CASE FOR ACTION- PROPOSAL TO NHMRC

Antimicrobial usage in residential aged-care facilities

Authors:

Doctor David Kong
Doctor Ching Jou Lim
Associate Professor Rhonda Stuart
Associate Professor Kirsty Buising
Doctor Deborah Friedman
Doctor Noleen Bennett
Associate Professor Leon Worth
Associate Professor Karin Thursky
Associate Professor Allen Cheng
Professor Anton Peleg
Associate Professor Caroline Marshall

NEW AND EMERGING HEALTH THREATS

The National Health and Medical Research Council (NHMRC) Research Translation Faculty (the Faculty) was established as a key advisory forum in 2012. The primary work of the Faculty for the 2013-15 Triennium has been to help NHMRC accelerate the translation of research by identifying the most significant gaps between research evidence and health policy and practice in each of the major health areas in the NHMRC Strategic Plan, and to propose to NHMRC possible action it could consider taking to address that gap – these are called Cases for Action. In April and May 2013, fourteen Faculty steering groups were established as NHMRC working committees to each oversee the development of a Case for Action.

The Faculty's New and Emerging Health Threats Steering Group is comprised of a range of experts and includes primary (1°) and secondary (2°) representatives of NHMRC Health Care Committee (HCC) and Research Committee (RC). Further information is available at: www.nhmrc.gov.au/research/research-translation/research-translation-faculty/research-translation-faculty-steering-groups.

NHMRC Research Translation Faculty New and Emerging Health Threats Steering Group - Membership

Professor Tania C Sorrell, AM (Chair)
Professor Steve Webb
Professor David Paterson
Professor Karin Leder
Professor Sharon Lewin
Professor Greg Dore
Professor Ross Coppel (RC)
Professor Chris Baggoley (HCC 1°)
Professor Sally Green (HCC 2°)

Acknowledgements of other contributors

Professor John Turnidge

Research Translation Faculty Steering Group Secretariat

faculty@nhmrc.gov.au

Declaration of interests

The declarations of interests of Steering Group members, authors and contributors are available at Appendix 1.

Suggested citation

Kong D, Lim C et al. *Case for Action proposal: Antimicrobial usage in residential aged-care facilities*. Submitted by the NHMRC Research Translation Faculty New and Emerging Health Threats Steering Group; February 2015. Available at: www.nhmrc.gov.au/research/research-translation/research-translation-faculty/ideas-research-translation-faculty-cases.

Date of release

11 May 2015

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NHMRC Research Translation Faculty
New and Emerging Health Threats Steering Group
Case for Action

Title: Antimicrobial Usage in Residential Aged-Care Facilities

Submitted to NHMRC: February 2015

Steering Group Members

Member	Position and affiliation
Professor Tania C Sorrell, AM (Chair)	Deputy Dean (Clinical) Sydney Medical School Professor and Director, Centre for Infectious Diseases and Microbiology & Marie Bashir Institute for Infectious Diseases & Biosecurity, University of Sydney Service Director, Infectious Diseases and Sexual Health Western Sydney Local Health District
Professor Steve Webb	Senior Staff Specialist, Intensive Care Medicine Royal Perth Hospital Clinical Professor, School of Medicine and Pharmacology and School of Population Health, University of Western Australia
Professor David Paterson	Professor, Medicine The University of Queensland Centre for Clinical Research Consultant Infectious Diseases Physician, Consultant Microbiologist and Medical Advisor Centre for Healthcare Related Infection Surveillance and Prevention
Professor Karin Leder	Head, Infectious Diseases Epidemiology Unit School of Epidemiology & Preventative Medicine, Monash University Infectious Disease Physician, Victorian Infectious Diseases Service, Royal Melbourne Hospital at the Doherty Institute for Infection and Immunity
Professor Sharon Lewin	Director, Doherty Institute for Infection and Immunity The University of Melbourne Visiting Infectious Diseases Physician, Alfred Health
Professor Greg Dore	Head, Viral Hepatitis Clinical Research Program the Kirby Institute for Infection and Immunity in Society the University of New South Wales Infectious Diseases Physician, St Vincent's Hospital Sydney
Professor Ross Coppel (RC contact)	Senior Deputy Dean and Director of Research Faculty of Medicine, Monash University
Professor Chris Baggoley (HCC primary contact)	Australian Government Chief Medical Officer
Professor Sally Green (HCC secondary contact)	Co-Director, Australasian Cochrane Centre School of Public Health and Preventative Medicine Monash University

Authors

Author	Position and affiliation
Doctor David Kong	Centre for Medicine Use and Safety, Monash University
Doctor Ching Jou Lim	Centre for Medicine Use and Safety, Monash University School of Pharmaceutical Sciences, University of Science Malaysia
Associate Professor Rhonda Stuart	Monash Infectious Diseases, Monash Health Department of Medicine, Monash University
Associate Professor Kirsty Buising	Victorian Infectious Diseases Service, Royal Melbourne Hospital at the Doherty Institute for Infection and Immunity Department of Infectious Diseases, St Vincent's Hospital Department of Medicine, University of Melbourne
Doctor Deborah Friedman	Department of Infectious Diseases, Barwon Health
Doctor Noleen Bennett	Victorian Healthcare Associated Infection Surveillance System Co-ordinating Centre
Associate Professor Leon Worth	Victorian Healthcare Associated Infection Surveillance System (VICNISS) Co-ordinating Centre Department of Infectious Diseases and Infection Prevention, Peter MacCallum Cancer Centre Infection Prevention and Health Care Epidemiology Unit, Alfred Health Department of Medicine, University of Melbourne
Associate Professor Karin Thursky	Victorian Infectious Diseases Service, Royal Melbourne Hospital at the Doherty Institute for Infection and Immunity Department of Medicine, University of Melbourne Department of Infectious Diseases, Peter MacCallum Cancer Centre
Associate Professor Allen Cheng	Department of Infectious Diseases, Alfred Health Department of Epidemiology and Preventive Medicine, Monash University
Professor Anton Peleg	Department of Infectious Diseases, Alfred Health Department of Microbiology, Monash University
Associate Professor Caroline Marshall	Victorian Infectious Diseases Service, Royal Melbourne Hospital at the Doherty Institute for Infection and Immunity Department of Medicine, University of Melbourne

Contributors

Contributor	Position and affiliation
Professor John Turnidge	Senior Medical Advisor, Australian Commission on Safety and Quality in Health Care

NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL

Research Translation Faculty - New and Emerging Health Threats

Antimicrobial Usage in Residential Aged-Care Facilities (RACFs): Case for Action (CFA)

Authors and affiliations.

Dr David CM Kong[1]*, Dr Ching Jou Lim[1,2], A/Prof Rhonda L Stuart[3,4], A/Prof Kirsty L Buising[5,6,7,8], Dr N. Deborah Friedman[9], Dr Noleen Bennett[8,9], A/Prof Leon Worth[8,9,10,15], A/Prof Karin Thursky[5,7,8,11], A/Prof Allen Cheng[12,13], Prof Anton Y Peleg[12,14], A/Prof Caroline Marshall[5,7,8].

[1] Centre for Medicine Use and Safety, Monash University, Parkville, Victoria, Australia.
[2] School of Pharmaceutical Sciences, University of Science Malaysia, Penang, Malaysia.
[3] Monash Infectious Diseases, Monash Health, Clayton, Victoria, Australia.
[4] Department of Medicine, Monash University, Clayton, Victoria, Australia.
[5] Victorian Infectious Diseases Service, Royal Melbourne Hospital, Parkville, Victoria, Australia.
[6] Department of Infectious Diseases, St Vincent's Hospital, Fitzroy, Victoria, Australia.
[7] Department of Medicine, University of Melbourne, Parkville, Victoria, Australia.
[8] Doherty Institute, Parkville, Victoria, Australia
[9] Department of Infectious Diseases, Barwon Health, Geelong, Victoria, Australia.
[10] Victorian Healthcare Associated Infection Surveillance System Co-ordinating Centre, Melbourne, Victoria, Australia.
[11] Department of Infectious Diseases, Peter MacCallum Cancer Centre, East Melbourne, Victoria, Australia.
[12] Department of Infectious Diseases, Alfred Health, Melbourne, Victoria, Australia.
[13] Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Victoria, Australia.
[14] Department of Microbiology, Monash University, Clayton, Victoria, Australia.
[15] Infection Prevention and Health Care Epidemiology Unit, Alfred Health.

*Contact details.

Dr David CM Kong. Centre for Medicine Use and Safety, Faculty of Pharmacy and Pharmaceutical Sciences, 381 Royal Parade, Parkville, Victoria, Australia 3052.

Ph: (O) 03 99039035, (M) 0413185278, Email: david.kong@monash.edu

INTRODUCTION

The emergence of multidrug-resistant organisms (MDROs) in the community poses a significant threat and burden to community-based healthcare. The **World Health Organisation (WHO), has designated antimicrobial resistance as a priority of our time**.[1, 2] Importantly, WHO in 2014 warned that "*A post-antibiotic era - in which common infections and minor injuries can kill - far from being an apocalyptic fantasy, is instead a very real possibility for the 21st century*".[2] As the development pipeline of new antibiotics continues to diminish, measures to contain the rising trend of MDROs have increasingly relied on effective infection control to limit the spread of these organisms, and antimicrobial stewardship (AMS) strategies to optimise the use of antimicrobials. However, these strategies are generally less developed in the community than in the hospital setting.

Residential aged-care facilities (RACFs) provide home-like care to an increasing proportion of Australia's (ageing) population and demand will continue to rise. It is estimated that by 2031, the number of individuals in Australia aged 65 years and over will increase from 12% of the total population (in 1998) to 21% and, the number of those aged 80 years and above will double from 3% of the total population to 6%.[3] Indeed, approximately 6% of those aged over 65 years and 30% of individuals over 85 years of age will live in RACFs.[3, 4] It is also important to appreciate that long-term residential high level nursing care centres also care for young people debilitated by chronic illnesses, and that many of the issues relevant to RACFs also apply to these groups. For the purpose of this Case for Action **(CFA)**, we have focussed on RACFs.

RACFs are a unique community resource whose remit is to provide a home-like environment which allows as much independence as possible for residents, who themselves typically have multiple and often complex medical conditions. Hence residents in RACFs (herewith abbreviated as RACF residents) are potentially a high-risk population with a high infection burden.[5] They have a high rate of transfer to acute-care hospitals, often to manage infections and a high burden of exposure to antimicrobials to treat or prevent infection. Both of these increase the selection pressure for acquisition of MDROs. Evidence from overseas suggests that elderly populations in RACFs are an important reservoir for introduction of MDROs into hospitals.[6-9] **Critically, there are significant gaps in RACFs with respect to surveillance of infection burden (i.e. infection syndromes, antimicrobial use and susceptibility patterns), and antimicrobial stewardship (AMS) activities in the RACF setting are in their infancy, particularly in Australian RACFs**. AMS refers to a systematic approach by a healthcare organisation to optimise antimicrobial use, with the aims of improving patient outcomes and reducing adverse consequences of antimicrobial use (including antimicrobial resistance, toxicity and unnecessary costs).[10, 11]

This CFA addresses a new and emerging health threat to the Australian community and beyond as identified by the New and Emerging Threat Steering Group of the NHMRC's Research Translation Faculty. The NHMRC's Strategic Plan (2013-2015) identifies under *New and emerging health threats – **infectious disease,** environmental hazards, changes in human environment* as a major health issue and strategic priority.[12] Managing antimicrobial use and containing antimicrobial resistance is a national priority, as evidenced by the activities of the Australian Commission on Quality and Safety in Health Care (ACSQHC) and the establishment of the Antimicrobial Resistance Prevention

and Control Steering Group (jointly chaired by the Secretaries of the Australian Government Department of Health and Agriculture with members comprising, the Australian Government Chief Medical Officer and Chief Veterinary Officer). This CFA contributes towards "*combating an emerging global threat*" addressing the call to action by the WHO.[2] Accordingly, this CFA will focus on the evidence-practice gaps and the rationale associated with antimicrobial use in RACFs. The CFA will propose actions to be considered or implemented and the potential impact or consequences.

EVIDENCE–PRACTICE GAPS AND THE RATIONALE

1. **There are limited to negligible antimicrobial stewardship (AMS) programs in Australian RACFs despite evidence suggesting an urgent need for AMS interventions to optimise antimicrobial use.** The reported range of inappropriate antibiotic prescribing in RACFs is between 40 to 75%.[13-19] In two Australian studies it was reported that up to 40% of antibiotics were prescribed for episodes that did not meet the McGeer criteria for symptomatic infections in RACFs.[20, 21] A recent (2014) Australian study using qualitative methodology revealed that most key stakeholders (e.g. general practitioners, pharmacists) recognised that antibiotics are over-prescribed in RACFs.[22] Increasing antimicrobial use is associated with the emergence of MDROs. Therefore, over-prescribing of antimicrobials (or inappropriate use) will contribute to the 'high' volume of antimicrobial use, thus, increasing the selection pressure for MDROs. Furthermore, inappropriate antimicrobial use affects patient safety and outcomes and is costly to the healthcare system. Importantly, **optimising antimicrobial use through AMS programs is a feasible intervention and reduction of inappropriate antimicrobial use is one of the few modifiable risk factors** (in contrast to patient-related risk factors such as age and comorbidities), **that drive emergence of MDROs**.

(a) AMS: components and guidelines
AMS is essential to prevent the emergence and spread of MDROs, and should complement other infection control activities.[23] The major elements of such programs include formulary restriction, pre-authorisation (broadly categorised as "front-end" strategies) and, audit and feedback (broadly categorised as back-end strategies).[24, 25] Successful and sustainable AMS programs should be tailored to the resources and organisational cultures related to antimicrobial prescribing practices at the institutional level.

Whilst AMS programs are well established in the acute-care hospital setting, it remains a relatively new concept in RACFs.[26] **Of the 265 managers of Australian RACFs (with 50 to 250 beds) who participated in a survey of infection prevention and AMS in Australian RACFs in 2013-2014, few facilities had any AMS policies, with only 14% stating they had any antimicrobial prescribing restrictions** (Stuart RL, unpublished data). In addition to curbing the emergence of antimicrobial resistance, there are other incentives to initiate AMS programs in RACFs. The elderly residents are generally more susceptible to adverse drug reactions and drug-drug interactions due to the physiological changes associated with ageing, co-morbidities and frequent receipt of polypharmacy.[27, 28] Repeated antimicrobial courses, especially the use of broad-spectrum antibiotics, increases the risk of *Clostridium difficile* infection.[29] Furthermore, the elderly population is at higher risk of acquiring toxigenic *C. difficile*.[30]

International guidelines for infection control and prevention in the long-term care setting have recommended the initiation of AMS programs in the RACF setting.[31] However, recommendations about practical AMS interventions specific to this setting, in which there are minimal medical resources, are not available. Existing guidelines recommend only a minimum standard for monitoring of antimicrobial use and local antimicrobial susceptibility profiles, with effective communication and feedback to relevant authorities.[31]

At a national level, the ACSQHC has published guidance on essential strategies for AMS in the healthcare setting, which emphasises the acute-care hospital setting.[32, 33] Implementation of such comprehensive interventions is unrealistic in RACFs, which both lack the resources and organisational structures available for hospital-based AMS and operate in a different cultural environment. As such, **specific guidelines for AMS programs tailored to the Australian RACF setting need to be developed**.

(b) AMS interventions

Efforts to optimise antimicrobial use (i.e. AMS interventions) specifically in the RACF setting have been reported in several recent overseas studies (summarised by Lim *et al.*[34]) Other recent interventions reported from overseas include the use of "participatory action research" and "resident antimicrobial management plans".[35, 36] Not surprising, most AMS interventions in the RACF setting were focused primarily on supplementary strategies (e.g. educational interventions or use of treatment algorithms for specific infections and guidelines).[34] The more proactive approaches used in hospital-based AMS programs (e.g. infectious diseases expertise consultation), which are more resource intensive, are limited in the RACF setting. However, there are examples from overseas of successful AMS interventions that have led to fewer prescriptions of antibiotics and reduced transfer of patients to acute-care facilities.[37-40] These include regular education of RACF staff and GPs visiting these sites,[41-45] care pathways for common conditions such as urinary tract infections (UTIs)[38, 40] and development of medical assessment and care services *in situ* (in-reach or 'hospital in the nursing home').[37, 39, 46, 47] **These have not been adequately evaluated in the Australian RACF context**. **As a result, data on the economic impact of AMS interventions in Australian RACFs are also lacking.** Caution in extrapolating AMS strategies or findings from one country to another is necessary in view of the variation in antibiotic prescribing patterns between countries. For instance in two studies from the United States (US) AMS interventions were introduced to reduce the widespread use of fluoroquinolones or intravenous (IV) antibiotics,[37, 41] but these antibiotics are infrequently used in Australian RACFs. It has been suggested that, at a minimum, an AMS program in RACFs should include executive support, education capability, and a means of monitoring and feedback antibiotic use to prescribers.[34]

(c) AMS: practical challenges for Australian RACFs

There are major practical challenges to developing a sustainable and effective model of AMS program in the RACF setting. Unlike acute-care settings, RACFs have different operational model and are resource-poor. The RACFs in rural and urban settings will have different challenges (i.e. geographical issues). Likewise, the Aboriginal and Torres Strait Islander communities may have different requirements. The RACF services in Australia (total of 2718 service providers as of 30th June, 2013) are provided by the not-

for-profit sector (comprising religious, community-based and charitable organisations) comprising nearly 60% of facilities, private (30%) and government-owned (both local and state) organisations (10%).[48] The size of the facilities also varies, the majority (94%) contained more than 20 places and 48% had more than 60 places.[48] It is also important to note that RACFs in Australia can be broadly divided into two tiers: high-level care (i.e. nursing home) and low-level care (i.e. hostel).[3, 4, 49] Nursing homes are RACFs that cater for populations who require 24-hour nursing care and related medical or psychosocial services.[50] Hostels, on the other hand, allow the residents to live more independently without intensive nursing care, while still receiving assistance with personal care and accommodation support.[3] In general, the nursing home population has a higher degree of dependency and a higher burden of illness than those who live in hostels.[49] **At present, there is little to negligible support for AMS activities within or across Australian RACFs**. A stepwise approach to AMS implementation in RACF settings was proposed by Smith *et. al.* who suggested that AMS initiatives should commence with the least costly and intrusive approach, with more advanced measures added incrementally based on available resources and institutional needs.[26] Any measures that are introduced must be sustained, as highlighted by Loeb *et. al.,* who observed a decreased effect of AMS intervention in the months after implementing the intervention in selected facilities[38]

A recent Australian survey of key stakeholders of RACFs suggested that AMS interventions are perceived as necessary and useful.[22, 51] The authors reported factors that influence antibiotic prescribing in Australian RACFs (and which would need to be considered when introducing AMS program). These included:

 (i) workflow-related factors *viz.* logistical challenges with provision of medical care, pharmacy support, nurse-driven infection management, institutional policies and guidelines, and external expertise and diagnostic facilities, and
 (ii) culture-related factors *viz.* pressure from family to prescribe antibiotics and institutional use of advanced care directives.

A number of **barriers to the introduction of AMS in Australian RACFs were also reported including inexperienced nursing staff, high workload, lack of training of nurses in antibiotic use, and lack of institutional infection management guidelines which hindered optimal antibiotic prescribing**.[51] The same investigators have proposed feasible AMS interventions applicable to the Australian RACF setting.[22] The range of AMS interventions considered most useful and feasible include nursing-based education, aged-care specific antibiotic guidelines and regular antibiotic surveillance.

In Australia, formal AMS programs are mainly undertaken in large tertiary care public hospitals;[52] **AMS strategies specifically designed for Australian RACFs remain to be fully implemented and evaluated for their clinical and economic impact**. A recent (2014) pilot study involving two Victorian-based RACFs which utilised a combination of education intervention and infection control clinical nurse consultant to drive the AMS program has reported changes in antibiotic prescribing particularly in cases of UTIs, and skin soft tissue infections.[53] The generalisability of this approach and its sustainability, however, remain to be fully explored. In the second half of 2014, the Victorian Nosocomial Infection Surveillance System (VICNISS) Coordinating Centre recommended the use of a clinical pathway for the management of UTIs in Australian RACFs.[54] This pathway was developed after revising the Grampians 2013 UTI Project and Victorian Aged Care Healthcare Associated Infection and

Antimicrobial Use Point Prevalence Study (2012 and 2013) results following extensive consultation with RACF clinical staff, the Grampians Medicare Local, Infection Control Consultants and Infectious Diseases Physicians. The initial pathway was modified in mid-2014 after a three-month trial in three RACFs in the Grampians, Victoria. In general, the UTI clinical pathway was thought to be useful and user friendly (Bennet N and Worth L, unpublished data). However, the pathway may have to be slightly modified again when the Therapeutic Guidelines (Antibiotic) Version 15 is published. In late October 2014, the NHMRC approved funding for a National Centre for Antimicrobial Stewardship (NCAS), under the Centres of Research Excellence funding scheme,[55] to support AMS using *"One Health"* concept. Whilst, one of the work plans of the NCAS is to support AMS in RACFs, NCAS is at its infancy. Contracts for NCAS remain to be finalised at time of writing this CFA. It is important to note that NCAS has activities focusing on other settings including acute care, livestock and companion animals.

In summary, whilst action is being taken to improve antimicrobial use in the acute-care setting with AMS programs becoming a stand-alone accreditation standard for all Australian acute-care hospitals from 2013 onwards,[56] **the effort to introduce AMS program in Australian RACFs substantially lags behind that of the acute-care hospital setting**. **An effective AMS program will facilitate the right antimicrobial(s) being prescribed to the right patient, at the right dose, right frequency and right duration; leading to better patient outcome and safety, and minimising the risk of resistance development.**

2. **Several specific areas of inappropriate antibiotic use or areas needing improvement have been identified.** It is important to appreciate that the clinical diagnosis of infection syndromes among elderly RACF residents is challenging, due in part to atypical clinical presentations associated with age and pre-existing comorbidities. The most common symptoms of infection among elderly residents are non-specific, e.g. delirium, falls, functional decline and breakdown of social supports.[57] Fever is absent or blunted in 20-30% of documented severe infections in the elderly population.[27] These atypical presentations can potentially lead to delayed diagnosis, late initiation of empiric antibiotic therapy and worse clinical outcomes. On the other hand, early antibiotic therapy is often preferred *"in case"* RACF residents deteriorate,[58] which often leads to antibiotic initiation without confirmed infection. Difficulties in performing investigations on RACF residents, especially those with cognitive impairment, further complicate the clinical decision making process.[59] Midstream urine cultures are almost impossible to obtain from this patient population, especially in the presence of urinary incontinence. This further leads to a lack of microbiological data on which to base antimicrobial treatment in the cases of presumed UTIs. A number of areas in which antibiotics are often used inappropriately has been reported and these include (as adapted from Lim *et al*[34]):

(a) Prophylactic antibiotics for UTIs[20, 60-63]
In Australia about a quarter of the indications for antibiotic prescriptions in RACF residents were for UTI prophylaxis.[21, 63] Evidence for the effectiveness of this strategy among institutionalised elderly patients, many of whom will have asymptomatic bacteriuria, remains scant. Prolonged antibiotic use in the absence of infection inevitably selects for resistant organisms. A study by Blix *et al* showed that

methenamine, a urinary prophylactic agent, represented nearly half of the defined daily doses (DDDs) administered.[60] The common use of this agent is problematic - evidence to support its efficacy for use in long-term urinary prophylaxis was inconclusive in the latest Cochrane Review.[64] Episodes for which prophylaxis for 'UTI' is often instituted, such as vague behavioural change with leucocytes on urine dipstick or bacteriuria on midstream urine, are unlikely to represent true UTI. It is critical that this type of misdiagnosis be addressed as it can lead to irrational long term antibiotic exposure.

(b) Empiric antibiotic prescribing without microbiological investigation[19, 65-67]

It has been reported that only about 15% of antibiotic treatment is given with microbiology investigations documented.[65, 66] Inappropriate antibiotic use is often associated with worse clinical outcomes and in some cases, increased mortality.[68] Therefore causative etiologic agents should be identified, especially in suspected symptomatic UTIs, to rationalise the use of antibiotic therapy. Interpretation of microbiological results needs guidance, with clinical algorithms likely to help staff understand when treatment is required versus results that more likely represent colonisation or the presence of commensal organisms.

(c) Antibiotic treatment for asymptomatic bacteriuria[15, 63, 67]

There is compelling evidence from several randomised controlled trials that asymptomatic bacteriuria should not be treated in institutionalised elderly patients, based on the lack of treatment benefit,[69-71] and the association with increased antimicrobial resistance.[72] Asymptomatic bacteriuria is particularly prevalent among RACF residents with chronic indwelling urinary catheters, and antibiotic therapy does not prevent recurrent bacteriuria or symptomatic infection.[73] Nearly all chronically catheterised patients are bacteriuric;[74] therefore, the indwelling catheter should be changed prior to the initiation of an antibiotic and a urine specimen should be collected from the newly placed catheter. Discontinuation of catheter use and proper aseptic technique in catheter changing are the keys to prevent UTIs or other urinary complications.[73]

(d) Widespread antibiotic prescribing for upper respiratory tract infections (URTIs) or acute bronchitis[67, 75]

Among the institutionalised elderly, URTIs are usually caused by viruses, where empiric antibiotic treatment is not effective; only in patients with prolonged symptoms, or those with pre-existing underlying lung diseases should antibiotics be considered.[59] An effort to differentiate viral or bacterial origin of presumed respiratory tract infections via microbiological methods is critical to reduce inappropriate use of antibiotics. Fundamentally, a minimum set of criteria regarding patient assessment and investigation should be followed prior to making decisions about empiric antibiotic therapy.[59]

(e) Prolonged duration of antibiotic treatment[13, 76, 77]

There is evidence that antibiotic courses of seven days or less are as effective as longer courses in the majority of common bacterial infections.[78, 79] Unnecessarily prolonged antibiotic treatment will increase the risks of side effects and the development of antimicrobial resistance.

(f) Widespread prescribing of quinolones as empiric treatment for UTIs[17, 18, 80]

Excessive use of these agents is mainly due to their excellent bioavailability, long half-life and broad-spectrum properties that are ideally suited for the treatment of lower respiratory tract infection, as well as complicated UTIs.[81, 82] Consequently, a high rate of quinolone-resistant Gram-negative organisms has been frequently observed in RACFs with high use of quinolones.[83-85] Within the Australian RACF setting, the use of quinolones, anecdotally, appears to be low. However, this cannot be confirmed given there is no coordinated antimicrobial use surveillance program across Australian RACFs.

(g) Broad-spectrum or parenteral antibiotic treatment for elderly residents with advanced dementia or end-stage illness[86, 87]

Evidence regarding the benefit of antimicrobial usage in the presence of dementia or at the end stage of life is conflicting. Some studies have suggested that antibiotic treatment is futile (i.e. did not prolong survival or reduce discomfort) at the end stages of life,[88-90] whereas others have shown that antibiotics do relieve discomfort among dying patients.[91, 92] In view of these contradictory results, aggressive antibiotic treatment for pneumonia among RACF residents with advanced dementia is contentious and among the elderly, is probably best guided by advanced care directives.[93]

In summary, **there are specific areas of inappropriate antibiotic use in RACF setting which warrant AMS interventions to optimise antimicrobial prescribing and patient care.**

3. **Australia currently does not have a systematic large scale (or national) surveillance program for monitoring rates/types of infection syndromes, antimicrobial use and resistance in its RACFs. Where surveillance exists at all, guidelines and methodologies vary in scope and detail.** Although the Australian Aged Care Quality Agency recommends that all Australian RACFs should have an "effective infection control program" (i.e. Standard 4.7) which includes an infection surveillance system, it does not delineate the specific nature of such a system.[94] Furthermore, the accreditation requirements have mainly focused on control of outbreaks, without reference to antimicrobial use hence benchmarking, of antimicrobial use across different Australian RACFs is impossible.[95] **Establishment of an effective surveillance system is fundamental to optimising antimicrobial use**.

A population-based study in Western Australia reported that one quarter of RACF residents were transferred to hospital as a result of infection, incurring inpatient costs of approximately AU$12.1 million over two years.[96] Furthermore, the frequent referral of RACF residents to hospitals is associated with worse clinical outcomes.[97, 98] It follows that **promotion of the management of infection within RACFs to avert hospital admission will improve health and health outcomes.** This, however, raises other practical issues, in particular, the availability of infectious diseases expertise and support to provide a reasonable standard of infection management and antimicrobial stewardship (AMS) in RACFs.

In 2008, the ACSQHC revealed the results of two infection surveillance studies (unpublished), documenting a mean point prevalence infection rate of 6.0/1000 beds (95%CI, 5.1-7.0) involving 19 RACFs in Victoria, and an incidence rate of 4.6 infections/1000 OBDs (ranged 1.9-9.0) across 10 RACFs in Perth in one year.[95] Prior to

2011, there was a scarcity of published data describing the trends of health care associated infections (HCAIs) in the Australian RACF setting. Forrest *et al* (2011) reported an average baseline HCAI rate of 3.2 infections/1000 OBDs over a 9-year period (2001-2009) in five RACFs in Sydney.[99] A six-month pilot study involving 30 RACFs in rural Victoria have revealed a total reported infection rate of 3.6 infections/1000 OBDs, higher than the confirmed infection rate of 2.2 infections/1000 OBDs according to the McGeer criteria for infection.[100] The marked difference between the two rates and the variation in reporting between RACF nursing staff and infection control consultants warrant further investigation.[101] Whilst the work by Lim *et al*[20] in Victoria reported that the types and incidence rate of infection [(3.2-4.6 infections)/1000 OBDs] in Australian RACFs[95, 99, 100] were comparable with overseas data [(1.8-11.8 infections)/1000 OBDs],[102-110] the patterns of antibiotic use in Australian RACFs were different when compared to overseas data; highlighting the importance of understanding the epidemiology of infection and antibiotic use in the local RACF setting.

Currently, there is a dearth of information on antimicrobial resistance patterns based on clinical isolates obtained from residents in Australian RACFs. Of concern are the two Victorian studies suggesting an emerging trend of multidrug-resistant (MDR) Gram-negative bacilli in Australian RACFs *viz.* extended spectrum beta-lactamase *Escherichia coli*[111, 112] and carbapenem-resistant *Acinetobacter baumannii*.[112] These observations not only emphasise the importance of a systematic large scale (or national) surveillance for antimicrobial resistance trends, but also **the urgency and need to establish effective AMS programs to optimise antimicrobial use** given that prior antimicrobial use was significant risk factor for carriage of MDROs in these studies.[111, 112]

The high burden of antimicrobial use in RACFs has been demonstrated in numerous studies as recently summarised by Lim *et al*.[34] **Importantly, there is a dearth of Australian data on the extent of antimicrobial use and prescribing patterns in the RACF setting**.[20] Such data are needed to guide AMS programs in RACFs. Data from the Pharmaceutical Benefit Scheme (PBS) do not provide sufficient information to differentiate antimicrobial use by RACF residents and those from the general community. Some RACFs have electronic medical record systems or electronic prescribing systems (or both), which may also include the resident's medication records. However, these systems are not consistently used across facilities and that, anecdotally, the quality of information stored in them is variable. Whilst the use of the National Inpatient Medication Chart (NIMC) across all Australian RACFs would facilitate consistent data collection, the NIMC is paper-based. As such, chart audits of the NIMC for antimicrobial use are likely to be resource intensive, prone to human error and unattractive in a resource poor setting. RACFs do not routinely have dedicated pharmacies (as exists in the hospital setting), and hence, cannot extract medication usage data from a pharmacy dispensing system – and most lack the necessary resources to retrieve antimicrobial usage data. The majority of the RACFs are small facilities ($\leq$ 50 beds), which is too small to participate in the National Antibiotic Utilisation Surveillance Program (NAUSP, a national antimicrobial surveillance program run by South Australia Health and funded by the Australian government). The antimicrobial usage data collected from these facilities using NAUSP methodology are likely to be too unreliable for benchmarking purposes.

Pleasingly, the discussion paper on Australia's first National Antimicrobial Resistance (AMR) Strategy was recently released by the Antimicrobial Resistance Prevention and Control Steering Group for consultations.[113] The outcome of this remains unknown at the time of writing this CFA. The ACSQHC has initiated the Antimicrobial Use and Resistance Australia (AURA) project to establish a coordinated national surveillance system for antimicrobial resistance and use in Australia. The project is in its early stages of development with funding beyond 2016 uncertain. Likewise, it remains a challenge with respect to how surveillance data from the RACF setting can be incorporated into the AURA project and more importantly, retrieved for analysis. Indeed the ACSQHC has also supported the National Antimicrobial Prescribing Survey (NAPS)[114] which is coordinated by the Victorian Infectious Diseases Service at Melbourne Health. This is a web-based tool which enables participating institutions to report antimicrobial prescribing at their institutions. Similar to the AURA project, NAPS is still at an early stage of establishment (~3 years old) with on-going funding uncertain. Participation from the resource-limited RACF setting has been low since NAPS was initiated; most of the institutions involved are acute-care hospitals which are better resourced. At the time of writing this CFA, a 'NAPS' module specifically for the RACFs is being considered for development with funding from ACSQHC.

In summary, surveillance programs are essential to guide and optimise antimicrobial prescribing. However, effective surveillance programs for RACFs in Australia remain to be established. Existing standards for "effective infection control programs" in RACFs lack clarity, resulting in variable depths of surveillance activities and making benchmarking difficult. The threat of MDROs becoming widespread in Australian RACFs, and ultimately, being transmitted into the general community and other healthcare settings, is real.

PROPOSED ACTIONS
The Proposed Actions (1 to 5 below) for this CFA are wide-ranging to highlight the opportunities available and are made from a system perspective. This is viewed as important, given that optimal antimicrobial stewardship requires a combination of different strategies. When implementing the recommended actions, it is important to consider the geographical challenges associated with the RACFs (e.g. rural vs urban setting), different operational models and, where applicable, the different requirements which the Aboriginal and Torres Strait Islander may require; there may not be necessarily a 'one size fit all' solution. The range of actions listed gives the NHMRC the opportunity to consider which option(s) it can realistically support with the resources available. This CFA relates to AMS in the RACF sector which covers RACFs offering high and low level care. Note that some of the proposed actions may be more suited to a high level care environment and others are applicable to both low and high level care (e.g. engaging the consumers), as indicated in the action points listed below.

1. **The NHMRC to develop, support and provide guidance on 'sustainable models of best practice' in infection management, particularly AMS programs in RACFs.** These models should be sustainable and ideally, build on existing infrastructures and resources, with aims to optimise antimicrobial prescribing, patient care and safety. An

effective AMS program needs to be tailored to the antimicrobial use patterns and the organisational resources of the individual RACFs. Actions to be considered include:

(i)   Identifying (and disseminating information on) opportunities to improve the 'health system' of Australian RACFs by working with relevant key stakeholders such as Department of Social Services (the Australian government's department responsible for the RACF setting), Department of Health and relevant professional bodies representing the RACFs (e.g. Leading Aged Services Australia). Applicable to both high and low level care RACFs.
Timeline & Priority: 1 year, Medium Priority.

(ii)   Commissioning and disseminating evidence-based guidelines to promote models of AMS programs designed for RACF setting which can be tailored to the antimicrobial use patterns and the organisational resources of the individual RACFs. For example, AMS models which incorporates nurse-driven infection management, the use of algorithms to facilitate infection management and the management of the deteriorating patients, and optimise communication between nurses and general practitioners. Where feasible, engagement with the National Centre for Antimicrobial Stewardship (NCAS) should be considered. Generally applicable to high level care facilities.
Timeline & Priority: 1 – 2 years, High Priority.

(iii)   Commissioning development of treatment algorithms to support and optimise the management of, in the first instance, infectious diseases commonly encountered in the Australian RACFs setting (e.g. UTIs, respiratory tract infections) by working in partnership with Therapeutic Guidelines and relevant professional bodies (e.g. Australian Society for Antimicrobials, Australian Society for Infectious Diseases, Royal Australian College of General Practice) and the ACSQHC. The treatment algorithms should take into consideration that the elderly residents in RACFs have less physician contacts compared to hospitalised patients, rendering infection management difficult and mostly driven by nurses or telephone assessment by off-site physicians.[51, 115, 116] Consideration should also be given to engaging NCAS, where appropriate, and, also the feasibility of including the role of families and consumers in the algorithm. Applicable generally to high level care facilities.
Timeline & Priority: 1 – 2 years, Medium Priority.

(iv)   Identifying and promoting existing "key AMS initiatives of excellence in Australian RACFs" and establishing forums for information sharing and discussion on "best practice" in AMS in the Australian RACFs. This may include exploring opportunity to utilise the NHMRC Research Translation Faculty's Annual Symposium to show case "key initiatives". Applicable to both high and low level care RACFs.
Timeline & Priority: 1 year, Medium Priority.

(v)   Promoting joint research fellowships (Partnership Grants) with relevant stakeholders, targeted NHMRC PhD scholarships or other NHMRC funding to further explore the translation of evidence into practice with respect to AMS

programs in RACFs and generate new evidence via research in response to existing knowledge gaps. Applicable generally to high level care facilities.
Timeline & Priority: 1 year, High Priority.

(vi)   Identifying and promoting key areas for research into AMS programs in RACFs. Evidence to be generated includes economic data or models related to AMS or surveillance programs in Australian RACFs, and sustainability of the various models. NCAS could be engaged to support this initiative, where appropriate. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, Medium Priority.

(vii)   Engaging with accreditation agencies (Australian Aged Care Quality Agency) to drive the implementation of AMS activities. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, High Priority.

2.   **The NHMRC to work with other 'key organisations/bodies'** (e.g. Australian Commission on Quality and Safety in Health Care, Antimicrobial Resistance Prevention and Control Steering Group, Antimicrobial Scientific and Technical Advisory Committee, Department of Social Services, Department of Health) to provide national leadership for AMS activities including the surveillance of infection burden, antimicrobial use and resistance in RACFs.

Activities may include:
(i)   Commissioning evidence-based guidelines for surveillance and benchmarking of infection burden, antimicrobial use and resistance in the RACF setting, in collaboration with the ACSQHC and Department of Social Services. This will contribute towards developing a consistent approach in surveillance activities across all Australian RACFs to ensure that data collected can be used appropriately for benchmarking (where necessary) and identify emerging threats to the health of the community. Such guidelines should be aligned with Australia's National Antimicrobial Resistance (AMR) Strategy[113] and is linked to the '*Prevention and Control of Infection in Residential and Community Aged Care*' released by the NHMRC in 2013,[117] and if necessary, the '*Healthcare-associated infections in Residential Aged Care*' publication by NHMRC.[118] Involvement of the Australian Aged Care Quality Agency and the respective Health Departments of States and Territories, and that of representatives from the RACF service providers (e.g. Leading Aged Services Australia) on content of the guidelines should also be considered. More applicable to high level care RACFs.
Timeline & Priority: 1 – 2 years, Medium Priority

(ii)   Contributing and supporting the development of guidelines for a coordinated national surveillance system/framework in the RACF setting (and the eventual establishment and operation of the system) by engaging and supporting the work of the ACSQHC on the Antimicrobial Use and Resistance Australia (AURA) project and National Prescribing Survey (NAPS), and the Antimicrobial Scientific and Technical Advisory Committee. Applicable to both high and low level care RACFs.

Timeline & Priority: 1 – 2 years, High Priority.

(iii) Strengthening existing guidelines or practice standards used in the accreditation of RACFs that are related to the surveillance activities in RACFs by working with the Australian Aged Care Quality Agency whereby, greater clarity is established for the definition of an "effective infection control program" (i.e. Standard 4.7). Engaging the Department of Social Services, the ACSQHC and professional bodies representing the RACFs (e.g. Leading Aged Services Australia) on this aspect should also be considered. More applicable to high level care RACFs.
Timeline & Priority: 1 – 2 years, High Priority.

(iv) Engaging professional bodies such as the Royal Australian College of General Practitioners, Australian New Zealand College of Geriatricians, Royal Australian College of Physicians and, the Health Department of States and Territories, Department of Social Services and Department of Health to address aspects related to the absence of requirement for general practitioners to monitor trends in antimicrobial use and resistance within the RACFs. More applicable to high level care RACFs.
Timeline & Priority: 1 – 2 years, Low Priority.

3. **The NHMRC to develop capacity (e.g. using the train the trainer approach) and foster clinical champions** to facilitate translation of evidence into practice in the resource poor RACF setting. This should include:

(i) Encouraging and promoting proposals related to antimicrobial use in RACFs as preferred topics for TRIP and other fellowships offered by the NHMRC. Applicable to high and low level care RACFs. Timeline & Priority: 1 year, High Priority.

(ii) Promoting joint research fellowships (partnership) with relevant stakeholders should also be considered. Applicable to both high and low level care RACFs. Timeline & Priority: 1 year, High Priority

4. **The NHMRC to establish and facilitate forums, training and access to other avenues in-partnership with key organisations to equip relevant key stakeholders.** This may include:

(i) The NHMRC compiling a portfolio of funded research in AMS (particularly those related to RACFs) and a list of local expertise or researchers in the field to provide easy access to information and support from those working in the field. Applicable to both high and low level care RACFs Timeline & Priority: 1 year, Low Priority.

(ii) The NHMRC using the information gathered from the aforementioned initiative to support establishing a forum for further discussion (and information sharing) on how to progress work in the area of interest. An avenue for such forum could be the NHMRC Research Translation Faculty's Annual Symposium. Applicable to both high and low level care RACFs Timeline & Priority: 1 – 2 years, Low Priority.

(iii) Fostering an environment where nurses who worked in RACFs are appropriately trained and supported to enhance their ability to manage infections given that in current practice, infection management in the RACF setting is primarily nurse-driven.[51] This can be achieved for example, by the NHMRC facilitating access to online education materials, regular group training and workshops. Key organisations to be engaged include NPS MedicineWise or the professional organisations representing the nursing profession (e.g. Australian Nursing Federation). This action will facilitate capacity building. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, High Priority.

(iv) The NHMRC facilitate the equipping of other key stakeholders (e.g. general practitioners and pharmacists) by actively engaging with the relevant professional bodies (e.g. Royal Australian College of General Practitioners, The Pharmaceutical Society of Australia, Pharmacy Guild of Australia). Similar to equipping the nurses, this action also facilitates capacity building. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, Medium Priority.

5. **Increase consumer awareness about appropriate use of antimicrobials by collaborating with other organisations** (e.g. NPS MedicineWise, Consumer Health Forum of Australia, Medicare Locals) in public campaigns. This is important given that healthcare practitioners encounter pressure from family members and others with respect to prescribing antimicrobials for the RACF setting.[51] Actions to be considered include:

(i) Identifying opportunities for the NHMRC to engage the consumers or consumer groups with respect to shared-decision making regarding antimicrobial use. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 year, Medium Priority.

(ii) Promoting appropriate antimicrobial use "behaviour" in RACFs (and other settings) which may include release of information targeted at consumers, working with organisations such as NPS MedicineWise and Consumer Health Forum of Australia and ACSQHC. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, Low Priority.

(iii) Promoting appropriate antimicrobial use and prescribing behaviour targeted at key healthcare providers (i.e. general practitioners, nurses and pharmacists) by working with organisations such as NPS MedicineWise, Medicare Local and ACSQHC. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 – 2 years, Medium Priority.

(iv) Actively promote and participate in Australia's annual Antimicrobial Awareness Week campaign coordinated by ACSQHC. Applicable to both high and low level care RACFs.
Timeline & Priority: 1 year (annual event), Medium Priority.

The co-ordination/oversight of each action proposed will ultimately be dependent on which individual(s)/party has been assigned the responsibility to implement the suggested action(s). Indeed responsibility to implement the actions suggested will probably lie with a number of individuals/organisations given that, the proposed activities embody a 'system's approach' to optimising antimicrobial use in RACF. Coordination/monitoring is possible with good organisation and communications between all involved. It is envisaged that NHMRC will be coordinating/monitoring any actions, given that this initiative is being promoted by the NHMRC. This could be assisted by recently funded CRE entitled the National Centre for Antimicrobial Stewardship (NCAS).

Ideally, a good starting place is with research actions, followed by transfer of the findings into practice and policy. Given the substantial threat of increasing antimicrobial resistance, actions are urgently needed to bring about change. A combination of research and practice change (as prioritised in action points above) operating in tandem would ensure that changes occur in a timely manner.

EVALUATION OF INITIATIVES, ETHICAL CONSIDERATIONS AND FEEDBACK

It is important that initiatives resulting from this CFA are assessed for their impact at institutional, state and national levels, as well as short and long term effects. The nature and type of evaluations will be guided by the action(s) taken. For example, models of AMS programs implemented in the RACFs should be evaluated not only from a clinical perspective, but also from a health economic perspective with consideration given to the program's sustainability. Given the variation between RACFs, (e.g. bed capacity, level of care) an economic evaluation should consider (where possible/appropriate) whether RACFs should be brought more into line with the acute care sector, with greater government involvement, minimum facility size etc. There should be consideration of core elements. For example, (i) the need to track costs over a reasonable period of time; (ii) the need for outcomes that are 'beyond' the Quality-adjusted life year (QALY), as for many residents, the life year (LY) gain is likely to be small; (iii) the need to distinguish between impacts directly attributable to inappropriate clinical use (e.g. side effects, or cost with no clinical benefit) versus contributions to antimicrobial resistance. Some novel economic modelling techniques may be required in circumstances where data are not readily available. Evaluations should also include, where appropriate, comparison with overseas data. Monitoring of unintended consequences as a result of the initiatives should be performed.

The recommended action points have minimal to negligible ethical issues given these activities are geared towards improving patient care and safety, with the community at large benefiting (see Potential Impact). All 'research-based' projects should be conducted with approval from the relevant institutional ethics committees, in accordance with NHMRC's ethical standards, and monitored for unintended consequences. For example, evaluating new treatment algorithm for the management of specific infections should be monitored for unintended consequences, in-addition to the benefits gain.

The lessons learned should be feedback to those involved (and others including the NHMRC) to further optimise or determine subsequent initiatives. Where applicable, data, tools and experienced gained should be shared with the relevant bodies or interested individuals. Considerations should also be made to reporting the initiatives (as appropriate)

in peer-review journals and presentation at conferences (e.g. NHMRC Research Translation Faculty's Annual Symposium).

POTENTIAL IMPACT

The current proposal will have direct impact on RACF residents and those working in the Australian RACFs. The RACFs in regional or rural and metropolitan settings of Australia will benefit from the improvements made to AMS programs, surveillance, capacity building, information sharing, patient care and consumer awareness. The actions proposed will have an indirect impact on "*those outside of the RACF se*tting" given that antimicrobial use and resistance is not confined to only the RACF setting. Indeed, the proposed actions will impact antimicrobial use and patient care in local, national and global settings, with short and long term consequences. **No actions today means no cure tomorrow**.[119] It would contribute to, for example:

1. Better patient care and safety particularly in the management of infections in RACFs, and better use of scarce resources.
2. Optimal antimicrobial use, leading to reduce selection pressure for the development of MDROs, and thus, "*preserving the miracle of antimicrobials*" for the future; a national priority and a global priority.
3. Capacity building with respect to developing and equipping the healthcare workforce for RACFs including opportunities for training of new researchers especially those with capacity for independent research and future leadership roles in RACFs.
4. Greater consumer awareness on appropriate antimicrobial use and improved participation in shared-decision making related to antimicrobial use; ultimately leading to improve antimicrobial use or consumption by the consumers.

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New and Emerging Health Threats Case for Action - Declarations of Interests

The declarations of interests of Steering Group members, authors and contributors to this Case for Action are listed below.

Name and Role(s)	Interests declared

Prof Tania Sorrell AM
• Steering Group Chair
	Employment
	• University of Sydney (Professor of Clinical Infectious Diseases and Director, Sydney Emerging Infections and Biosecurity Institute; Senior physician in infectious diseases, Westmead Hospital.
	Grants
	Holds the following NHMRC grants and intends to apply for further NHMRC grants throughout period of Steering Group membership:
	• Research Support and Project Grants - Pathogenesis of cryptococcal meningitis
	• Cell therapy to prevent and treat fungal infections in transplant patients
	• Centre for Research Excellence (CRE) in critical infection
	• Signalling pathways and fungal virulence – the inositol polyphosphate kinase pathway in Cryptococcus neoformans.
	Support for travel/accommodation
	• Travel and/or accommodation support received in relation to invited presentations, expert testimony, advisory roles and relationships (as noted below).
	Meals/beverages
	• Received for invited presentations noted below.
	Speeches/lectures
	• Invited Symposium presentation, WHO Collaborating Centre influenza, 2011 (received travel support)
	• Lectures on the Sydney Emerging infections and Biosecurity Institute (SEIB) and related EIDs to Colleagues in Indonesia, Thailand, Vietnam (received travel/accommodation support)
	• Presentations of EIDs at annual scientific Colloquium, SEIB (meals support)
	• Emerging Infectious Diseases and the One Health agenda; implications and relevance to ASID. Symposium "Musings of the Masters" Annual Scientific meeting of the Australasian Society for Infectious Diseases, Canberra, ACT, March 21-24, 2013.
	• Invited to participate in Australian Federal Parliamentary Health and Ageing Standing Committee enquiry into health issues across International Borders, Canberra, July 2012.
	• Published comments/opinion pieces:
	    o Konstantinos A, Simpson G, Sorrell T, Marais B. Doing the right thing for tuberculosis control in the Torres Strait Islands. Comment Letter. Med J Aust 195(9): 512, 2011
	    o Marais B, Crawford J, Iredell J, Ward M, Simpson S, Gilbert L, Griffiths P, Kamradt-Scott A, Colagiuri R, Jones C, Sorrell T. One world, one health: beyond the Millennium Development Goals. Comment, letter. Lancet 380 (9844):805-6, 2012
	    o Sorrell TC, Lonsdale C. Urgent strategic research into influenza to inform health policy and protect the public. Med J Aust 185 (Suppl10):S77-9, 2006.
	Expert Testimony/Advisory roles/Relationships
	• Chair, Advisory Group of Independent Experts (AGIES) (received travel and accommodation expenses)
	• Member, Commonwealth Department of Health and Aging. Member, Strategic Influenza Advisory Group, 2007-9 (received travel expenses)
	• Member, Scientific Advisory Committee, NHMRC Centre of Clinical Research Excellence in Infectious Diseases, University of Melbourne, 2003-2007 (received travel expenses)
	• Member, Commonwealth Emergency response Advisory group, Commonwealth Department of Health and Ageing, 2003-4 (received travel and meals support).

Name and Role(s)	Interests declared
Prof Gregory Dore • Steering Group member	**Board membership** • Advisory Board membership (including honoraria): Roche, Merck, Janssen, Gilead, Bristol-Myers Squibb, Abbvie • Member of several pharmaceutical company advisory boards: Roche, Merck, Janssen, Gilead, Bristol-Myers Squibb, Abbvie. **Grants** • Contracted research grants as Principal Investigator at St Vincent's Hospital, Sydney and Kirby Institute, UNSW from: Roche, Merck, Janssen, Gilead, Bristol-Myers Squibb, Vertex, Boeringher Ingelheim, Abbvie, National Institutes of Health, Canadian Institutes of Health Research, Cancer Council of NSW, NSW Health, NHMRC (Program, Partnership Project, CCRE, CRE, Practitioner Fellowship). **Support for travel/accommodation** • Travel sponsorship received as part of Advisory Board membership and conference participation/presentation from: Roche, Merck, Janssen, Gilead, Bristol-Myers Squibb.
Prof Sharon Lewin • Steering Group member	**Employment** • Director, Doherty Institute for Infection and Immunity, The University of Melbourne • Consultant physician, Department of Infectious Diseases, Alfred Hospital and Monash University. **Consultancy fees/honorarium (paid to institution) and related travel** • Gilead, Viiv, Merck. **Board membership** • Director, Board, Burnet Institute • Director, Board Snowdome Foundation. **Grants** • NHMRC, Merck, Gilead, National Institutes of Health (NIH), Wellcome Trust, National Institute for Health, Danish Medical Research Council, University of Malaya. **Support for travel or accommodation** • Nil. **Investigator initated industry funded grants** • Viiv, Merck, Gilead.
Prof Chris Baggoley • Steering Group member • Health Care Committee (HCC) primary contact	• Nil interests to declare.
Prof Sally Green • Steering Group member • HCC secondary contact	**Grants** • Current funding: Department of Health and Ageing, NHMRC, Victorian Neurotrauma Initiative (Transport Accident Commission), Physiotherapy Registration Board of Victoria • Past funding: Wellcome Trust, Andrology Australia, National Heart Foundation of Australia, Monash Problem Gambling Research and Treatment Centre, Department of Human Services Victoria, Cancer Australia and the Cochrane Collaboration. **Consultancy fees/honorarium** • Paid consultancies from Department of Health and Ageing and NHMRC • Received Honoraria from Department of Health and Ageing and the Royal Australian College of General Practitioners • Past Member of Cochrane Steering Group. **Employment** • Other competing interests: Practising physiotherapist in part-time practice (self-employed), and as such, receives numerous remuneration for the delivery of physiotherapy interventions.

Name and Role(s)	Interests declared
Prof Steve Webb • Steering Group member	**Ownership interests** • Shareholder and Director of Aalix Health Services Consulting – clients include Genetech and Abbott Ibis Biosciences. **Consultancy fees/honorarium** • See ownership interests (above). **Grants** • Received from NHMRC, Wellcome Trust, Bill and Melinda Gates, European Union. Industry support for research from Hospira and Fesenius. **Support for travel/accommodation** • Travel support for academic meetings and other academic activities. **Direct or indirect pecuniary interests** • Only via Aalix consulting work. **Speeches/lectures** • Presentations at MJA Summit of Clinical Trials Groups. Advocacy by publication (MJA 2013: 198: 127-8). **Relationships** • Member of interim executive of Australian Clinical Trials Alliance with advocacy role for investigator-led clinical researchers.
Prof David Paterson • Steering Group member	**Consultancy fees/honorarium** • AstraZeneca, Merck Sharp and Dohme (MSD), Pfizer.
Prof Karin Leder • Steering Group member	**Employment** • School of Epidemiology and Preventive Medicine, Monash University • Victorian Infectious Disease Service, Melbourne Health. **Grants** • NHMRC Fellowship and Project Grants, Sanofi Pasteur, GlaxoSmithKline (GSK). **Consultancy fees and/or travel support** • GlaxoSmithKline, Sanofi Pasteur, Immuron, Centre for Disease Control/International Society of Travel Medicine. **Meals/beverages** • Speaker at educational dinners which included meals/beverages from GSK, Sanofi Pasteur and CSL. **Gifts or gratuities** • Educational travel-medicine textbooks from CSL and GSK. **Board member** • International Society of Travel Medicine.
Prof Ross Coppel • Steering Group member • Research Committee contact	**Board membership** • Member of Alfred Medical Research and Education Precinct (AMREP) Animal Services Board. **Relationships** • Adjunct Professor Griffith University at the Institute for Glycomics • Wellcome Trust member of Translation fund committee.
Dr David Kong • Author	• Has sat on advisory boards for Pfizer and Merck, Sharp and Dohme (MSD), and has received financial support (not related to the current work) from Pfizer, Roche, MSD and Gilead Sciences.
Dr Ching Jou Lim • Author	• Nil interests to declare.
A/Prof Rhonda Stuart • Author	• Nil interests to declare.
A/Prof Kirsty Buising • Author	• Nil interests to declare.
Dr Deborah Friedman • Author	• Nil interests to declare.
Dr Noleen Bennett • Author	• Nil interests to declare.

Name and Role(s)	Interests declared
A/Prof Leon Worth • Author	• Nil interests to declare.
A/Prof Karin Thursky • Author	**Non-financial interests** • Awarded NHMRC Centre for Research Excellence (CRE) funding for Antimicrobial Stewardship (AMS) – a One Health Approach. Aged care will be one component of this.
A/Prof Allen Cheng • Author	**Non-financial interests** • Advisory committees for Therapeutic Goods Administration, Therapeutic Guidelines, National Prescribing Service.
Prof Anton Peleg • Author	• Nil interests to declare.
A/Prof Caroline Marshall • Author	• Nil interests to declare.
Prof John Turnidge • Contributor	**Non-financial interests** • Australian Commission on Safety and Quality in Health Care (ACSQHC) leadership in setting clinical care standards and guidelines for antimicrobial stewardship.