regular smokers[2] and until the 1980s smoking was permitted nearly everywhere including hospitals, school buildings, buses, trains and planes.

Publicity regarding the health effects of smoking first emerged in the 1950s and early 1960s[2], however economic dependence on tobacco growing and the manufacture of tobacco products created demands for government assistance and support for tobacco consumption. By the 1980s, tobacco leaf growing was the most heavily government-subsidised economic sector in Australia.[3]

Image: Cigarette advertising. Wikicommons

In the 1960s and 1970s, restrictions were passed on broadcasting and voluntary agreements were reached on minimal health warnings on packages and advertising. This was followed in the 1980s by print advertising restrictions and bans as well as sponsorship replacement. There were also educational campaigns, major tax increases, government-endorsed strong health warnings, and some limited restrictions on environmental tobacco smoke. Legislation and regulations were often piecemeal and their introduction protracted, due to extensive pressure from tobacco-related interests both in the economy and within political parties.[3]

History of Second hand Smoke Legislation in Australia

There has been an incremental public health policy response to the harms of second hand smoke in Australia. People have been protected from harm by legislation under some circumstances but have remained exposed in others.[4]

During the late 1980s and early 1990s, concerns about the health effects of exposure to second hand smoke led to restrictions on smoking in more and more workplaces. The Commonwealth Department of Health implemented a smoke-free workplace policy in 1986 and by the mid-1990s, smoke-free policies had been introduced extensively including in all government offices, many shopping centres, hospitals, schools, childcare settings and entertainment venues.[2]

In the 1990s, the ACT was a leader in smoke-free legislation in Australia. The *Smoke-free Areas (Enclosed Public Places) Act 1994* enabled various public places to be declared smoke-free. Under this Act the ACT was the first state or territory to prohibit smoking in restaurants. Other states and territories followed and, by 2003, all states and territories had implemented smoke-free indoor dining.[2]

In 1998, the ACT was also the first state or territory to prohibit smoking in pubs and clubs with no exemption given for high roller rooms in casinos, as has occurred in a number of other states and territories.[2]

Second hand smoking policy

In 2013, "Future Directions for Tobacco Reduction in the ACT 2013-2016"[6] was launched by the Chief Minister, Katy Gallagher MLA. This document initiated a public consultation on options for new smoke-free areas in outdoor public places[7] and it has influenced the direction of smoke-free initiatives taken in the ACT.

Article

Safe public spaces – tobacco and smoke-free policy *(continued)*

The National Tobacco Strategy 2012-2018[5] aims to improve the health of all Australians by reducing the prevalence of smoking. It includes a priority area to reduce exceptions to smoke-free workplaces, public places and other settings. This strategy was endorsed by all state and territory Health Ministers in 2012.

Image: Plain packaging. Australian Government 2006

Current second-hand smoke legislation

<u>Prohibited smoking areas in the ACT</u>

Under the *Commonwealth Air Navigation Act 1920* and the Interstate *Road Transport Act 1985* smoking is prohibited on aeroplanes and buses.

The ACT S*moke-Free Public Places Act 2003* prohibits smoking (including personal vaporisers) in the following places:

- enclosed public spaces (including the high roller area in the Casino);
- outdoor eating and drinking places (there may be designated outdoor smoking areas of licensed premises);
- under-age functions;
- within 10 metres of children's play equipment in public play spaces (by declaration); and
- declared public events.

Smoking is prohibited in cars with children under the *Smoking in Cars with Children (Prohibition) Act 2011*.

In addition, smoke-free policies are in place in the ACT in the grounds of many major facilities, including all hospitals and ACT Health facilities, ACT Government schools, all tertiary institutions, the GIO Stadium and Manuka Oval.

Declaration of new smoke-free public places and events

Until 2016, new smoke-free areas could only be created through primary legislation in the ACT. This contributed to long delays in introducing smoke-free areas and the ACT has fallen behind other states and territories in introducing new smoke-free public places. In 2016, an amendment to the *Smoke-Free Public Places Act 2003* allowed the establishment of new smoke-free public places and events by Ministerial declaration. This is now enabling the ACT to introduce new smoke-free areas more quickly.

The first declaration was made under this amendment in September 2016 to prohibit smoking within 10 metres of children's play equipment in public play spaces.

Image: Playground. Public Health Image Library

The ACT and WA are the only jurisdictions that have not yet implemented tobacco-free areas at public-transport waiting areas. An ACT consultation on smoke free public transport waiting areas ended in April 2017 and is currently being considered by the ACT Government.

Future of public places smoking legislation in the ACT

Growing evidence about the health effects of smoking has contributed to a deluge of anti-smoking sentiment worldwide.[2] This is reflected strongly amongst the ACT population. The ACT has the lowest daily smoking rate in Australia for people aged 14 or older (9.9 percent in 2013, compared to 13.3 percent nationally).[8]

Future tobacco interventions in the ACT will align closely with the actions of the National Tobacco Strategy but will also consider local influences and needs. More than 80 percent of respondents to the 2015 public consultation by the ACT Government on options for new smoke-free areas in outdoor public places supported skate parks, public building entrances, sporting events and outdoor public swimming pools being made smoke-free.[5] The *Public Pools Act 2015* made it an offence to smoke within the boundary of a public pool.

Smoke drift in multi-unit developments is an emerging and complex issue due to the private nature of the dwellings and the rights of residents within their own homes. The ACT Government has released a fact sheet to advise residents and Body Corporates of their options for managing this issue.[9] NSW introduced the *Strata Schemes Management Act 2015* which specifically includes smoking as a possible nuisance or hazard and increases the by-law enforcement powers of owners corporations. Queensland is also consulting on a recommendation to introduce a by-law to change the power of a body corporate so that smoking can be prohibited in an outdoor area where that smoke drifts to an adjacent lot.[10]

Safe public spaces – tobacco and smoke-free policy *(continued)*

Third-hand Smoke

Smoking leaves residual particles on surfaces and in dust. These particles can be inhaled, ingested or absorbed through skin and are particularly likely to affect young children who play at floor level, put contaminated objects in their mouths and have close physical contact with parents or carers who smoke. The health hazards of this 'third-hand smoke' are not yet fully understood however in-vitro and animal studies have demonstrated a range of health effects that may impact on human health, including toxicity to the liver and lung, reduced wound healing and hyperactive behaviour.[2]

If it is confirmed that human health is impacted by third-hand smoke this could lead to more severe tobacco restrictions.

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Article

Health promotion practice: then and now

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This article summarises the development of health promotion through the ages – from its conception in Rome where the first aqueducts provided safe drinking water, through to the ACT Towards Zero Growth: Healthy Weight Action Plan which aims to prevent the growth in overweight and obesity levels in the ACT now.

Introduction

Health promotion is the process of enabling people to increase control over their health and its determinants, thereby improving their health.[1] It takes a proactive approach to reducing or eliminating modifiable risk factors for disease and contributes to reducing demand on the health system. It is an intrinsic part of population health and without it, key messaging about health protection and prevention would not reach the broader public and changes in action and attitudes would not be realised.

Health promotion – then

In 312 BCE, a Roman censor named Appius Claudius arranged the building of the very first type of aqueduct. It brought water from the hills into the city of Rome, mostly through an underground tunnel.[2] By about 300 BC, Rome had a population of more than half a million people and could no longer rely on local rivers or groundwater alone. Being able to bring water from far away using canals and aqueducts was important because once there is a large settled population, nearby water becomes contaminated.[3] The Roman system of aqueducts to supply fresh, safe drinking water to Rome and other major population centres such as Pompeii is one of the first known initiatives to prevent disease in a community of people.

Another well-known example is Edward Jenner's discovery of a smallpox vaccine. In the late 1790s, he realised that contracting the mild disease, cowpox, protected against the often fatal disease, smallpox. He experimented on several pauper children by deliberately infecting them with cowpox. They were then protected against subsequent smallpox infection. The interesting point about Jenner's work is that he didn't know smallpox was caused by a virus as they weren't discovered until about a century later, and he didn't know anything about how the body's immune system reacted to the cowpox infection to give protection.[4] It wasn't until about a 150 years later that governments began mass immunisation programs to reduce the number of infections from diseases like polio, measles, whooping cough, diphtheria and others.

In the 19th century government authorities began significant action to prevent disease on a broader scale. In the United Kingdom in 1848, the *Public Health Act* regulated for clean water, sewers and waste disposal. In 1854 a doctor/anaesthetist called John Snow, realised that a cholera outbreak in a particular region of London was linked to its water supply.[5] It was not until 1883 that the bacterium responsible for the disease was identified.

Toward the end of the 1800s, disease causing bacteria were first identified and the use of microscopes allowed a better understanding of bodily function. This led to the development of antibiotics and vaccines to reduce infectious diseases. In 1900, 30.4 percent of all deaths occurred among children aged younger than five years; in 1997, that percentage was only 1.4 percent. In 1900, the three leading causes of death were pneumonia, tuberculosis, diarrhoea and enteritis, which (together with diphtheria) caused one third of all deaths. Of these deaths, 40 percent were among children aged younger than five years.[6]

Doctors and governments began to focus on ill-health as a product of disease caused by germs or a loss of body function.[5] As a result, health care began to be dominated by the "biomedical model". This was a significant advance in many respects, particularly in the understanding, treatment and cure of infectious diseases. Doctors and medicine are critically important in the treatment of people who are already ill. The downside of the biomedical model is that it doesn't take into account the wide range of other health determinants that allow the illness to occur in the first place.

Thomas McKeown was a doctor who pointed out that, in fact, the number of people dying from infectious diseases had reduced even before effective medical treatment for those diseases was used. He suggested that rising living standards had a bigger impact on mortality rates than medical treatment. A further refinement of this argument is that improved living and working conditions, better education, improved nutrition and regulation of sanitation meant that the conditions in which disease flourished were eliminated.[7]

After the end of the Second World War in 1945, Australia and other countries increasingly spent money on developing medical technologies. This spending only had a limited effect on improving health and such technologies were not available in poorer countries. By the 1970s, governments in Australia and the rest of the world began to work within a social model of health, focusing on broader health determinants to improve the health of populations).[8]

The Declaration of Alma-Ata was produced at the International Conference on Primary Health Care with 134 countries in 1978. Alma-Ata was a city in the former Union of Soviet Socialist Republics (USSR). The Declaration starts by reaffirming the WHO definition of health as a state of complete physical, mental and social wellbeing. The Declaration finishes by pointing out that the attainment of health by the people of one country directly concerns and benefits every other country. At its core, the Declaration is based on the principle that every person is entitled to the highest possible level of health.[8]

In 1986, the first International Conference on Health Promotion was held in Ottawa, Canada. It produced a charter "for action to achieve Health for All by the years 2000 and beyond". This charter, the Ottawa Charter for Health Promotion builds on the philosophy of the Declaration of Alma-Ata. The Charter sets out five 'action areas' for the promotion of health[8]:

- Build Healthy Public Policy - Policy in all areas of government needs to be examined for its impact on health.
- Create Supportive Environments - Living and working conditions have to be assessed for health impact, especially in the areas of technology, energy production and urbanisation. Natural resources have to be conserved and the natural environment protected. This highlights the need for ecological sustainability in promoting health.
- Strengthen Community Action - Communities can and should determine their needs and how those needs can be best met. Community empowerment and participation assists this process.
- Developing Personal Skills - This allows people to have more power in decisions affecting them. People can take informed action to promote or protect their health if they have the necessary information, training or other resources.
- Reorient Health Care - The health sector needs to move toward health promotion, and beyond simply providing clinical and curative services. Changes to the attitude and organisation of health services are required in order to refocus those services onto the needs of the individual as a "whole person", respecting cultural needs.

Health promotion practice: then and now *(continued)*

Since 1986, there have been eight further WHO international or global conferences of Health Promotion and many other world conferences involving health education and promotion. The world has changed since 1986 so later conferences have explored developments in the understanding of health and health determinants including issues such as the human genome, computer and internet usage, third world debt, climate change, terrorism and globalisation.[8]

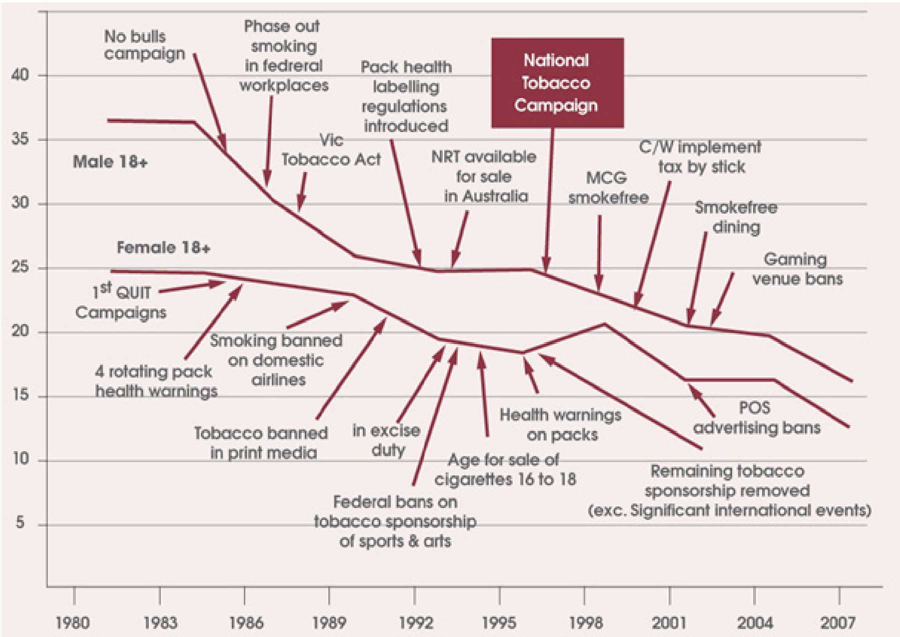

Figure 1: Milestones in reducing smoking in Australia 1980-2007. Source: The Cancer Council of Victoria 2009.

Health promotion now

One of the major changes in population health in the twenty-first century is a change of focus from communicable disease prevention to health promotion and non-communicable disease prevention.

Thanks largely to the success of vaccination, communicable diseases have become only one aspect of modern health promotion work. A second type of disease - non communicable disease (NCD) - is a major population health problem in the world today, and the key focus of health promotion work.

NCDs, also known as chronic diseases or conditions, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors. Modifiable behaviours, such as tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol, all increase the risk of NCDs. An important way to control NCDs is to focus on reducing the risk factors associated with these diseases.

In the ACT, about 80 percent of the burden of disease is attributable to chronic conditions. The ageing of the ACT population, in combination with risk factors such as obesity, smoking and lack of physical activity present a major challenge for ACT Health.[10]

A good example of health promotion in action in the ACT today is the "Towards Zero Growth: Healthy Weight Action Plan". This action plan takes a whole-of-government approach to tackling overweight and obesity. Launched in 2013, it has involved every ACT Government Directorate, to create environments that make healthier choices easier. The plan acknowledges that many of the factors contributing to the rising levels of overweight and obesity lie beyond the traditional reach of the health sector.[10]

The Plan involves diverse sectors including urban planning, transport, school and workplaces, to create healthy policies and challenge the promotion and availability of energy dense, nutrient-poor foods and drinks. Some initiatives so far include healthier food and drink options at schools and workplaces, and improving the delivery of quality physical education programs in all schools for children. There have also been improvements to cycling paths, footpaths, parks and active living principles were being embedded into the planning laws such as the Territory Plan.

Conclusion

Since the first aqueducts were built around 2,300 years ago, factors affecting the health of populations have shifted from predominately communicable disease to non-communicable disease. As a result, health systems have moved away from a diagnosis and treatment only model to also incorporate health promotion, disease prevention, disease-management, rehabilitation and palliative care services. Health promotion practice has evolved over time with a strong focus on outcomes-based programs and initiatives that aim to achieve real change and improve the health of the population.

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Case Study

Health promotion practice: then and now *(continued)*

History of anti-tobacco campaigns and activities

The effectiveness of the modern approach to health promotion – progressive, multi-faceted and wide-reaching – is proven by the declining rates in the use of tobacco in Australia (see Figure 1 on page 22). In the 1950s three-quarters of Australian men smoked. Now less than one-fifth of men smoke.[1]

In the past, before the world understood the serious health and economic impacts that smoking has on communities, tobacco companies were encouraged to openly advertise smoking and the so-called benefits of smoking.[8]

Once research began to prove the detrimental impacts that smoking has on population health in the 1960s, major anti-smoking campaigns began in earnest in the 1970s in Australia. While promotional campaigns were effective in reducing the rates of smoking men and women, a more comprehensive approach was implemented from the 1980s which sought to implement proactive changes within the community and complement promotional campaigns. These included smoking bans in workplaces and public spaces, staged banning of tobacco advertising, increased excise on tobacco products and plain packaging.

A local example

The ACT Chief Health Officer's Report 2014 showed that ACT women are smoking less during pregnancy than their counterparts in other states and territories, with nine percent of ACT women smoking during pregnancy in 2011 compared with 13 percent nationally. However, the lower smoking in pregnancy rate for the ACT is not consistent among all population groups. At the time, the ACT self-reported data on cigarette smoking collected from women who gave birth in the ACT from 2000 to 2011 indicated that smoking during pregnancy decreased significantly with increasing maternal age. Women in younger age groups were significantly more likely to use tobacco during pregnancy, with 44.4 percent of teenage women who gave birth in the ACT reporting they smoked during pregnancy. Also, smoking during pregnancy was significantly higher for younger Aboriginal and Torres Strait Islander women with 68.0 percent of Aboriginal and Torres Strait Islander women aged under 20 years and 59.2 percent of those aged 20–24 years reporting they smoked during pregnancy.

In response to this, the Health Improvement Branch developed a successful business case for the two year Smoking in Pregnancy project to reduce the rates of smoking in pregnancy amongst young women in the ACT. The project includes two key elements targeting young pregnant smokers to encourage smoking reduction/cessation (Quit for you Quit for Two) and young women in general to promote prevention (Your Future's Not Pretty - see promotional images on page 20). An evaluation plan has been developed to capture both process and outcome evaluation, which will inform what is needed to address this issue into the future. It is expected that this project will have a positive impact on reducing the rates of smoking in young women in the ACT.

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Technological changes to testing and reporting in ACT Government Analytical Laboratory

Dr Timothy Altamore, Daniel Andres, Dr Swarup Chatterjee, Deborah Denehy, Ian Fox, Simon Rockliff, Dr Ian Whittall, ACT Government Analytical Laboratory, Population Health Protection & Prevention

The ACT Government Analytical Laboratory (ACTGAL) is made up of four analytical disciplines: these are Environmental Chemistry, Microbiology,Toxicology and Forensic Chemistry. Since the 1950s, when the first Public Health Laboratory in Canberra was formed, technology has changed considerably. This article focuses on some of those changes and how they have affected the work of each of the analytical disciplines.

Environmental Chemistry: Ambient Air Quality Monitoring and Reporting

Changes in technology have led to many significant improvements in the way Environmental Chemistry collects and reports data. Here we focus on two of these technology changes. First are the changes in electronic communications which has seen a move from manual and analogue data collection into the digital and internet world. Secondly the change in detection technology that has allowed the move from the collection of particle samples over a 24 hour period to instruments that can produce a reliable particulate matter concentration in real time for a half hour period. Both of these have seen reporting of data moving from an (at best) monthly time period to being reported hourly.

In the 1980s, Canberra's ambient air monitoring consisted of a station in Civic (monitoring carbon monoxide and oxides of nitrogen), several dust fall sites spread across the city and at least 3 high volume sampling sites collecting Total Suspended Particulates (TSP). Since then the network has grown and changed, with some of the change being driven by technology. In the 1980s, communicating the data for the ACT's ambient air quality involved data being collected as hourly averages by analogue data loggers that took a voltage output from the instrument, converted it to an approximate reading and then stored the data which was then transferred by an officer via dial up modem once a day. After the data was verified it was only being reported in occasional reports released by government.

During the 1990s, a new station was established in the Tuggeranong Valley. Although data was still collected with the same analogue type system, a quarterly report on ambient air quality was published by ACT Health. In 1998, the Ambient Air Quality (AAQ) National Environment Protection Measure (NEPM) legislation was passed in the Federal Parliament. The AAQ NEPM required the publishing of an annual report by each State or Territory. The responsibility for the reporting for the ACT fell to the Environment Protection Authority (EPA) and ACT Health stopped producing the quarterly air quality report once the EPA started publishing the annual report.

Reporting and data collection remained the same for much of the 2000s. While data reports were still released annually, the distribution of the report moved online. Late in the 2000s, work began on introducing digital data logging. All the air monitoring instruments now had the capability to allow digital communication. With this method, direct and exact readings could be obtained from the instruments over short time intervals, stored and then transmitted automatically every five minutes. Digital data logging software is also more sophisticated than analogue versions and is able to log the instrument diagnostics and operating parameters as well as allowing for remote access/control of the instrument. The software can also detect high pollution concentrations or system faults and send out alerts. Late in 2009, the digital data logging system was switched on and data began to automatically download from the sites every 10 minutes.

With digital data logging in place, work began on reporting the ambient air quality data on a website via DataACT. It was decided that the data be reported as an Air Quality Index (AQI) with hourly updates. In late 2014, the ACT's AQI website was launched. Air Quality reports are still released by the EPA on an annual basis. Over the past three and a half decades, communication technology has allowed ambient air quality data to go from periodic reporting in a printed publication to real time reporting on the internet.

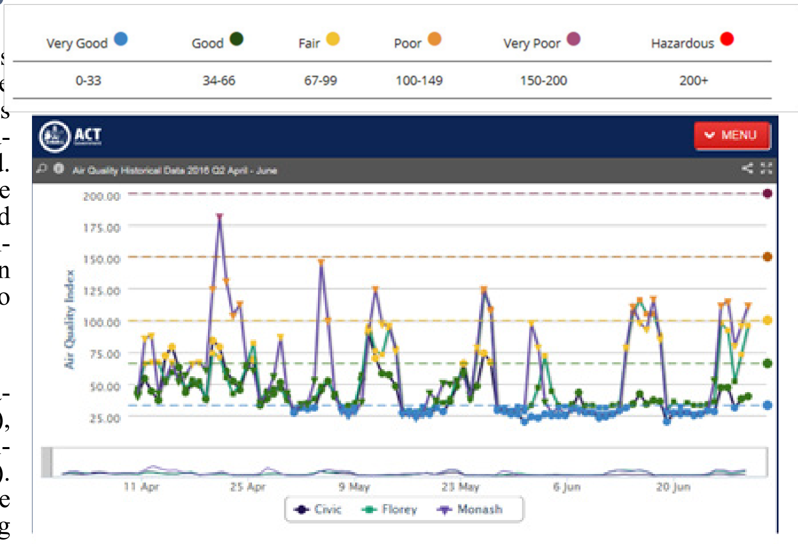

Image: Air Quality monitoring graph April - June 2016. ACT Government

Similarly technology has transformed the monitoring of Particulate Matter (PM) in the ambient air. Initially, PM was monitored using a dust fall method (a monthly average) and high volume samplers (daily average every sixth day). In the 1990s, it was acknowledged that there were negative health effects resulting from high concentrations of PM less than 10 micrometres in diameter (PM_{10}) in the air. This lead to the TSP high volume samples being modified with a size selective inlet so that only PM10 particles would be captured. Further research also showed that PM less than 2.5 micrometres in diameter ($PM_{2.5}$) was also a significant problem that required monitoring as well.

In the early 2000s, new detectors for PM10 were approved for use: Tapered Element Oscillating Microbalances (TEOM) and Beta Attenuation Monitors (BAM). Both these detectors allowed for reliable monitoring of PM_{10} down to half hour intervals. Methods for monitoring $PM_{2.5}$ were developed and started out with low volume samplers collecting samples over a day. Low volume samplers can be loaded with multiple filters and programmed to sequentially sample filters for 24 hour periods. TEOM and BAM monitors were evaluated to sample for $PM_{2.5}$, with approval for their use being made in the late 2000s. When connected to the digital data logging system these instruments provide "real time" PM data.

Technological changes to testing and reporting in ACT Government Analytical Laboratory *(continued)*

Microbiology Food and Water testing

Microbiology is currently a rapidly changing field. After the second world war the introduction of antibiotics and applied research into infectious disease enabled the development of better microbiological techniques for the recovery and identification of bacteria from food and water.[1]

There have been significant changes in Food and Water Microbiology in the last 20 years including the development of selective, selective/differential and Chromogenic media, molecular biology such as Polymerase Chain reaction (PCR) to recover and identify target bacteria.

Polymerase Chain Reaction (PCR) methods, which allow selective and repeated amplification of targeted DNA, enables our laboratory to screen out negative samples which saves time in reporting and cost in consumables.

A positive sample screen can be detected within 48 hours of testing for some pathogens which helps to focus the Public Health response.

Selective and chromogenic media improvements have also decreased the time required for confirmed results for bacteria such as *E.coli*. Colour producing substrates are incorporated into the incubation media which are specific for a target organism. For *E.coli* in Tryptone Bile X-Glucuronide (TBX) media, colony forming units of *E.coli* are blue and obvious to count as in the picture below.

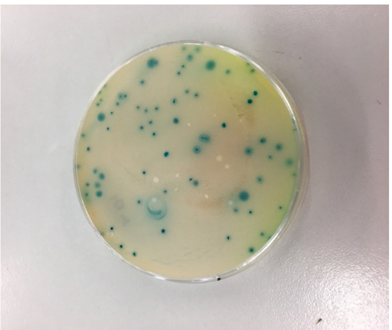

Image: *E.coli*. ACT Government

In previous years, *E.coli* enumeration in food could take up to 96 hours, involving two different selective media each with 48 hours incubation. Using chromogenic agar, a confirmed count of *E.coli* can now be reported within 24 hours of testing.

The future of Microbiology is changing rapidly. Technology such as Matrix Assisted Laser Desorption/Ionization - Time of Flight (MALDI-TOF) and Whole Genome Sequencing can be used for rapid identification of bacteria once a pure isolate is obtained. All new methods and equipment have to be verified before being implemented into the laboratory. Verification includes investigating whether the new approach performs well and can be used competently and safely by staff. Verification takes time but is an important aspect of laboratory work.

Image: Water sampling. ACT Health

Toxicology/Forensic Chemistry

The Toxicology and Forensic Chemistry Unit at ACTGAL provides analytical support for forensic investigations relating to drugs and poisons with analysts providing expert opinion to the ACT Courts when required. Specifically, the service provides analytical toxicology to support coronial investigations, road transport cases and drug treatment programs; and analytical chemistry to support controlled substances legislation and clandestine drug laboratory investigations. In order to perform these duties, a reliance on utilising advanced instrumentation, the adoption of new technologies, and the development of new methods is paramount for continued success.

In the forensic space (as well as other industries) increased sample complexity has driven the need to develop technology to improve separation of complex mixtures into their individual components. This includes resolving drugs and drug metabolites from within biological matrices (such as urine, blood, saliva, etc) as well as separation and identification of illicit substances from diluents or 'cutting agents'. In the early days of illicit substance testing, analysts relied on basic separation and detection techniques such as thin layer chromatography and colour or spot tests.[2,3] However, this regime of testing only provides indications of the drug present with high limits of detection and no definitive structural information for individual components. With the development of gas chromatography (GC) in the 1950s, the ability to resolve similar compounds (for example separating amphetamine from methylamphetamine) along with an improved sensitivity and increased sample throughput was realised.[4] This resulted in increased confidence (through the use of appropriate standards) of the compounds detected and the use of less substance for testing. The increased sensitivity of methods has also allowed the detection of compounds at low levels that were previously unattainable (for example, low dose opiates).[5,6] The coupling of advanced detectors to the GC system, such as a mass spectrometer (MS), represented a major advancement as the mass spectrometer was able to give structural information on the components of the mixture separated by the GC system.[7,8] This allowed operators to routinely identify commonly detected drugs, but also gave some insight into the structural identity of unknown and novel compounds. As such the GC-MS system has become both the workhorse and gold standard in substance identification in the forensic chemistry space and is routinely used within the Toxicology and Forensic Chemistry Unit at ACTGAL.

Over time, the number of substances included in legislation as controlled or prohibited has substantially increased, requiring an increased detection and identification capability[9,10] Currently, detections of novel psychoactive substances (NPS) have also increased worldwide as criminal organisations attempt to circumvent current legislation.[11,12,13] This increase in substance detection has driven the need to develop improved instrumentation and methodologies to detect the vast array of compounds. Within the Forensic Chemistry area, this has resulted in the detection of synthetic cannabinoids, novel amphetamine-type substances and synthetic opiates. Changes in legislation have also stimulated new ways of performing testing on samples supplied to the Unit. For example, the RTA introduced random oral fluid testing, which required the development of a robust analytical drug confirmation technique.[14,15,16]

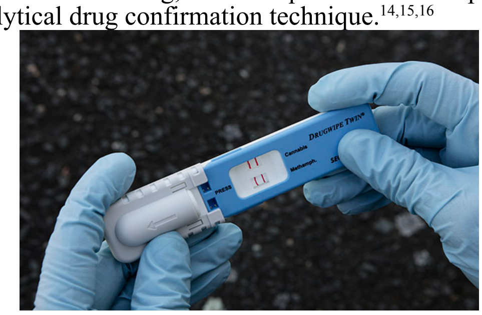

Image: Roadside drug test. ACT Policing

Technological changes to testing and reporting in ACT Government Analytical Laboratory *(continued)*

With the establishment of the National Australian Testing Authorities (NATA) after the Second World War came an increased awareness of quality control, method validation processes and industry standards.[17] Within the forensic space, adoption of these processes has resulted in the rigorous testing of methods and techniques to both clearly define appropriate uses and more importantly to identify and be aware of significant limitations. This gives the scientists of the Toxicology and Forensic Chemistry Unit increased confidence in the validity of results obtained, a reduction in experimental uncertainty and more robust methods for use in the laboratory. Although accreditation to these standards requires significant resources, the benefits in quality, repeatability and robustness far outweigh this initial workload. The Toxicology and Forensic Chemistry Unit currently holds NATA certification.

Image: Forensic testing. ACT Health

Instrumentation and methods used within the forensic space are constantly evolving and improving to address the issues of detection of a broad range of drug and drug metabolites in samples of increasing complexity. Therefore, there is a need to also improve processes to take advantage of technological advances to give increased analysis efficiencies and throughput of samples. The Toxicology and Forensic Chemistry Unit is always looking to improve sample handling, analysis methodologies and data analysis processes to realise this. During the 2015-16 financial year, the Toxicology and Forensic Chemistry Unit at ACTGAL analysed in excess of 8000 samples resulting from illicit drug seizures and toxicological investigations.

Image: Illicit drug samples. ACT Health

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Flutracking: modern surveillance for an age-old problem

Sarah Moberley, and Sandra Carlson, Hunter New England Population Health, NSW Health; and Craig Dalton, Hunter New England Population Health, NSW Health; University of Newcastle; Hunter Medical Research Institute.

Outbreaks and pandemics of influenza have been documented for more than 400 years and have the potential to kill millions. The influenza virus frequently changes, proving a challenge for prevention by vaccination. Current vaccines are developed based on forecasts of which strains of influenza are most likely to circulate, and vaccine immunity is strain specific. Despite being an age-old problem, deaths due to influenza continue to occur and it is critical that health systems are able to recognise the characteristics of an outbreak so that interventions are timely and appropriately directed to those most in need.

Measuring disease or disease surveillance is a corner stone of public health. In economically developed countries, most disease surveillance systems collect information from hospitals, laboratories and sometimes general practitioners. These systems provide important information, but tend to only capture the most severe in the spectrum of disease and take time to collate.

Flutracking started in 2006 and is now the largest citizen's surveillance system in the world; monitoring flu symptoms in over 30,000 people across Australia in winter. Participants are members of the general public who have signed up and everyone is welcome to join. Weekly emails are sent and data are collected on whether participants had fever, cough and whether that sickness resulted in time away from normal activities. Participants who report symptoms consistent with an influenza-like-illness are also asked about whether they sought medical advice, and information about any tests taken to confirm influenza. Responding to the email generally takes less than ten seconds for a person with no symptoms.

The Flutracking system compares rates of influenza-like-illness by vaccination status, age and geography, and reports are available online. Reports are generated weekly, posted on the Flutracking website and distributed to state and national health officials. Flutracking provides near to real-time surveillance and is able to contribute otherwise unmeasured information on the burden of influenza-like-illness in the community.

Join us in measuring the burden of influenza in Australia! More information can be found at http://www.flutracking.net.

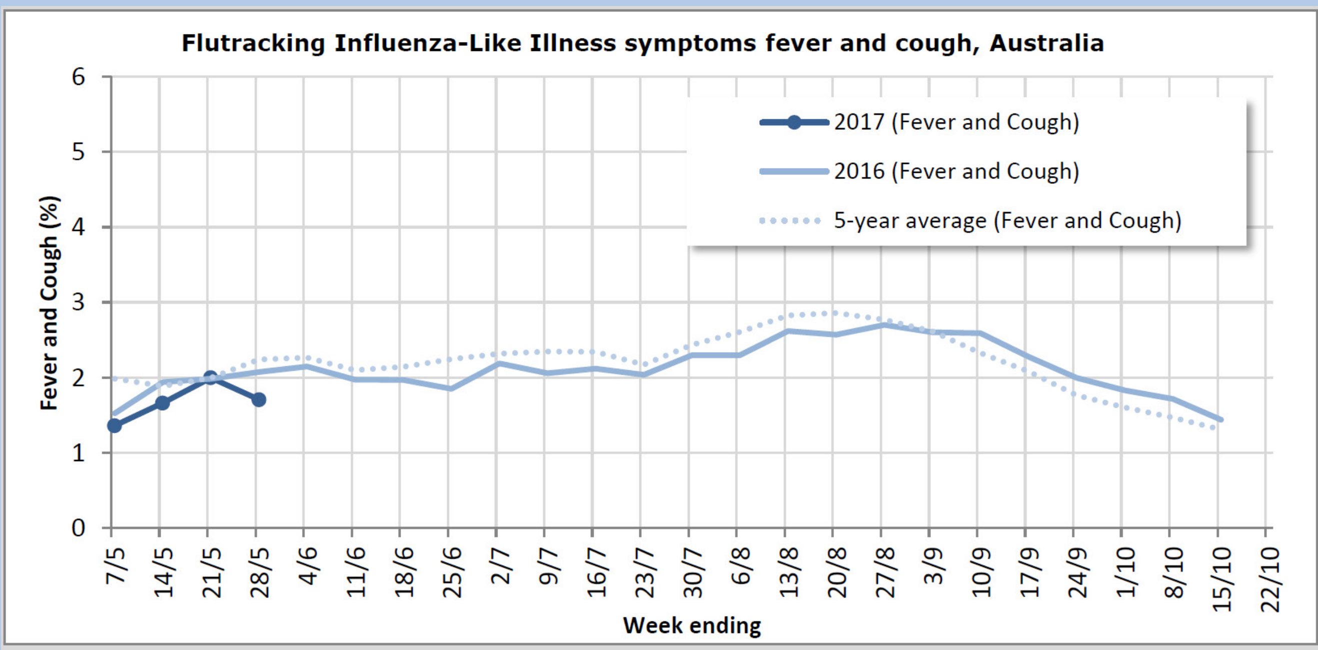

Figure 1: Flutracking influenza-like symptoms feveer and cough, Australia. May 2017. FluTracking

Article

Predicting the future: climate change and public health

Oscar Yang, Epidemiology Section, Population Health Protection & Prevention

In summer 2016–17, Australia experienced prolonged and extreme heat over New South Wales (NSW), southern Queensland, South Australia and parts of northern Victoria, with many records set. January 2017 set the highest monthly mean temperatures on record for Sydney and Brisbane, and the highest daytime temperatures on record for Canberra.[1] Over the last 20 years, the frequency of such intense and large-scale heatwaves has increased in Australia across spring, summer, and autumn.[1] Severe tropical cyclone Debbie in 2017 had caused a long trail of significant destruction stretching from north Queensland and NSW to New Zealand. Although cyclone frequency is unlikely to rise in the Australian region due to global climate change, cyclone intensity is predicted to increase, with more frequent occurrences of destructive cyclones.[2,3] There is ample evidence that climate change is occurring and human activities such as greenhouse gas production and deforestation have been at least partly responsible for the increase in global temperature in the last few hundred years. However, agreement to cut greenhouse gas emissions has so far proved elusive, because it requires nations to sacrifice their own interests and individuals to make significant lifestyle changes.

The Health Impact of Climate Change

Because our health is affected by everything around us, climate change poses significant immediate and long-term threat to human health and wellbeing in many ways. Directly, climate change will cause an increase in frequency and intensity of extreme weather events, leading to mortality, injury, psychological harms, and damage to health infrastructures. Indirectly, climate change affects human health through changing the distribution of infectious diseases, threatening food and water supplies, and undermining social stability. Children, the elderly, socioeconomically disadvantaged populations, and those with pre-existing medical problems are particularly vulnerable.

Infectious Diseases

One major threat to health is the increased risk of infectious diseases. Infectious diseases are highly sensitive to climate conditions. Increasing temperature and changing rainfall patterns will have strong influence on the reproduction, survival, and behaviour of disease vectors such as the mosquitoes that transmit malaria and dengue fever. Slight changes in temperature can significantly affect the replication and development of infectious agents. Climate projections suggest that the geographical and temporal distribution of many infectious diseases is likely to change, which poses significant threats to the health system.[4] The key climatic factors affecting malaria are temperature, precipitation and relative humidity. Australia is projected to remain malaria free in the next 30 years apart from sporadic cases that can be treated effectively.[5] Globally, the epidemic potential of malarial transmission has been projected to increase as a result of climate change.[6] While most previous studies predict increased dengue transmission under climate warming, other modelling studies suggest that dengue epidemic potential may decrease in Australia under climate warming due to mosquito breeding sites becoming drier and mosquito survivorship declining.[6-9] Rising temperature, changes to water supply and extreme weather events are also likely to increase the risk of food and waterborne diseases such as bacterial gastroenteritis and other forms of diarrhoeal disease.[7,10] Climate change can tilt the balance between pathogens and hosts, creating opportunities for pathogens to mutate, jump to new hosts, spread to new regions and encounter populations that lack immunity to fight them off.[11] When this happens, we are at risk of an outbreak of a deadly pandemic.

Extreme Weather Events and Disasters

Reports of extreme weather events and disasters have more than tripled since the 1960s, and such events are expected to become more frequent and severe in the future in many parts of the world due to climate change.[4] The direct consequence of global warming is increased heat stress. Since 1910, mean temperatures across Australia have increased by around 1°C, and the duration, frequency and intensity of extreme heat events have increased across large parts of Australia. This trend is projected to continue throughout the 21st century due to climate change with even more frequent, hotter and longer lasting heatwaves.[3] Because of the heat island effect, people living in urban environments are at particular risk.[11]

Extreme weather events such as floods and cyclones can cause physical and psychological harms, damage health infrastructure, and trigger outbreaks of infectious diseases. Excessive heat is a particularly growing public health threat for Australia as our climate continues to warm. Everyone is at risk during extreme heat events, but elderly, chronically-ill and socioeconomically disadvantaged individuals, people working outdoors and children are particularly vulnerable. Exposure to prolonged heat stress exacerbates existing health conditions and increases the rate of heat-related illness, such as dehydration, heat exhaustion, and heatstroke.[5,12] Exceptional heatwave conditions have resulted in substantial increased rates of ambulance call-outs, Emergency Department presentations, hospital admissions, and mortality in Australia.[13] During the heatwave in January and February 2009 in southeastern Australia, there were an estimated 374 excess deaths in Melbourne and 50 to 150 in Adelaide, with more than 3,000 reports of heat-related illnesses.[14] In Europe, the 2003 intense and extended heatwave is estimated to have claimed about 35,000 to 70,000 lives across Europe with the economic cost of $13 billion.[11] Heatwaves also increase the risk of bushfires and exacerbate drought and urban air pollution.

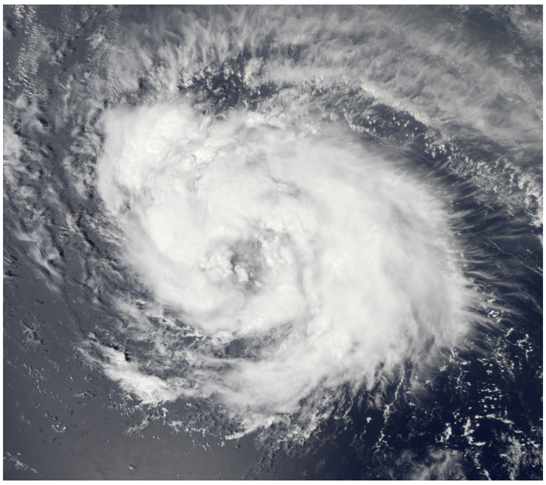

Image: Category 4 hurricane. NASA, Public Health Image Library

Mental Health

In addition to physical damages, extreme weather events and disasters (such as cyclones, flood, drought and bushfires) can cause considerable mental health impact on many people who experience injury, trauma, loss of loved ones, destruction of property, social dislocation, and financial instability.[12] With increased frequency and intensity of natural disasters and other catastrophic events due to climate change predicted, it is important that efforts are made to prepare for mass-scale mental health challenges.[15]

Air Pollution and Aeroallergens

Both anthropogenic and naturally occurring air contaminants are influenced by climate factors like temperature, wind, and precipitation. Climate change has important implications for people with respiratory problems including asthma and allergic rhinitis. Weather conditions directly affect the formation, dispersion and deposition of atmospheric pollutants such as toxic ozone and particulate matters.[10,12] As the CO^2 concentrations and surface temperatures increase, the production of pollen from plants and the length of the pollen season is expected to increase.[16] Mortality and morbidity from respiratory and cardiovascular disease is expected to increase from exposure to increased concentrations of pollen, ozone and particulate matters in a warmer world.[10,12]

Article

Predicting the future: climate change and public health *(continued)*

Food and Water Security

In addition to other challenges such as population increase and land degradation, climate change poses further threats to the availability of healthy food, with adverse effects on access to nutritious food and the incidence of diseases associated with malnutrition. Changes in rainfall pattern will increase the severity and occurrence of droughts in some regions and floods in others. A decline in rainfall across southern Australia has been observed in recent decades, and this trend is projected to continue due to ongoing climate change, causing an increase in drought frequency and severity.[3] Persistent droughts directly affect food production due to declining crop yields and livestock losses. Northern Australia is expected to receive more heavy rains, increasing the risk of flooding and infrastructure damage.[10] Patterns of crop pests and diseases may change in the wake of climate change, which will further destabilize food production. Climate change has many ways to disrupt access to clean water. When access to clean water is interrupted, large populations may be exposed to disease risks.

Social Instability and Conflict

The effects of climate change have the potential to increase conflict and challenge social stability on both local and global scales. Climate change impacts contribute to the decline in basic resources for subsistence such as food, fresh water, living space, and arable land. As scarcity of resources increase, regional tensions and violent conflict may rise within and between countries.[17,18] Large numbers of people are expected to be forced to migrate as larger areas of the earth become uninhabitable as a result of climate change and environmental degradation. It is estimated that between 200 million and one billion people could be displaced by climate change over the next 40 years. Vulnerable regions include sub-Saharan Africa, the Middle East, South and Southeast Asia, and the Pacific Island Countries.[19] Climate change is unlikely to increase conflict in the immediate future within Australia. However, requirements may arise internationally for engagement in peacekeeping operations, humanitarian missions, and climate refugee intake.[17]

Mitigation and Adaptation

Despite some uncertainties about the extent and nature of climate change influences, there is broad agreement that climate change will have direct and indirect adverse impacts on human health, both globally and in Australia. Facing the climate crisis honestly, to prevent catastrophic consequences, we have to take actions to mitigate climate change by substantially reducing greenhouse gas emissions and preventing deforestation. However, because individuals and nations may not be willing to sacrifice their own interests and bare some of the costs to prevent long term threat, taking effective action at the global level to mitigate climate change is difficult. Regional measures to restrict greenhouse gas emissions implemented at the state or national level will not be very effective unless other states and nations abide by similar restrictions.[20] While strategies to mitigate climate change are crucial to reduce the severity of impacts in the longer term, it is clear that adaptation policies and practices to reduce the adverse health impacts of climate change are becoming increasingly urgent. However, Australia lags behind comparable countries in actions and plans to protect the health of citizens from the impacts of climate change.[10,21] A gradually changing climate will place large additional disease burdens on the health system and challenge its existing capacity. If the current response strategies are inadequate and ineffective, the impacts of climate change have the potential to add very large healthcare costs in the future.[22] Adaptation requires a range of actions, from preventing, preparing through to responding as well as recovering.

Support Research and Data Collection

Effective adaptation policies and interventions require knowledge and data. Because of the complex interactions with many other interrelated factors, understanding the relationships between climate variables and health outcomes is difficult. There are still many uncertainties and a lack of quality data about the extent and nature of the future health impact from climate change. Research organisations and health institutions must collaborate to develop cost-effective, long-term studies to assess the health risks of climate change.[10,22] There is also a need to establish a facility at the national level to collect, archive and provide access to climate and health data.[17] Knowing the nature of the future risks, who is at risk, as well as where and when these risks are likely to be greatest is essential for the strategic allocation of resources and development of efficient adaptation strategies.

Promote Awareness through Education and Communication

Efficient risk reduction relies on people's understanding of the health risks they face with gradually changing climate. Education has a vital role to play in raising public awareness and support. Education and training within the health sector about the significance of climate change adaptation is very important. A workforce equipped with the skills and knowledge needed is fundamental for preparing and responding adequately to the challenges of climate change.[10,22] Effective communication by public health professionals is critical to ensure that the general public, policy makers and other stakeholders understand the potential health impacts and accept the adaptation measures.[22]

Encourage Greater Resilience through Prevention and Planning

Climate change affects public health mainly through exacerbating existing health problems. A healthy, resilient and sustainable community will reduce future health impacts in the event of disasters and disease threats. When developing adaptive strategies, identifying those at greater risk can assist preparedness and planning. Children, the elderly, socioeconomically disadvantaged populations, and those with pre-existing medical problems are particularly vulnerable. Adaptation strategies should include measures to promote good health, prevent common chronic diseases, and reduce potential exposure, especially in vulnerable communities. Adaptation policies should also be developed to improve the resilience and preparedness of the healthcare system by building climate-resilient health infrastructure, enhancing the skills and capacity of healthcare workforce, and implementing response action plans. In the long-term, better building and urban design will reduce exposure and offset some adverse health impact from climate change. Climate change adaptation measures require continuing financial support. Due to many other issues confronting public health, investment from government to prepare the health system for climate change may be limited.[22] In a budget-constrained environment, strategic allocation of resources is necessary.[23] Identifying the likely future scenarios, associated healthcare need and areas of priority will support the development of economically sensible adaptation plans.

Improve Surveillance, Prediction, and Early Warning

Climate events and associated health impacts vary spatially and temporally. Successful implementation of risk reduction and rapid response programs depend on the quality and effectiveness of the surveillance, prediction, and early warning systems.[17,24] Due to complex interrelation with environmental, social and health factors, complex modelling tools are required for predicting future health risks arising from changing climate variables. The current disease and climate surveillance systems must be strengthened to inform modeling of future risk patterns.[17] Based on accurate surveillance and prediction, early warning of extreme weather events and disease threats can provide advance notice for decision-making and allow timely response actions to take place.

Predicting the future: climate change and public health *(continued)*

Establish Effective Governance and Strengthen Collaboration

Effective adaptation measures require higher levels of government effort to lead and coordinate. Communities, health agencies, governments on all levels, and research institutions must collaborate to develop and implement effective local and national adaptation plans. The public health sectors should provide leadership in promoting public awareness, seeking government engagement, and coordinate activities. Many decisions within other non-health sectors (such as water management, building design, urban planning, and transport infrastructure) will have direct and indirect impacts on public health outcomes.[22] Multi-level, interdisciplinary, and integrated response is necessary to manage the increasing health risks associated with the changing climate.

Summary

In summary, climate change poses a wide range of risks to human health. While urgent action is required to mitigate climate change by substantially reducing greenhouse gas emission, adequate adaptation policies and practices should be developed and implemented to minimise the adverse health impacts. Effective adaptation requires a range of actions including promoting community awareness, addressing vulnerable groups, improving prediction and early warning, and developing emergency response plans. Health risks arising from climate change will vary over time and location. This uncertainty requires the adaptation strategies to be flexible and capable of responding to varying demands.[22,23] Health systems (including essential infrastructure and workforce) must be robust enough to cope with the increased extent and changing nature of climate change-related emergencies.[23]

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Harnessing new technologies to inform health decision making: Dynamic simulation modelling as a decision support tool for diabetes in pregnancy

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There is mainstream acceptance that decision making for health programs and policies should be evidence-based; however this can be difficult to achieve. The concept of "evidence informed decisions" is particularly challenging in population health policy and practice, where many of the current "big questions" are complex and not easy to address. These problems have multiple interacting causal factors with competing possible courses of action for decision makers to choose between, each course of action potentially resulting in complex and unintended consequences.[1,2] Many factors, including availability and diversity of information, opinion and experience, timing, the political cycle, local norms, the influence of external players, and the availability of funds all influence decision-making.[3,4]

Research methods in prevention science have traditionally taken a reductionist approach focusing in detail on components of a system.[5,6] For example, many studies have looked at the effectiveness of specific interventions on specific target groups. These studies have contributed, and will continue to contribute significantly to our knowledge, however, these methods have difficulty accounting for the complexity of population health where there are delays between cause and effect and unanticipated consequences of interventions.[7] New approaches, such as dynamic simulation modelling, provide insights into broader system behaviour in population health and enhance the evidence available for decision making.

Dynamic simulation modelling

Dynamic simulation modelling is a systems science method that recreates complex systems and human behaviours as a computer, or mathematical, model. These models can answer 'what if' questions about the likely impacts over time of different policy and intervention options and combinations so that they can then be considered more broadly before implementation in the real world.[1,8] Dynamic simulation modelling has been used to map health system components and their interactions, bring together evidence, examine and compare the potential outcomes of interventions, and guide more efficient investment and conscientious disinvestment of resources.[8] This is important for preventive health policy and practice where decision support tools must have the capacity to steer a course through the complexity of interactions that give rise to real-world public health problems such as the global epidemic of chronic disease.[1,8,9]

Advances in technology have made modelling methods more user-friendly and allow for greater participation in model development. Participatory model development engages multidisciplinary stakeholders in a group model building process where participants share their knowledge about the causal pathways for the focus issue and where and how interventions have an impact on outcomes. Through a series of participatory workshops, the model building group, informed by evidence and data, collaboratively identify and map the key risk factors and likely causal pathways leading to outcomes of interest. The map is then used to construct, quantify and test a computer modelled representation of the causal pathways and intervention effects for the focus issue.[1,8,10-12]

The Population Health Protection & Prevention, ACT Health, in partnership with The Australian Prevention Partnership Centre, has brought together local, national and international researchers, clinicians and policy makers (see modelling participant group description below) to collaboratively develop a dynamic simulation model for Diabetes in Pregnancy in the ACT.[13] More information about this process is available here: http://preventioncentre.org.au/our-work/research-projects/gestational-diabetes-through-a-systems-science-lens/.

Diabetes in Pregnancy in the ACT

Diabetes in pregnancy (DIP) is increasing both in the ACT and Australia,[14,15] and this is challenging the capacity of diabetes services. The increase in DIP is associated with an increasing prevalence of risk factors such as overweight and obesity, older maternal age and increasing numbers of women from high-risk ethnic groups.[14] Diagnostic screening guidelines were modified in 2015 to address the changing characteristics of women becoming pregnant and the increasing prevalence of type 2 diabetes mellitus.[16] The new guidelines recommend that women who are high risk for developing diabetes in pregnancy should be screened in the first trimester of pregnancy.[16] Consequently, these women are diagnosed with DIP earlier in their pregnancy and require services for a longer period of time. With increasing prevalence of risk factors, service providers report that women are more frequently presenting with a combination of risk factors resulting in more complex diabetes care needs.

Image: Pregnant woman. Freedigitalphotos.net

Harnessing new technologies to inform health decision making: Dynamic simulation modelling as a decision support tool for diabetes in pregnancy

The rising prevalence of DIP is having a significant impact on health service demand and resources, and the need to "do things differently" was identified by participants. The model can inform investments for intervention in DIP, spanning the spectrum from clinical to population health interventions. Workload and resource use have been incorporated into the model to enable it to act as a resource allocation decision support tool. Prevention of risk factors was also prioritised in the model as small delays in the development of diabetes will have large implications for the longer-term burden of disease and costs to the health system. The model considers the short, intermediate, and long term implications of the increasing prevalence of risk factors for DIP. At the time of publication, this model was being finalised.

What if?

Dynamic simulation modelling is a decision support tool allowing for policy and practice scenarios to be simulated and explored. This "what if" capacity can be used to compare interventions alone or in combination before they are implemented. Examples of "what if" questions that can be explored in the ACT Diabetes in Pregnancy model include: What if we implemented population health interventions to reduce modifiable risk factors for diabetes in pregnancy? What if we targeted particular sub-groups with these interventions? How should the intervention be delivered? What if we modified the model of care for diabetes in pregnancy services? What is the likely impact on resource use?

Diabetes in Pregnancy ACT Modelling Group Participants

The Diabetes in Pregnancy Modelling group participants included policy and program officers, endocrinologists, a neonatologist, a general practitioner, diabetes educator, public health professionals, medical and population health researchers and dynamic simulation modelling experts. Participants included local, national and international experts in the field travelling from South Australia, Northern Territory, New South Wales and Saskatchewan, Canada to participate in the workshops.

Conclusion

Participatory dynamic simulation modelling provides opportunity for diverse health stakeholders to collaborate and explore policy and health service scenarios for priority public health topics and support decision making. Technological advances in modelling software combined with participatory modelling methods place the decision maker at the centre of the process in the development of dynamic decision support tools. Research into the impact of these methods on decision making is ongoing.

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Section Highlight

Infection Control Unit

The Infection Control Unit is a part of the Communicable Disease Control Section (CDC) of the Health Protection Service (HPS).

The Infection Control Unit is responsible for the coordination of the community based Infection Control Program:

- Regulate businesses in the ACT that perform skin penetration procedures including dental practices, podiatry clinics, acupuncture clinics, physiotherapists/osteopaths performing needling, pathology collection centres, beauty therapists, tattoo and body piercing studios and nail salons;
- All skin penetration businesses require an Infection Control Activity Licence and are inspected annually by public health officers from the infection control unit to check for compliance with the ACT Health Infection Control for Office Practices and Other Community Based Services Code of Practice;
- Investigate complaints concerning poor infection control practices in the community;
- Provide infection control advice for the management of influenza like illness and gastroenteritis outbreaks in Aged Care Facilities and Child Care Centres; and
- Assist with the investigation and management of infectious disease outbreaks.

CDC can be contacted on (02) 6205 2155 for advice on infection control and disease surveillance or 6205 2300 for immunisation advice or email at hps@act.gov.au

Photograph: L-R: Romaine Huggett, Sandy Wynn, Sam Kelly

Notifiable Disease Report

Number of notifications of notifiable conditions received in the Australian Capital Territory, 1 January to 31 March 2017 (Q1 2017).

	Q1 2017	Q1 2012-2016 Average	Ratio Q1 2017: Q1 2012-2016 Average	Annual Total 2016	Annual Average 2012-2016
VACCINE PREVENTABLE CONDITIONS					
INFLUENZA	**56**	48.8	**1.1**	1603	1057.6
PERTUSSIS *	**120**	69.6	**1.7**	504	377.4
GASTROINTESTINAL DISEASES					
CAMPYLOBACTERIOSIS	**157**	136.8	**1.1**	581	509.6
CRYPTOSPORIDIOSIS	**51**	13.0	**3.9**	48	32.4
GIARDIA	**42**	40.2	**1.0**	128	128.8
HEPATITIS A *	**1**	1.0	**1.0**	2	3.0
HEPATITIS E	**0**	0.2	**0.0**	2	1.0
LISTERIOSIS	**2**	0.2	**10.0**	0	0.6
PARATYPHOID	**1**	1.2	**0.8**	3	3.0
SALMONELLOSIS	**206**	77.6	**2.7**	268	248.4
SHIGELLOSIS	**0**	2.4	**0.0**	5	7.0
STEC/VTEC	**0**	0.4	**0.0**	0	1.8
TYPHOID	**0**	0.4	**0.0**	3	2.4
YERSINIOSIS	**3**	3.4	**0.9**	16	12.0
SEXUALLY TRANSMITTED INFECTIONS					
CHLAMYDIA	**384**	340.4	**1.1**	1362	1275.4
GONNOCOCCAL INFECTION	**71**	38.4	**1.8**	201	133.4
VECTORBORNE & ARBOVIRUS					
BARMAH FOREST VIRUS INFECTION	**0**	1.2	**0.0**	0	2.2
CHIKUNGUNYA	**0**	0.2	**0.0**	2	1.0
DENGUE FEVER *	**11**	7.2	**1.5**	36	21.2
LEPTOSPIROSIS	**0**	0.2	**0.0**	0	0.2
MALARIA	**1**	4.4	**0.2**	9	10.0
Q FEVER	**0**	0.2	**0.0**	2	0.8
ROSS RIVER VIRUS INFECTION	**11**	3.0	**3.7**	15	9.6
RESPIRATORY CONDITIONS					
TUBERCULOSIS #	**6**	5.8	**1.0**	24	22.4

All Diseases except Tuberculosis are reported by onset date or closest known test date. Tuberculosis is reported by notification date.

* This condition includes cases that meet the probable and confirmed case definitions. Both probable and confirmed cases are nationally notifiable.

For the relevant year, Q1 refers to 1 January to 31 March, Q2 refers to 1 April to 30 June, Q3 refers to 1 July to 30 September, Q4 refers to 1 October to 31 December.

N.B. Data reported are the number of notifications received by ACT Health. Data are provisional and subject to change.

The number of notifications received for all notifiable diseases in the ACT is available at: http://www9.health.gov.au/cda/source/cda-index.cfm

Notifiable Disease Report

Population Health Bulletin - Communicable Disease Control – Quarterly Report Q1 2017

Vaccine-preventable Diseases

During Q1 2017, there were no cases of measles, invasive meningococcal disease, mumps, rubella, or tetanus notified in the ACT.

The number of influenza notifications received during Q1 2017 (n=56) was similar to the same period in previous years, and consistent with expected inter-seasonal activity.

Pertussis notifications in Q1 2017 (n=120) were 1.6 times the five-year Q1 average, and ranged in age from 7 months to 86 years. Of the Q1 2017 pertussis notifications, 45 percent were for children aged zero to 15 years old, and the remaining 55 percent were for adolescents and adults aged 16 to 86 years. Vaccination is the most effective way to avoid pertussis infection, however immunity does fade over time and it is still possible to get pertussis even if vaccinated in the past. Pertussis immunisation is offered to children and adolescents as part of the National Immunisation Program. In addition, a pertussis booster is recommended and funded for pregnant women during each pregnancy when they are between 28-32 weeks gestation.

Gastrointestinal Diseases

During the first quarter of 2017, there were 463 notifications of gastrointestinal diseases. This is significantly higher than the five-year first quarter mean. A higher number of notifications than expected of salmonellosis and cryptosporidiosis largely drove this increase. While campylobacteriosis notifications were higher than the five-year first quarter mean, they were about the same as the first quarter of 2016. There were 2 notifications of listeriosis this quarter in a maternal/foetal pair.

There were three outbreaks of suspected foodborne salmonellosis and 22 outbreaks of non-foodborne gastroenteritis investigated during the first quarter of 2017. Among the non-foodborne outbreaks there was either no testing or no pathogens identified, but a viral agent was suspected.

Vectorborne and Arbovirus infections

Eleven notifications of dengue were received by ACT Health during Q1 2017, which was 1.4 times the 5-year average. Cases diagnosed with dengue infection in Q1 2017 acquired their infections in Vanuatu (n=5), Nauru (n=2), Thailand (n=1), New Caledonia (n=1), Solomon Islands (n=1), or East Timor (n=1). Since August-September 2016, increased dengue case numbers were reported across the Pacific Region, with outbreaks declared in parts of the Solomon Islands, Vanuatu, New Caledonia, American Samoa, and Fiji.[1] Travellers to areas of high dengue activity are at higher risk of acquiring the infection, and should prevent mosquito bites by using mosquito repellent and wearing long, loose-fitting, light-coloured clothing.

In Q1 2017, there were 11 cases of Ross River virus notified to ACT Health. This is a significant increase in cases compared with previous years (4.7 times the 5-year average). All cases reported possible exposures in the ACT and/or interstate (including in NSW). Symptoms can include: an influenza-like illness (fever, chills, headache, muscle aches); joint pain, swelling, or stiffness; a rash over the body, arms or legs; and a general feeling of being unwell, tired or weak.

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Hot Issues

Lead exposure

Population Health Protection & Prevention (PHPP) recently assisted the Australian National University (ANU) in relation to elevated lead levels in environmental samples from two of its childcare centres. Public Health Officers undertook a health risk assessment at the Centres and the Chief Health Officer provided advice to the ANU, staff and parents in relation to the health risks posed by lead in the environment.

Lead is a naturally occurring metal found in the ground. People can be exposed to lead in the environment through food, drinking water, air, dust, soil and some consumer products, including lead containing paint, some glazed pottery, fishing sinkers and toys and products manufactured overseas.

Children under five years of age are at greater risk because they tend to put their hands or objects into their mouths; they absorb more ingested lead than adults; and their brains are still developing, so they are more sensitive to the effects of lead. Absorption of lead through the ingestion or inhalation of lead containing dust, paint, food or water, can affect a child's mental and physical development.

Identifying and controlling the source of lead exposure reduces the risk of harm. Environmental lead levels in the ACT are generally low due to the absence of industries like metal-smelting. Air monitoring of lead was discontinued in 2002, as lead-containing petrol was being phased out and measured levels were consistently low. However, lead in houses built before the 1970s can be released during building works; residents should seek professional advice prior to renovations.

The National Health and Medical Research Council recommends blood lead level testing in individuals if there is a reason to suspect they have swallowed or breathed lead from a particular source (more than the very small amounts that exist in most people's everyday environments); or if they have unexplained health problems that could be due to lead.

For more information see http://www.health.act.gov.au/datapublications/fact-sheets/environmental-health#Lead Exposure

Winter is here