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Personalized medicine: Roadmap to better health care

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With improving living conditions and therapies, longevity has increased dramatically worldwide. Yet, continued expansion of the world population and growing environmental and societal pressures put these gains in jeopardy. Also, common diseases such as cardiovascular and CNS disorders, and diabetes, become more prevalent with advancing age while drug therapies remain only partially effective and can cause severe adverse effects. Tailoring therapies and prevention strategies to the individual promises to yield substantial improvements. First, vast new information on genomic features, at the level of DNA, RNA, protein, and metabolite, reveals disease processes and variation between subjects that can be exploited for targeted therapies. Where a single gene can be identified as a cause of disease, for example somatic driver mutations in cancer or germline mutations in cystic fibrosis, drugs targeting these proteins can be highly effective. These therapies require a companion diagnostic test, as such drugs are inactive when the mutation is absent. Over the recent years, ~25% of new drug approvals by the FDA have been linked to companion tests, a trend that will further increase. Second, genomics studies have yielded deep insight into the etiology of common multigenic diseases, paving the way for improved therapy matching the disease process prevalent in the individual patient. Multi-factorial biomarker panels (including genetics) can serve to define an individual's disease risk, enabling early intervention or even prevention, and guiding the optimal therapeutic strategy person-by-person. Yet, we are far from understanding genomic factors resulting in substantial heritability of disease risk and drug response (termed the 'missing heritability') (Sadec et al.). Moreover, disease complexity impedes therapeutic success relying on single drugs, defying the idea of precision medicine. Rather, lifestyle, diet, and behavioural interventions are equally critical for successfully therapy. Third, novel approaches are beginning to live up to the promise of truly individualized therapy, including tissue engineering, cellular reprogramming *in vivo*, immune therapies of cancer and autoimmune disorders, and *in vivo* genome editing. Such therapies will have potential for substantial impact on health care delivery within the coming ten years. As the 20th century was marked by drug discovery, we now enter uncharted territory in trying to maintain an individual's health throughout life in novel ways. Health care services and research have to meet these new challenges.

Sadec W et al (2014) *Hum.Gen.* 133: 1199-1215

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Let it go? Rationalising medicines for patients with life limiting illness

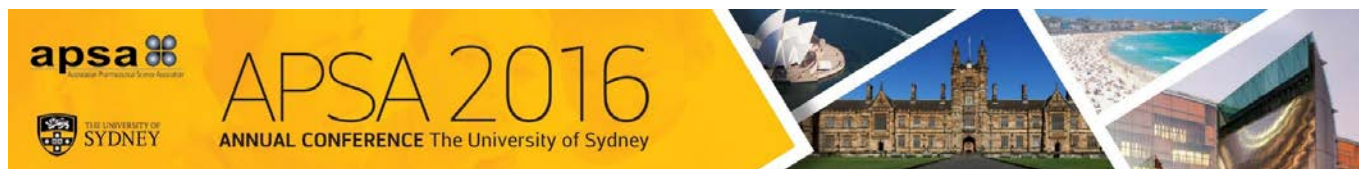
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Introduction. Polypharmacy and pill burden are common in patients with life-limiting illness such as cancer, heart failure, renal disease and dementia. It is widely acknowledged these patients are frequently exposed to the harms of medication, including increased risk of developing adverse drug reactions and drug-drug interactions. Previous work has shown that many medications are prescribed inappropriately in the context of life limiting illness. In order to understand why this occurs, it is crucial to understand the perspective of patients, their caregivers and the healthcare professionals responsible for prescribing their medication. Unfortunately, however, there is a scarcity of literature in this area.

Aims. To explore the lived experience of patients, caregivers and healthcare professionals in the context of medication use in life-limiting illness.

Methods. In-depth interviews, using a phenomenological approach: methods of transcendental phenomenology were used for the patient and carer interviews, while hermeneutic phenomenology was used for the healthcare professional interviews. **Results.** In total, thirty-six participants were recruited to the study (twelve patients, twelve caregivers, and twelve healthcare professionals). The study highlighted that medication formed a significant part of a patient's day-to-day routine; this was also apparent for their carers who took on an active role-as a gatekeeper of care-in managing medication. Patients described the experience of a point in which, in their disease journey, they placed less importance on taking certain medications; healthcare professionals also recognize this and refer it as a 'transition'. This point appeared to occur when the patient became accepting of their illness and associated life expectancy.

Discussion. Future deprescribing strategies should seek to establish patient expectations, consider the timing of the discussion about ceasing treatment and encourage the involvement of other stakeholders in the decision-making process.



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Advancing pharmacist practice in Australia – Where are we heading?

Dr Lance Emerson, CEO, Pharmaceutical Society of Australia, DEAKIN ACT 2600

This presentation will focus on the future of pharmacist practice in Australia, including progress over the past ten years, an overview of the current state of evidence, opportunity and preparedness of the profession to use this evidence to progress new roles, trends in pharmacy practice in other countries, examples of new and expanded roles within Australia and plans for the future.

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Enabling expanded scopes of practice

Assoc Prof Debra Rowett, Drug and Therapeutics Information Service

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Pharmacists in General Practice – Show me the evidence

Dr Christopher Freeman. School of Pharmacy, University of Queensland, Brisbane, QLD

At a time of significant health care review and reform, integration of a pharmacist into the general practice environment offers opportunities for the profession to further contribute to health consumer outcomes within primary care and at transitions of care. Australia continues to observe the international lead of this emerging model while it considers how it may best be applied in its unique context. The 'Practice Pharmacist' offers the pharmacy profession but one example of what advancing practice may look like. However, what is the evidence to support pharmacist integration into the general practice medical team?

Chris will explore the evidence as it relates to pharmacist integration into general practice both at an international and local level and will consider current and ongoing research in this area. The presentation will conclude with the current research gaps and what could be done to translate this body research into practice.

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Pharmacists in general practice – A lived experience of advancing pharmacy practice

Dr Ian Williams. Camp Hill Healthcare, Brisbane, QLD

Pharmacists integration within general practice medical teams provides the pharmacy profession with an opportunity for an alternate career path and acts as an example of advancing pharmacy practice. The 'Practice Pharmacist' can be viewed as an extension of the role of the community pharmacist, providing increased access to health consumer to expertise in medicines. As the evidence for this role continues to emerge, pockets of practice have gradually arisen, attempting to translate the research into practice.

Ian will explore a model of 'Practice Pharmacist' that has emerged in his medical centre located in Camp Hill, Brisbane. In 2009, a pharmacist joined his multidisciplinary team to improve the quality use of medicines for the practice population. The presentation will describe the roles and activities of the practice pharmacist as described through the lens of a General Practitioner.



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Blocking lymphatic metastasis using pharmaceutical strategies

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Introduction. Under normal physiological conditions, the lymphatic system maintains homeostasis by directing cells and solutes from the interstitial fluid of peripheral tissues through lymphatic vessels and into lymph nodes, where they undergo immune examination. In cancer, the lymphatic system also provides a route for tumour cell dissemination and metastasis. However, few studies have investigated physiological factors that regular lymphatic function and defined their effect on cancer dissemination.

Aims. To define the impact of peripheral neural signalling on lymphatic vascular architecture, and identify drug intervention strategies to stop tumour cell dissemination through lymphatic pathways.

Methods. We used advanced in vivo imaging technologies to define the effect of pharmaceutical interventions on lymphatic structure and function in mouse models of cancer.

Results. We show that VEGFC is required for neural remodeling of lymphatics, and that this is inflammation dependent. Beta-blockade of neural signaling prevented lymphatic remodeling *in vivo* and reduced lymphatic metastasis in preclinical cancer models and in patients with breast cancer.

Discussion. These findings reveal unanticipated communication between stress-induced neural signaling and inflammation, which regulates tumor lymphatic architecture and lymphogenous tumour cell dissemination. These findings suggest that limiting the effects of SNS signaling to prevent tumor cell dissemination through lymphatic routes may provide a strategy to improve cancer outcomes.

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Solid-state diagnostic technologies towards improved staging of lymphatic metastases

Benjamin Thierry. Future Industries Institute, Adelaide, SA

Introduction. A technology enabling the accurate detection of tumour markers in biopsied and resected tissues within the time-frame of surgery would significantly improve cancer patient care. For instance, the possibility to intraoperatively detect the presence of metastatic tumour cells in regional lymph nodes would guide the surgeon during intervention and spare a significant number of patients a subsequent repeat surgery (up to 25% for breast cancer).

Aims. To develop solid-state sensing technologies able to (1) accurately map intraoperatively lymphatic drainage from primary tumours and (2) determine within the time-frame of a surgery the presence of tumour cells within a resected specimen.

Methods. Two solid-state technologies have been developed based on state-of-the-art Magnetic Tunnelling Junction (MTJ) sensors and Silicon Nanowire Field Effect Transistor (SiNW FET) sensing.

Results&Discussion. The Sentinel Lymph Node (SLN) concept describes the preferential lymphatic metastasis of a primary tumour to one or more draining regional LNs and is the current standard of care in breast cancer and melanoma. However, anatomical and technological challenges associated to the use of radioactive tracers limit the application of the SLN concept to other more complex cancer type such as head and neck cancer. We have developed and validated pre-clinically a novel handheld magnetometer technology based on MTJ sensing. Key features include high spatial resolution (~x4 times that of conventional gamma probes), small physical footprint allowing for smaller incision (~x6 times smaller than existing probes), no interference from metallic tools such as retractors, and high stability eliminating the need for intra-procedural calibration. The technology has been validated in a large animal model (swine) and a clinical prototype is currently under development. Conversely, we have developed a Silicon Nanowire Field Effect Transistor (SiNW FET) sensing platform able to detect a single tumour cell within an hour in a whole LN. This remarkable result demonstrates that Si FETs are prime candidates for the realization of intraoperative molecular diagnostic technologies. In this presentation, we will discuss the requirements and challenge of such intraoperative diagnostic platform and present recent developments in our laboratory on the fabrication and operation of such devices.



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Engineering antibodies and antibody fragments to enhance exposure and activity in the lymphatic system

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Introduction. Drug conjugated and unmodified human recombinant antibodies are increasingly being developed and used for the treatment of cancer. In some cases, the use of antibody fragments presents several advantages over the use of full length antibodies. However, a key downside of this approach is the limited exposure of the lymphatics to smaller (eg. Fab') fragments.

Aims. This work was therefore aimed at identifying how the lymphatic exposure and biological activity of Fab's could be optimised through PEGylation.

Methods. Fab' fragments of the recombinant human monoclonal antibody trastuzumab (Herceptin) were prepared from the commercial antibody and conjugated with single linear 10 or 40 kDa PEG chains at the hinge region. The full length antibody was also conjugated with a 40 kDa PEG. The IV and SC lymphatic pharmacokinetics of the un-conjugated and PEGylated antibodies were then evaluated in thoracic lymph duct cannulated rats.

Results. The full length antibody displayed the greatest plasma and lymph exposure after IV and SC administration (~45 and 27% dose respectively recovered in lymph over 30 h). PEGylation did not have a significant impact on lymphatic exposure, but accelerated the plasma clearance of the antibody after SC administration. The Fab' displayed limited plasma and lymphatic exposure as expected, but conjugation with 10 kDa PEG increased lymphatic exposure by 11 to 5 fold after IV and SC administration respectively, and had minimal impact on the receptor binding affinity and in vitro activity of the Fab'. Increasing PEG size significantly improved plasma exposure, but had little impact on lymphatic exposure compared to the 10 kDa PEG-Fab' and reduced its receptor binding affinity by ~50%.

Discussion. PEGylation has the potential to limit the systemic activity of full length antibodies as a result of accelerated clearance after SC administration (presumably due to the generation of anti-PEG antibodies). However, minimal PEGylation (approx. 20% PEG loading) has the potential to optimally enhance the plasma and lymphatic exposure and activity of Fabs, while retaining maximal biological activity compared to the use of much larger PEGs.

Chan LJ et al (2016) Mol Pharm 13:1229-41

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Understanding the secrets of nanoparticle cell interactions

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Introduction: To engineer 'smart', responsive materials for drug delivery it is essential to understand how nanoparticles interact with cells. Targeted delivery of drugs to specific cells in the body by immobilising therapeutics inside antibody functionalised nanoparticles has the potential to revolutionise the treatment of many diseases. However, our understanding of how these nanoengineered materials interact with cells is limited.

Results: We are developing tools to understanding how these materials interact with cells,^{1,2} so we can engineer materials that respond better to the biological conditions they encounter.^{3,4} In particular, we are interested in understanding the internalisation, processing and trafficking of nanoparticles in cells. This presentation will focus on understanding the internalisation of polymer nanoparticles into cells, and their subsequent fate once they are inside the cell. It will also outline the progress we are making towards understanding how nanoparticles can induce transport of drugs from the endosomal compartments into the cytoplasm.

¹ Liu, H.; Johnston, A. P. R. *Angew Chem Int Edit* **2013**, 52, 5744–5748.

² Selby, L. I.; Kongkatigumjorn, N.; Such, G. K.; Johnston, A. P. R. *Advanced Healthcare Materials* **2016**, 5, 2333–2338.

³ Mann, S. K.; Czuba, E.; Selby, L. I.; Such, G. K.; Johnston, A. P. R. *Pharmaceut Res* **2016**, 33, 2421–2432.

⁴ Mann, S. K.; Dufour, A.; Glass, J. J.; De Rose, R.; Kent, S. J.; Such, G. K.; Johnston, A. P. R. *Polym. Chem.* **2016**, 7, 6015–6024.

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Oxaliplatin preformulation studies for the development of innovative topical drug delivery systems

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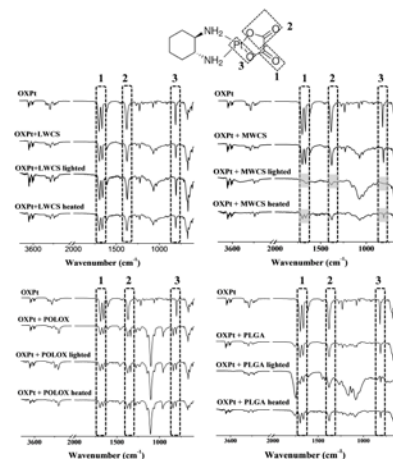
Introduction. Oxaliplatin (OXPt) is a third generation platinum chemotherapeutical compound with reduced incidence of certain toxicities related to other platin-based regimens. Dose related toxicity, however, has been observed in clinical trials in which this drug was systemically.

Aims. This work aimed to assess physicochemical characteristics of OXPt and to determine its compatibility with the polymeric matrices with most relevance in development of topical drug delivery systems.

Methods. Physicochemical characteristics of drug were assessed following solubility and partition coefficient (Log P) assays. Thermal analysis (DSC and DTG) associated with molecular (FTIR), crystallographic (XRPD) and morphologic (optical microscopy) characterizations of the drug alone or associated (50:50, w/w) with polymeric matrices (PLGA, Poloxamer 407, chitosan of low or medium molecular weight) were conducted.

Results and Discussion. OXPt could be classified as a class III drug according to BCS, i.e., it is highly water-soluble ($8.02 \pm 0.23 \text{ mg mL}^{-1}$) but low permeable (Log P was -2.06 ± 0.22). Probable difficulty of OXPt in permeating biological membranes justifies our

search for novel polymeric delivery systems aiming topical application. OXPt in solid state showed to be adequate for regular pharmaceutical manufacturing conditions, being stable even when exposed to heating and light. Among tested polymers, only chitosan of medium molecular weight showed to be incompatible with OXPt, with strong evidence of chemical decomposition and physical changes in drug-polymer samples. Another tested polymers may be indicated for the development of innovative topical delivery systems containing OXPt.



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Drug delivery systems based on polymeric nanocarriers and polysaccharide hydrogels for local treatment of bone tissue diseases

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Introduction. Bone tissue diseases such as osteomyelitis, osteoporosis or bone metastasis affect millions of people worldwide. Bone infections are usually treated with antibiotics via parenteral route, while osteoporosis and bone metastasis are predominantly treated with bisphosphonates administered orally. Both routes suffer from insufficient biodistribution and systemic toxicity of the drugs.

Aims. The main objective was to develop local drug delivery systems based on poly(lactide-co-glycolide) (PLGA) nanoparticles (NPs) processed into injectable or implantable drug delivery systems.

Methods. NPs produced by solid-in-water emulsification and characterised by DLS, SEM, AFM were: i) suspended in polysaccharide hydrogels to be administered by injection or ii) immobilised within highly-porous PLGA scaffolds to be implanted locally in the affected area. The systems were studied with respect to surgical handiness, mechanical properties (compression, rheology), drug release kinetics and in vitro activity (antimicrobial with *Staphylococcus* spp. or cytocompatibility with osteoblasts and osteoclasts).

Results and Discussion. Defined-size drug loaded NPs ($280 \pm 30 \text{ nm}$ in diameter, drug encapsulation efficiency $70 \pm 5\%$) were produced by double emulsification. The carriers released the drugs in a sustainable manner up to 35 days, which was prolonged up to 3 months when the carriers were suspended in hydrogels or processed into implantable forms. The systems containing antibiotics showed antimicrobial activity against classical strains of *S. aureus* and *S. epidermidis* and their clinical isolates from infected bones. The systems containing bisphosphonates downregulated osteoclasts and simultaneously did not affect osteoblast functions. Proposed processing methods preserved biological activity of encapsulated drugs and thus the systems may constitute promising solutions in site-specific therapies of bone tissues diseases.

This study was supported by National Science Center, Poland (No 2012/05/B/ST8/00129)

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Evaluation of insulin-containing tablets *in vitro*

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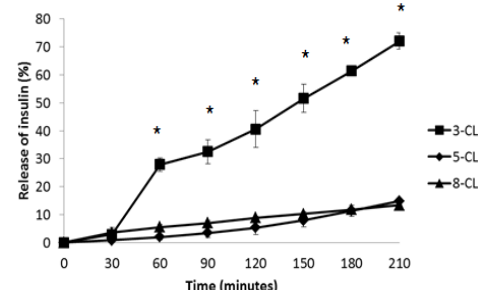
Introduction. Subcutaneous insulin injection is employed to lower blood glucose in patients with type 1 diabetes. Some incidence of concomitant side-effects, such as local pain, discomfort, irritation, needlestick injuries and possible skin infection by *Staphylococcus aureus* and *Mycobacterium chelonae* associated with injections may occur during treatment. Side-effects and stress of multiple daily injection can also reduce patient compliance and hinder the control of blood sugar level.

Aims. Administration of oral insulin could present a more convenient dosage form and improve patient compliance. The aim of the present work was to develop an enteric coated insulin tablet formulation using polymers, absorption enhancer and enzyme inhibitor, which protect the tablets in acidic pH and enhance systemic bioavailability.

Methods. In this study, the influence of coating by cellulose acetate hydrogen phthalate solution, and chosen excipients on Glut-4 transporter translocation in C2C12 skeletal muscle cells was examined. Following the determination of optimum number of coating layers, two dissolution buffers including pH 2, 0.01M hydrochloric acid and pH 7.4, 50mM phosphate were employed to determine the *in vitro* release of insulin.

Results. Insulin was protected by the coating during the dissolution process. Glut-4 translocation in C2C12 cells was promoted by the chosen excipients. No detrimental metabolic effects were observed in these cells.

Discussion. To date, limited studies combine the overall effectiveness of multiple excipients. Our study showed that the coated tablets have an immediate release effect in phosphate buffer. The combination of 5-CL of cellulose acetate hydrogen phthalate solution, chitosan (absorption enhancer) and sodium glycocholate (enzyme inhibitor) produced the desired effect of Glut-4 translocation in C2C12 cells.



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Addressing inequity in the care of premature and vulnerable infants: Improving cost-effectiveness of palivizumab respiratory syncytial virus (RSV) prophylaxis through rational dose regimen design

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Introduction. RSV is a major cause of lower respiratory tract infection and bronchiolitis in infants and can be fatal. At present, there are no recommended pharmacological treatments for RSV disease; the only option is prevention by prophylaxis with palivizumab. In the context of high drug cost and the absence of PBS funding, affordable access to palivizumab for vulnerable infants has been devolved to local jurisdictions. As a result of discrepant outcomes, there now exists a situation in Australia whereby at-risk infants receive different care purely on the basis of the State in which they reside. Consequently, there is a significant need to improve the cost-effectiveness of palivizumab prophylaxis, and in doing so provide the opportunity for universal access for this vulnerable patient group.

Aim. The objective of this project was to design a pharmacokinetically-guided palivizumab dose regimen for RSV prophylaxis in premature and vulnerable infants that reduces drug utilisation whilst maintaining therapeutic efficacy.

Methods. Using advanced modelling and simulation, enabled by a rigorous industry-developed pharmacokinetic model, optimal palivizumab dose regimens were explored for a representative patient population through the moderation of dose magnitude, number of doses and dose interval; this was investigated using an iterative approach.

Results. A logical, clinically practical palivizumab dose regimen was identified that reduces drug utilisation by 25%. Furthermore, the rational design of the regimen also enables a greater proportion of infants attaining target concentrations, particular those considered to be at greatest risk of RSV. Importantly, because of injection site volume restriction, this regimen also results in a substantial reduction in the number of infants who require more than one injection in order to achieve their requisite dose at any individual time-point.

Discussion. Through maximisation of pharmacokinetic efficiency and intelligent dose regimen design, a substantial reduction in palivizumab drug requirements can be achieved. The identified rationally-designed palivizumab dose regimen can be readily implemented, with no further imposition as compared with the standard regimen, but will generate substantial cost savings to those institutions already providing palivizumab therapy, and provide greater equity of access across Australia and internationally.

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Development of a LC-MS/MS method for the analysis of ivacaftor, its metabolites and lumacaftor in cystic fibrosis patients treated with ORKAMBI/KALYDECO

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Introduction: ORKAMBI (ivacaftor-lumacaftor [LUMA]) and KALYDECO (ivacaftor; IVA) are two new breakthrough cystic fibrosis drugs that directly modulate the activity of the defective CFTR underlying the CF disease state. Currently, no therapeutic drug monitoring assays exist for these very expensive, albeit, important drugs.

Aims: For the first time HPLC and LC-MS methods were developed and validated for rapid detection and quantification of IVA and its metabolites M1 and M6; and LUMA in the plasma and sputum of CF patients.

Methods: With a mobile phase consisting of acetonitrile/water:0.1% formic acid (60:40 v/v) at a flow rate of 1 mL/min, a linear correlation was observed over a concentration range from 0.01 to 10 µg/mL in human plasma.

Results: The assay was successfully utilized to quantify LUMA, IVA, M1 and M6 in the plasma and sputum of patients treated with KALYDECO (IVA 150 mg/q12 h) or ORKAMBI (200 mg/q12 h LUMA-125 mg/q12 h IVA). The KALYDECO patient exhibited IVA plasma concentration of 0.97 µg/mL at 2.5 h post dosage. M1 and M6 plasma concentrations were 0.50 µg/mL and 0.16 µg/mL, respectively. Surprisingly, the ORKAMBI patient displayed very low plasma concentrations of IVA (0.06 µg/mL) and M1 (0.07 µg/mL) and comparable M6 concentrations (0.15 µg/mL). We observed a relatively high plasma concentration of LUMA (4.42 µg/mL).

Discussion: This novel method offers a simple and sensitive approach for TDM of KALYDECO and ORKAMBI. The introduction of the assay into the clinical setting will facilitate pharmacokinetics/pharmacodynamic analysis and assist clinicians to develop more cost effective and efficacious dosage regimens for these breakthrough CF drugs.

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Can the co-spray drying of a lung surfactant, 1,2-dipalmitoyl-sn-glycero-3-phosphatidylcholine (DPPC) with anti-TB drugs increase aerosolization of the drugs?

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Introduction. The treatment via pulmonary delivery is potentially more efficient than current oral and parenteral anti-tubercular treatments due to its ability to deliver a higher drug concentration to the lungs. For treating TB, a high dose of the drug (many milligrams) needs to be delivered to the lungs requiring to develop highly aerosolizable powders.

Aims. The aim was to investigate the influence of lung surfactant, DPPC, on the aerosolization of a hydrophilic anti-TB drug, pyrazinamide and a hydrophobic drug, moxifloxacin HCl in the presence or absence of L-Leucine.

Methods. Individual powders of supplied pyrazinamide and moxifloxacin HCl alone and with 10% L-leucine and 10% DPPC were produced by spray drying. The powders were characterized for physicochemical properties. Aerosolization behavior (fine particle fraction (FPF) which is an in vitro measure of deep lung delivery and emitted dose were determined by a next generation impactor.

Results. The particle size of all powders except spray dried pyrazinamide was < 5 µm. The emitted doses of all the spray dried powders were very high (~80%). The spray dried pyrazinamide showed poor aerosolization behaviour (FPF of 18.7 ± 3.4%). However, the co-spray drying of pyrazinamide with L-leucine produced spherical hollow particles and improved aerosolization (FPF 53.0 ± 3.2%). The co-spray drying of addition of pyrazinamide with DPPC and L-leucine further improved aerosolization (FPF 74.5 ± 5.3%). However, the aerosolization of spray dried moxifloxacin although increased by co-spray drying with L-leucine (FPF from FPF 55.6 ± 3.3% to 74.1 ± 1.3%), it was not further increased when spray dried with both DPPC and L-Leucine.

Discussion. The lung surfactant, DPPC can improve aerosolization of a relatively hydrophilic anti-TB drug, pyrazinamide in presence of L-Leucine. However, the aerosolization of relatively hydrophobic moxifloxacin HCl can be increased with L-Leucine, the addition of DPPC with L-Leucine cannot increase aerosolization. Although further studies are required, it is postulated that improved aerosolization could be due to the DPPC migrating to the surface.

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Evaluation of a simulated training package about a hospital patient's journey

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Introduction. Exposing pharmacy students to hospital pharmacy through work-integrated learning provides an opportunity for students to develop a working knowledge of hospital procedures and practices. The Australian Pharmacy Council Accreditation Standards for Pharmacy Programs state that it is important for hospital practice settings to be experienced during undergraduate degree programs.¹ Anecdotal feedback from hospital pharmacists and students during placement debrief sessions indicated that students would benefit from and value having a greater understanding of the model of care that operates within a hospital prior to completing such placements.

Aims. To develop an online training package for undergraduate students to simulate a patient's hospital journey, and medication management and reconciliation processes, which was to be completed prior to hospital placements.

Methods. Mixed methodology was used for the evaluation of the five module training package and the impact of the training on students' confidence, knowledge and skills. Evaluation involved 1) written pre- and post-tests and (April 2016) 2) an end-of-training survey to obtain quantitative and qualitative feedback (June 2016).

Results. At baseline, 79 students completed the pre-test and there were differences between students who had already completed a hospital placement and those who had not. Following the training, 44 students completed the post-test and those who had not previously undertaken a hospital placement showed statistically significant improvements and gained similar test scores to those that had previously undertaken a hospital placement ($p=0.5838$). The change in score for the 44 participants who completed both tests was very statistically significant ($p<0.0001$). Assessment of students' confidence according to the 16 ranking statements also improved markedly post-training.

Discussion. The training package appeared to significantly increase students' test scores and confidence in dealing with a range of situations. This online package will in future be used with face-to-face workshops to better prepare students for hospital pharmacy placements.

1. Australian Pharmacy Council Ltd. Accreditation Standards for Pharmacy Programs in Australia and New Zealand. Australian Pharmacy Council; 2012. p. 1-22.

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Consumers with a Lived Experience of Mental Illness as Simulated Patients: An Innovative Education Tool For Pharmacy Students.

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Introduction. Suicide is the second leading cause of death globally among adolescents and young adults. Trained health care professionals including pharmacists have the potential to recognize and assist those at risk of a suicidal crisis.

Aims. To assess the impact of consumers with a lived experience of mental illness as simulated patients on final year pharmacy student's confidence towards suicide, post Mental Health First Aid (MHFA) training.

Methods. A three group pre-post-post test design was used. Following MHFA training, the first group directly *participated* in the simulation, the second group *observed*, and the final group had no exposure to the patient scenario. Consumers with a lived experience of mental illness enacted patients experiencing a mental health crisis. Surveys measuring changes in student confidence (8-item test) were conducted at three time points; pre and post MHFA and then at 6 weeks follow up.

Results. 33 participants, 99 observers and 48 comparator group students completed the survey at all 3 time points. Mean confidence scores significantly improved for all groups post MHFA training ($p<0.001$). At 6-week follow up, all 8 confidence items for the participant group, and 4 of the 8 items for the observer group further improved and maintained significance from baseline post intervention ($p<0.001$). Whilst the final comparison group showed improved confidence post MHFA, all mean confidence scores decreased at 6 weeks follow up.

Discussion. These data suggest that the use of consumers with a lived experience of mental illness as simulated patients had a significant effect in sustaining the positive impacts of MHFA on pharmacy student confidence. Future larger scale studies are needed to further investigate the impact of this innovative teaching intervention in aiding the retention of learning and cementing of confidence towards supporting people at risk suicide.

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A systematic review of educational interventions to teach medication history taking

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Introduction. Obtaining an accurate medication history is central to preventing medication errors and forms the basis for clinical decision making. However, sound medication history taking skills and the required communication skills have been found to be lacking or poorly developed in health professionals and students.

Aims. This review aimed to examine the effectiveness of various education interventions in teaching medication history taking skills.

Methods. MEDLINE, EMBASE, CINAHL and International Pharmaceutical Abstracts (IPA) were systematically searched up to April 2016 according to the PRISMA guidelines. Included studies focused on educational interventions designed to teach medication history taking skills and had at least one outcome measure for evaluation of the intervention.

Results. Sixteen studies met the inclusion criteria. Various methods of teaching and assessment were used in different educational interventions. Educational interventions included didactic methods, interactive workshops, self-instructional modules, patient simulation and real-life medication history interviewing with patients.

Discussion. Experiential learning demonstrated the most favourable results followed by simulation. Interventions which used purely didactic teaching methods found statistically insignificant or unfavourable results. Overall, this review found that teaching and assessment methods of learners that were constructively aligned achieved better learning outcomes.

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Community Medicines Clinic – a patient-centred example for student engagement with health literacy

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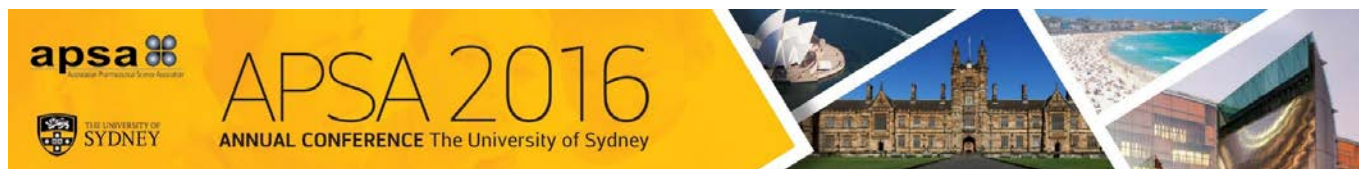
Introduction. In 2014, the School of Pharmacy at the University of Otago, Dunedin, commenced Medicines Health and Literacy Clinics (MHLC) within local communities. The MHLC (adapted from 'Brown Bag' Medication Reviews) encourages patients to bring all of their medicines and supplements to a community setting, without appointment or cost, for patient-initiated discussion with pharmacists and students. This paper reports on the clinic outcomes over one year focusing on opportunities for student engagement and learning about adult health literacy.

Aims. The aim was to both gauge and receive feedback if providing a community based patient-centred placement opportunity for final year students would better their understanding about adult health literacy.

Methods. Final year pharmacy students volunteers were selected to attend MHLC held approximately monthly in suburban community settings between June 2014 and June 2015. Student pre-and post-clinic activities included 1) pre-clinic health literacy related readings, 2) a post-clinic reflection assignment and 3) voluntarily consent to completing an exit survey to identify changes in student understanding on health literacy. The survey was approved by the University of Otago Ethics Committee.

Results. A total of 65 patients and 36 students attended 11 clinics during this period. Twenty four students consented to complete the study survey. There was an overall small mean positive shift of knowledge on adult health literacy reported (3.41 prior to 2.85 after attending MHLC on a 5 point Likert scale). Seven students reported a negative shift in literacy learning however several had reported overestimating their level of knowledge prior to clinic attendance. Student reflection comments demonstrated valuable clinical and literacy tuition from academic pharmacists during the clinic and that students were supported in their own conversations with patients. Commonly reported concerns prior to attending clinics were 1) insecurity about lack of prior knowledge and 2) that their communication may be misunderstood. Student contribution to patient conversations were reported as being adequate or fully inclusive and all students wished to participate further in future clinics.

Discussion. Student survey and reflection feedback showed positive literacy learning experiences when clinics were supported with resources including pre-readings, academic pharmacist support when contributing to patient conversations, debriefing opportunities and post clinic reflections. Additional clinic opportunities are recommended.



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Students' and pharmacy educators' perceptions of integrating the Reflective Ability Clinical Assessment (RACA) into an undergraduate curriculum

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Introduction. Reflective practice has the potential to improve reflective thinking, self and peer reflection, problem solving, counseling skills, and provide skills for better future practice [1]. The RACA (Reflective Ability Clinical Assessment (RACA) was developed, tested and evaluated as a novel learning and teaching tool in a pharmacy curriculum to enhance reflective capacity of students [1].

Aims. To evaluate students' and pharmacy educators' perceptions of the utility of the RACA in an undergraduate pharmacy curriculum at an Australian University.

Methods. A mixed method study was employed. The administration of a 7-item student survey on a 6-point Likert-type scale and a focus group or telephone interview with educators was conducted.

Results. Student responses ($n=199$) indicated statistically significant positive correlations between self-directed learning, counseling skills, relevance to future practice and performance in an oral examination ($p < 0.05$). Seven key themes emerged from the pharmacy educators' ($n=3$) focus group/telephone sessions: (i) Usefulness; (ii) Value; (iii) Student Experience; (iv) Student Engagement; (v) Challenges; (vi) Sustainability and (vii) Improvement.

Discussion. The study revealed both students' and pharmacy educators' perceived value with the implementation of the RACA as a novel educational tool to enhance self and peer reflection to improve skill development for future clinical practice. Most students, despite their initial apprehensive thoughts, perceived the RACA as a useful component of the curriculum, and reported its greatest value as assisting them with counseling skills. The pharmacy educator participants perceived the RACA to be beneficial and provided insights for scaffolding of this tool for future cohorts.

[1] Tsingos-Lucas C *et al.* (2016) The effect of reflective activities on reflective thinking ability in an undergraduate pharmacy curriculum. *Am J Pharm Educ*; 2016; 80(4), Article 65.

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Making Bachelor of Pharmacy Students Hospital Placement Ready: a Monash Experience

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Introduction. Many pharmacy students at Monash University work part-time in community pharmacy and are well prepared for their community pharmacy professional experience placement (PEP). In contrast, the first hospital PEP in late third year or early fourth year, for most students provides their first real hospital pharmacy experience. Feedback from hospital preceptors and lecturers suggested a need to develop hands-on training and assessments focused on hospital practice, to better prepare students for their hospital PEPs.

Aims. To develop and implement a hospital practice tutorial series to prepare pharmacy students for their hospital PEP, evaluate changes in student perceptions of their understanding and obtain feedback on their experiences.

Methods. Case vignettes based upon real patient scenarios were developed by the investigatory team comprising the unit coordinator, teaching staff and an education projects coordinator. These vignettes were video recorded at the Austin Health Simulation Centre. Three two-hour tutorials were developed to include the video case vignettes, discussion and small group tasks/formative assessments. Practising hospital pharmacists delivered the tutorials to third year students ($n=203$) before students undertook their hospital PEP. Student perceptions were evaluated using an anonymous questionnaire administered before the first tutorial and after the last tutorial. The questionnaire included seven items on preparedness for hospital placement, rated on a scale of 1 (very poor) to 5 (excellent); changes in perceptions before and after the tutorial series were assessed using Mann-Whitney U test. Students could comment on their perceived preparedness for hospital PEPs and provide suggestions.

Results. Six case vignettes were developed based on key hospital practice content areas: medication reconciliation and review, counselling and medicines information. Participation rates in the pre- and post-tutorial surveys were 68% and 81%, respectively. Significant ($p < 0.001$) improvements from baseline in clinical knowledge, and student understanding of the hospital system, pharmacist roles and interactions with other health professionals were found. Most students appreciated the learning opportunity, however some wanted more practical hands-on activities.

Discussion. The hospital tutorials prepare students for PEPs by improving their understanding of hospital practice and pharmacist roles. Additional tutorials and clinical activities may further increase student confidence.



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Systematic review of polypharmacy definition, assessment tools and association with clinical outcomes

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Introduction. Multimorbidity and the use of multiple medicines, commonly referred to as polypharmacy, is common in the older population. However there is no consensus definition of polypharmacy.

Aims. To conduct systematic reviews of polypharmacy definition, polypharmacy assessment tools and their associations with clinical outcomes.

Methods. Three systematic reviews were conducted using Medline/Embase databases of articles in English between 2000-2016 which i) defined polypharmacy ii) explored tools that assess polypharmacy and iii) examined their associations with clinical outcomes.

Results. A total of 112 articles were identified for polypharmacy definitions. While the most commonly reported definition was five or more medications daily (n=51, 45.5%), definitions ranged from two or more, to 11 or more medications daily. While a small minority of studies (6.3%) distinguished between appropriate and inappropriate polypharmacy, this distinction was not based on the pharmacology of medications. A total of 26 polypharmacy tools were identified and divided into two broad categories; tools with a scoring system (n=8) such as the Drug Burden Index and Anticholinergic Risk Scale and tools that do not provide a score (n=18) but criteria for appropriate or inappropriate prescribing such as the Beers Criteria. Out of the 26 tools identified, 50% were associated with at least one clinical outcome. Four of the tools were associated with mortality, hospitalisation and functional decline.

Discussion. Whilst the majority of studies used five or more medicines to define polypharmacy, a numerical definition does not consider the pharmacology of medications involved and may not be clinically relevant for defining appropriate from inappropriate polypharmacy. There is a need for tools which consider polypharmacy at an individualised-patient level to provide tailored guidance around optimising appropriate therapy and deprescribing inappropriate therapy to improve health outcomes.

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Adherence by disease state – Can a Leximancer™ analysis shed light on common and dissonant factors?

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Introduction. Adherence is the major factor in determining improved health outcomes from medicines in the long term. Systematic reviews are often focussed on one factor or condition to reduce the workload of reading and analysing hundreds of articles. Leximancer™ can reduce the workload by providing a textual analysis which can then be interpreted by the researcher.

Aims. To use Leximancer™ software to analyse adherence by disease state in a subset of articles found using a systematic search protocol for general adherence to medication.

Methods. Full text articles were extracted from an EndNoteX7 database containing 1197 articles by title disease state keyword. Disease keywords were: hypertension (HT), heart failure (CHF), heart disease (CVD), asthma, HIV, diabetes and mental health (MH). All full-text articles were added to separate folders and a Leximancer™ project and the data cloud produced tagged with the folder names (disease state). Part words included in the analysis were removed as were word artefacts (eg "Table") and singular/plural versions of the same word were combined.

Results. A total of 336 were included in the analysis. "Adherence" was centrally located. Diabetes, and asthma tags were almost collocated around concepts of "control", "monitoring", "management" and "costs". Diabetes, asthma, HT, and CHF were more closely associated with the "patient" theme, whereas HIV and MH were more closely associated with "participants". CVD was approximately equidistant. "Adherence" was closely associated with "research", "interventions", "treatment" and "health". "Compliance" was almost equidistant between the CHF and HT folder tags and more closely associated with "patient" compared to "adherence". "Drug" and "clinic" were co-located equidistant between HIV and MH tags. "Baseline" was next to "analysis" and close to the MH tag and "scale" indicating the propensity of psychologists for robust data protocols and analysis.

Discussion. This sub-analysis shown some interesting relationships between the vocabulary used in reporting adherence between different disease states. Most would assume the adherence vocabulary would be constant across disease states, whereas this analysis shows subtle differences. These differences could dilute the messages being delivered in this space, but can also indicate the differing vocabularies used between disciplines discussing their patient groups.

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Development and principal components analysis of a survey measuring pharmacists' attitudes towards perinatal depression

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Introduction. Australian recommendations encourage perinatal depression (PND) assessment/screening by health care professionals (HCPs). A systematic review on PND screening acceptability reported a lack of psychometrically tested acceptability measures.¹ Furthermore, pharmacists were not among the HCPs involved.¹

Aims. To develop and psychometrically evaluate a survey that measures pharmacists' attitudes towards PND, including their acceptability of being involved in screening.

Methods. A 31-item survey was developed based on the systematic review and previously published surveys. The survey was distributed to members of the Australian Association of Consultant Pharmacy using a Survey Monkey link through electronic reminders. Principal components analysis (PCA) with direct oblimin rotation was conducted using SPSS.

Results. A total of 153 useable surveys were collected. PCA resulted in a six-component solution, explaining 59.8% of the variance. No items cross-loaded at less than 0.2. Six items loaded (0.561-0.870) onto component 1 and explored the acceptability of screening. Seven items loaded (0.445-0.722) onto component 2 and explored PND stigma. Three items loaded (0.551-0.880) onto component 3 and explored attitudes towards therapy. Three items loaded (0.578-0.878) onto component 4 and explored readiness to screen. Three items loaded (0.588-0.714) onto component 5 and explored attitudes towards medication counselling. Two items loaded (0.717, 0.802) onto component 6 and explored opinions on how PND affects other family members. Cronbach alpha of each component ranged from 0.448-0.855.

Discussion. A survey measuring pharmacists' attitudes towards PND has been developed and psychometrically evaluated. Using PCA, the construct validity and internal consistency reliability of the survey were demonstrated.

1. El-Den, S., O'Reilly, C. L., & Chen, T. F. (2015). A systematic review on the acceptability of perinatal depression screening. *Journal of Affective Disorders*, 188, 284-303.

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Discursis® visualization of hospital pharmacist-patient communication during medication counselling

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Introduction. Effectiveness of pharmacist-patient communication can be successfully investigated using Communication Accommodation Theory (CAT) strategies. Discursis® software, as an adjunct to qualitative analyses, provides a chronological, visual plot of communication exchanges and allows for the identification of interactant engagement. Interpretation of pharmacist-patient interactions may be enhanced by using Discursis®.

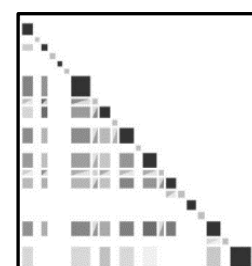
Aims. To examine Discursis® plots of pharmacist-patient exchanges, and to invoke CAT to further investigate Discursis® identified communication patterns, and episodes of engagement/non-engagement.

Methods. Graphical Discursis® plots were produced from transcribed audio recorded pharmacist-patient interactions conducted as part of a larger PhD project. Representative plots from inpatient and outpatient settings were selected to show low/high levels of speaker engagement. Details of engagement were investigated using CAT strategies (approximation, interpretability, discourse management, emotional expression, and interpersonal control) to better understand communication taking place.

Results. Characteristic patterns in outpatient interactions (medication reviews) showed longer patient responses (larger squares) whereas most inpatient interactions occurred at discharge and reflected pharmacists' conversation dominance with larger, more frequent squares. High pharmacist-patient engagement was depicted by multiple half/half squares meaning each speaker picked up on the other's previous concept (shown in plot). Low engagement episodes were shown as alternating squares only. Engagement episodes revealed pharmacist use of CAT strategies such as discourse management (face-maintenance or allowing the patient to save face).

Conclusions. Discursis® plots allowed for the identification of distinct patterns occurring within pharmacist-patient exchanges, and as an effective visualisation tool to pin point episodes for further analysis using CAT strategies.

■ Pharmacist ■ Patient
■ Shared concept



Discursis® Plot
Inpatient Setting
Engagement
Episode

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“The value of ‘I don’t know’ – handling missing data in electronic surveys”

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Introduction. Completing paper-based surveys can lead to respondents’ choices being artificially constrained if the option “I don’t know” is not available. Yet, missing data can lead to a loss of power in performing analyses. Electronic surveys can overcome this source of missingness by forcing responses for every item, even if “I don’t know” is not available. This could lead to inaccurate interpretation of data.

Aims. To determine whether survey responses of “I don’t know” are reflective of conceptual thought.

Methods. A cross-sectional study was conducted using an electronic survey, completed by consumers while waiting for their prescriptions in an Australian metropolitan pharmacy with a price-focused marketing strategy (PFMS). Inclusion criteria were adults who visited the pharmacy regularly for a prescription or non-prescription medicine. A response to each item was required before progressing using a Likert-type response scale with an option of “I don’t know”. Little’s test for missing completely at random (MCAR) was used to determine the nature of “I don’t know” responses. Parallel analysis, a form of exploratory factor analysis, was used to identify factors.

Results. Data from 372 participants were analysed. Responses of “I don’t know” were converted to a missing value before analysis. Tests showed data was not missing completely at random (MCAR) suggesting that these responses are either missing at random (MAR) or missing not at random (MNAR). Parallel analysis of the dataset with and without high levels of missing items yielded a one factor difference suggesting that data is missing not at random (MNAR). Conceptual analysis of the items that contained high levels of missing values formed the construct “perceptions of special services”.

Discussion. The PFMS pharmacy does not focus its marketing on the special services it may or may not provide. As such, respondents to a survey that assesses service quality could not form an opinion on “special services” when they have had minimal or no exposure. Performing factor analysis with “I don’t know” responses can provide valuable insight into respondents’ conceptual thoughts, attitudes and intended behaviours. This demonstrates that providing respondents with the option of “I don’t know” allows greater definition in capturing participant perceptions.

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Assessing genome-wide association studies for spin and quality

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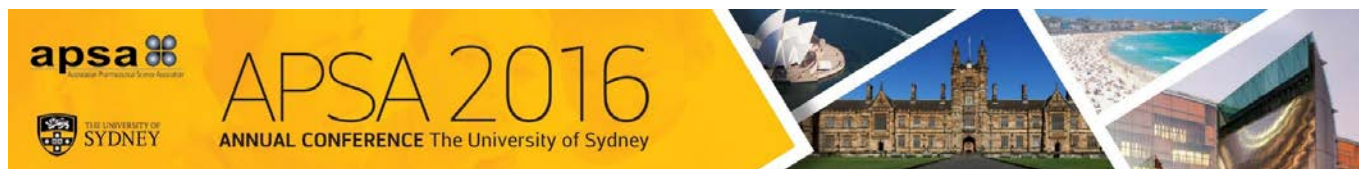
Introduction. Genome-wide association studies (GWAS) are commonly used to identify genetic variants that may be associated with particular traits or clinical conditions. An emerging application of GWAS is in the area of drug development and precision medicine, with researchers aiming to use genetic evidence to identify potential targets for drug therapy. However, GWAS are unable to definitively establish clinically relevant causal or predictive relationships between variants and phenotypes, thus conclusions related to drug discovery may be overly optimistic.

Aims. To assess the quality of, and to identify occurrences of ‘spin’ (biased interpretation of results) in GWAS, using a sample of studies by the genomics company, 23andMe, and a matched second sample with no 23andMe affiliations.

Methods. After performing an affiliation search for 23andMe on six electronic databases, a sample of 23andMe-affiliated studies were included. A second sample was generated to match the 23andMe sample by clinical topic and year of publication. Quality was assessed using a tool based on components from the Strengthening the Reporting of Genetic Association Studies reporting checklist. Spin was assessed by identifying occurrences of inappropriate attribution of causality, or over-extrapolation of the genotype-phenotype relationship.

Results. Fifteen studies with authors affiliated with 23andMe and 11 non-23andMe-affiliated studies were included. All 23andMe studies used online questionnaires to collect self-reported phenotype data from its voluntary customers, and contained selection and measurement bias. Thirteen of the studies did not sufficiently adjust for confounders. Spin was identified in 13 of the 15 studies, and over-extrapolating results was the most common spin strategy used. The matched studies had a lower prevalence of selection and measurement bias, and spin.

Discussion. Spin in GWAS is common and the methods of determining genotype-phenotype associations are of variable quality. While GWAS are useful, unbiased tools for identifying novel genetic variants across the genome, its applicability to drug development and screening for disease risk has yet to be fully established.



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The Tasmanian Atrial Fibrillation Study: Transition to Direct Oral Anticoagulants, 2011-2015.

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Introduction. Contemporary Australian data regarding antithrombotic prescribing patterns following approval of direct oral anticoagulants (DOACs) in patients with atrial fibrillation (AF) are limited.

Aims. We aimed to assess antithrombotic prescribing patterns in AF before, during and after the introduction of DOACs.

Methods. Using digital medical records, this retrospective cohort included all patients with AF as a primary or secondary diagnosis who were admitted to the Royal Hobart Hospital, Tasmania, Australia, between January 2011 and July 2015.

Results. Antithrombotic agents were prescribed for 2078 of 2261 (91.9%) patients with AF without documented contraindication to therapy. Warfarin or a DOAC were prescribed for 920 (40.7%) and 383 (16.9%) patients, respectively; 745 (33.0%) patients received antiplatelet therapy. A higher proportion of patients was prescribed OACs following Government subsidisation of DOACs in Quarter 3 (Q3) 2013 than OAC prescribing in the preceding quarters, (54.4% in Q3, 2013 to 68.1% in Q2, 2015, $p < 0.001$), with the prescribing of warfarin and antiplatelet agents declining (38.1% to 22.1% and 45.6% to 31.9%, respectively, $p < 0.001$). The proportion of patients receiving a DOAC steadily increased from 3.9% among OAC users in Q3, 2011 to 67.6% in Q2, 2015 ($p < 0.001$). In a sub-set of patients with newly diagnosed AF, patients commenced on DOACs were younger (70.4 vs. 73.8 years, $p = 0.04$) and had lower stroke and bleeding risk scores (CHA₂DS₂-VASc 2.8 vs. 3.3, $p = 0.03$, HAS-BLED 2.1 vs. 2.3, $p = 0.04$) than patients newly prescribed warfarin.

Discussion. DOACs rapidly became the drugs of choice for stroke prevention in NVAF and higher OAC prescribing rates were observed later in our study period. This corresponded with the commencement of Government subsidy of the new agents in August 2013. Nonetheless, antiplatelet agents accounted for a quarter to a third of all antithrombotic prescribing after DOACs became widely available highlighting the need for further improvement.

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The Utilisation of Antithrombotic Therapy in Older Patients in Aged Care Facilities with Atrial Fibrillation

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Introduction. Oral Anticoagulants are essential drugs for the prevention of thromboembolic events in patients with atrial fibrillation (AF). While the underutilisation of anticoagulants in elderly patients with AF has been demonstrated internationally, few studies have been conducted among aged care residents in Australia.

Aims. The aim of this study was to determine the utilisation of anticoagulants with respect to stroke and bleeding risk among people with AF residing in aged care facilities.

Methods. We performed a non-experimental, retrospective analysis designed to evaluate antithrombotic usage in older patients with AF in Australia using data collected by pharmacists while performing Residential Medication Management Reviews (RMMRs). The utilisation of antithrombotic therapy and the appropriateness of therapy were determined based on the CHADS₂, CHA₂DS₂-VASc and HAS-BLED risk stratification schemes, and the appropriateness of therapy was considered in the light of documented contraindications to treatment. Predictors of anticoagulant use were determined using multivariate logistic regression.

Results. A total 1952 RMMR patients with AF were identified. Only 35.6% of eligible patients (CHADS₂ score ≥ 2 and no contraindications to anticoagulants) received an anticoagulant. As age increased, the likelihood of receiving an anticoagulant decreased, and the likelihood of receiving antiplatelet therapy or no therapy increased. In patients with a high risk of stroke (CHADS score ≥ 2), utilisation of anticoagulants dropped by 19.7% when the HAS-BLED score increased from 2 to 3, suggesting that physicians placed a heavier weighting on bleeding risk rather than stroke risk in the study population.

Discussion. Anticoagulant medications appeared to be underused in this elderly population, whose risk of stroke often exceeded their risk of bleeding. Prescribing of anticoagulants was influenced to a greater extent by bleeding risk than it was by the risk of stroke. Further research investigating whether the availability of direct oral anticoagulants changes practice in this patient population is needed.

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The relationship between anticoagulation knowledge, health literacy and medication adherence in patients with atrial fibrillation

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Introduction. Atrial fibrillation (AF) is associated with significant morbidity, mortality and economic implications. Patients with AF are often prescribed anticoagulants for the prevention of cardioembolic stroke and other embolic events. Patients' anticoagulation knowledge, level of medication adherence and health literacy are known to affect treatment outcomes. However, contemporary data regarding the relationships between these variables are lacking.

Aims. The aim of this study was to determine the relationships between anticoagulation knowledge, health literacy and medication adherence, and to investigate if knowledge is affected by health literacy levels.

Methods. A cross-sectional survey was conducted in 48 patients with AF identified from general practices. The Anticoagulation Knowledge Tool (AKT) was used to assess anticoagulation knowledge, the Short Test of Functional Health Literacy in Adults (s-TOHFLA) for health literacy and the 8-item Morisky Medication Adherence Scale (MMAS) for medication adherence. The relationships between study variables were assessed using Pearson's correlation coefficient, t-tests and regression analysis.

Result. Participants in the study had mean scores of 61.6 ± 15.8 for the AKT, 7.2 ± 1.1 for the MMAS-8, and 24.7 ± 9.5 for the s-TOHFLA. A significant correlation was observed between both anticoagulation knowledge and health literacy with medication adherence (0.45 , $p < 0.01$ and 0.36 , $p < 0.05$, respectively). Participants with adequate health literacy had a significantly higher knowledge score than those with limited health literacy (66.1% vs 55.8% , $p < 0.05$), and regression analysis showed that both anticoagulation knowledge and health literacy scores were significant independent predictors of adherence levels ($0.03(95\%CI, 0.01-0.05)$, $p = 0.001$ and $0.04(95\%CI, 0.01-0.07)$, $p = 0.01$, respectively).

Discussion. Anticoagulation knowledge, health literacy and medication adherence were closely related and suboptimal in patients with AF. Further research in a larger population is required to definitely elucidate the magnitude of this problem. Future studies should also focus on developing effective interventions to improve anticoagulation knowledge, health literacy and medication adherence in this patient population.

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Self-management experience among Chinese women with Gestational diabetes

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Introduction. Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy. Women with GDM and their infants are at increased risk of serious health outcomes such as obstructed labour, congenital abnormalities, and stillbirth. Compared to many other ethnicities, Chinese women in Australia are more likely to develop GDM. To ensure they are provided with sufficient support, it is important to have an understanding of their experience in self-managing GDM. However, to date, no study has explored this area.

Aims. To investigate self-management experiences among Chinese migrants with GDM in Australia and factors influencing their self-management practice.

Methods. A qualitative study involving individual, semi-structured face-to-face interviews was conducted in August 2016. Participants were recruited from the antenatal clinic at the Royal Prince Alfred Hospital (RPAH). Interviews were audio-recorded, transcribed verbatim and thematically analysed. The study has ethics approval from the Sydney Local Health District Ethics Review Committee (RPAH Zone).

Results. Fifteen women aged 29-41 were interviewed at the clinic. Most of the participants came from China. The majority of participants demonstrated some knowledge of GDM, however, some expressed concerns about the rigidity of the prescribed diet, challenges when eating away from home and lack of nutritional information about Chinese food. Several factors influencing self-management were identified: barriers included lack of understanding of the self-management principles, lack of culturally sensitive dietary support and family and work responsibilities. Important facilitators included family support and concern for their baby's health.

Discussion. To assist Chinese women with GDM to better self-manage their condition, there is a need for greater cultural sensitivity among health care professionals and closer attention to ensuring a clear understanding of the principles behind lifestyle modification and self-monitoring practice in GDM.

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Current practices of assessing medication adherence in Australian dialysis centres

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Introduction. Despite the high prevalence of medication nonadherence in dialysis patients, little is known about the practices of assessing medication adherence in Australian dialysis centres.

Aims. To determine the current practices of assessing medication adherence in Australian dialysis centres.

Methods. We conducted a cross-sectional survey of renal healthcare professionals (HCPs) in Australia between March and May 2016. An invitation flyer describing the study aims and a hyperlink to the online survey was sent to the HCPs through email alerts, e-newsletters, and social media posts through coordination with the professional organizations. Adherence assessment practices were identified using a 4-point graded response with do not practice at all until practice for every patient. Descriptive and inferential statistics were used for data analysis.

Results. Of 176 respondents, 171 identified their profession as renal nurses (n = 112), physicians (n = 18), and pharmacists (n = 41). Majority of the HCPs agreed (59.6%, n = 99) patients do not take their medicines as prescribed. Most of the HCPs agreed (86.7%, n = 137) medication history interview can be effective in identifying nonadherence however, over half the time (51.0%, n = 78) it was not practiced for every patient. Patient's family or carer were asked about medications only for those with high risk of adverse reactions (43.1%, n = 66). Most of the HCPs informed that objective assessment such as measuring phosphate levels or blood pressure monitoring was routinely conducted for every patient in their centres (78.3%, n = 119), though asking patients to bring their medication and counting them was rarely practiced (16.4%, n = 25). HCPs mostly agreed (90.5%, n = 143) presence of dedicated pharmacists would facilitate effective medication management in dialysis patients, however most of the time (55.9%, n = 85) pharmacists were not available for medication reviews and reconciliation in dialysis centres.

Discussion. HCPs acknowledged to high prevalence of medication nonadherence in dialysis patients however, the methods of screening medication adherence behaviour in patients were less utilized in the dialysis settings. Future research should explore the barriers to pharmacists' involvement in dialysis centres.

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Comparative effectiveness of interventions to reduce inappropriate prescribing in renal impairment: A Systematic Review

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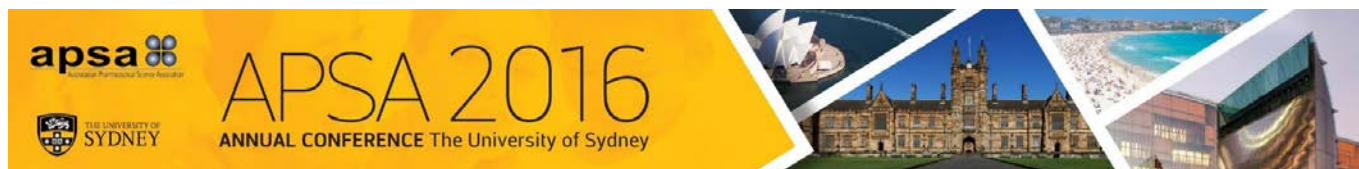
Introduction. Reduction in renal function is associated with accumulation of medications causing unwanted adverse effects in patients with renal impairment. Reducing the doses of renally cleared medications and avoidance of nephrotoxic medications is a standard clinical practice though the prevalence of inappropriate prescribing (IP) in renal impairment is high.

Aims. To systematically review the prevalence of IP and compare the relative effectiveness of available interventions in reducing IP in patients with renal impairment.

Methods. Studies were identified searching PubMed/Medline, EMBASE, Cochrane Library, IPA, Web of Science, Ovid/Medline, CINAHL, and PsychINFO databases up to June 2016. Medical subject headings and keywords such as "renal impairment," and "dose adjustment" were used. Studies defining renal impairment based on laboratory parameters, studies quantifying the prevalence of IP and measuring the effect of interventions were included.

Results. Forty-nine studies from 23 countries met the inclusion criteria. The prevalence of IP ranged between 9.4 and 81.1% of the medications prescribed to renally-impaired patients. IP was associated with prolonged hospital stay [Mean (SD) of 4.5 (4.8) Vs 4.3 (4.5)], increased risk of mortality [40%], higher drug expenditure, and adverse drug events. Twenty-one studies reported the impact of interventions on decreasing IP. Manual supports involving training and feedback to physicians was the main form of intervention applied (n=11) followed by computerised alerts (n=8) and prompts of reduced estimated glomerular filtration rate (eGFR) (n=2). The most significant reduction in IP was obtained when physicians received concurrent feedback from a clinical pharmacist ($p < 0.001$); on the other hand, prompts of reduced eGFR were not able to decrease IP in patients with renal impairment ($p = 0.9$ and $p = 0.81$). Polypharmacy, comorbidities, and age were identified as predictors of IP.

Discussion. IP in renal impairment is high and is associated with poor patient outcomes. A number of interventions exist though pharmacist-based and computer-aided approaches have shown the most promising results. A multidisciplinary approach addressing the wide-spread prevalence of IP in renal impairment is urgently needed.



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Personalising health care: delivering an innovative smoking cessation intervention in Paris, France.

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Introduction: A personalised, photo ageing tool combined with health care counselling was successfully delivered in Australian community pharmacies to motivate behavioural change in young smoking adults. Could this innovative smoking cessation intervention be delivered to another population of young adults with a higher prevalence of smoking and associated morbidities?

Aims. The primary aim of the study was to see if it was feasible and acceptable to demonstrate a novel, proven smoking cessation intervention to young French smoking adults and if they were engaged with it. The secondary aims of the study were efficacy of the intervention on quit attempts and reduced nicotine dependence.

Methods. A pilot study was conducted in France with 98 young adult smokers recruited from a Paris University. All students received standardised smoking cessation advice. 50 of the students also received a personalised smoking cessation message (photo ageing intervention) where they previewed an image of themselves as a lifelong smoker and as a non-smoker. The outcome measures were feasibility and acceptability of the intervention, quit attempts and nicotine dependence. All students were followed-up by telephone after 3 months.

Results. Students were successfully recruited to the study and actively participated in the healthcare counselling sessions. There was no statistical significant difference between the intervention and control groups in smoking dependence at recruitment. At the three month stage, the proportions of each group who had attempted to quit smoking were 37% (control) vs 46% (intervention). These percentages suggested a positive result for the intervention, although the difference was not statistically significant ($p=0.39$). There was no difference in smoking dependence between groups.

Discussion. The photo ageing smoking cessation intervention was acceptable and feasible to deliver to young French smoking adults. The design of the French pilot study was not as robust as the Australian randomised controlled trial design which may have led to the statistically insignificant results. Therefore further research recruiting smokers from the general French population is required, to explore if the innovative personalised health message can motivate young French adult smokers to quit.

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Asking patients and caregivers how frequently they have received messages about the harmfulness of medicines could help elicit poor adherence

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Introduction. Clinicians are often advised to elicit patients' medication concerns so that these worries can be addressed in order to improve adherence. Medication concerns however, can be deeply private and people may be reluctant to reveal them, thinking that the clinician may not approve of these personal beliefs. There is a need to find alternative ways to guide clinicians on how best to introduce conversations about patients' genuine concerns about their medicines. This is particularly relevant when using topical corticosteroids, where "steroid phobia" is prevalent.

Aims. The aim of this study was determine whether patients' and caregivers' recall as to how frequently they have received concerning messages about topical corticosteroids is predictive of their level of adherence.

Methods. A cross-sectional survey was completed by patients (and/or the caregivers of children) with inflammatory skin conditions while waiting to see specialist dermatologists. The MARS-5 was adapted to measure self-reported adherence. The BMQ – Specific scales were adapted to suit the context. A new 12-item scale was developed to measure the frequency of receiving concerning messages, including for example concerns about skin thinning. Structural equation modelling (SEM) was used to test the relationships between the variables.

Results. Questionnaires from 121 patients and 77 caregivers were analysed. The scales for MARS-5, BMQ-Necessity, BMQ-Concerns and the frequency of receiving concerning messages had acceptable convergent validity. Tests of measurement invariance showed equality in item-factor scaling for patients and caregivers. The SEM demonstrated acceptable fit indices and predicted 18% of the variation in adherence. Receiving higher frequency of concerning messages had a moderately positive effect on BMQ-Concerns ($\beta = 0.36$, $p < 0.001$) and a mildly negative effect on adherence ($\beta = -0.19$, $p < 0.05$). BMQ-Concerns had no significant effect on adherence.

Discussion. This study shows that patients' recall of the frequency with which they have received messages about the potential harms of topical corticosteroids, predicts even greater amount of variation in adherence than estimates of concerns themselves. This supports the notion that clinicians' screening questions for adherence could include the emotionally neutral question "How frequently have you heard about the potential harms of this medicine?"

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Surgical antibiotic prophylaxis use and infection prevalence in breast surgery

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Background In Australia, guidelines for the appropriate use of antibiotic prophylaxis are provided in the Therapeutic Guidelines: Antibiotics. However, their inappropriate use remains a concern.

Aim To examine adherence to guidelines in breast surgery and identify trends of non-adherence in a Western Australian teaching hospital.

Method A retrospective study collected data from a random sample of 150 of a total of 1049 eligible medical records of patients who underwent a breast surgical procedure in 2013 or 2014. A binary classification (adhered to/not adhered to) was utilised to assess adherence of preoperative antibiotic use to the head, neck and thoracic therapeutic guidelines: antibiotic that were current at the time. Secondary analyses investigated any link between adherence to guidelines and development of an infection.

Results Antibiotic prophylaxis was prescribed by 14 surgeons for 140 (92.7%) procedures. Adherence to all guidelines occurred in 20 (13.3%) procedures, whilst 11 (7.3%) did not adhere to any element of the guidelines. Appropriate timing was the main factor not adhered to occurring in 65 (43.3%) procedures. Postoperative antibiotics were prescribed in 35 (23.3%) of surgeries, with 32 (91.4%) administered beyond 24 hours. The average antibiotic course was 8.21 days. The length of stay was significantly different ($p=0.0036$) between surgical groups but being only statistically significantly longer ($p=0.0066$) in the 'other' surgical grouping (other than mastectomy, axillary node clearance and reconstruction). There was a tendency for risk of an infection to be decreased with compliance (odds ratio: 0.23; 95% CI: 0.05, 1.07; $p=0.06$).

Discussion A gap between clinical practice and guidelines exists possibly owing to lack of specificity in the guidelines current at the time. With the update guidelines, there is hope that adherence to the guidelines will be increased. Education and guidelines based upon the Therapeutic Guidelines: Antibiotic for breast surgery needs to be implemented at the hospital.

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Powder formulations for respiratory delivery to treat tuberculosis

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Introduction. Current pharmacotherapeutic regimens for TB require high oral and parenteral doses of multiple drugs for long periods (6-24 months), leading to significant adverse effects. Thus, a shorter, safer, well tolerated and more effective treatment option is required. Since ~80% of Mtb are localized in the lung, pulmonary delivery of anti-TB drugs offers several potential advantages. In particular, achievement of high drug concentrations in the lung using relatively low doses has the potential to increase treatment success, reduce the risk of drug resistance and systemic toxicity. For TB, powders of high aerosolization are essential.

Aims. The aim was to develop dry powders containing single or multiple drugs by spray drying which would be highly aerosolizable, physically stable, safe and well tolerated.

Methods. Powders containing one or more anti-TB drug(s), rationally designed, were developed by spray drying in combination with L-leucine and a lung surfactant DPPC. Powders were characterized for physical properties, surface composition, and aerosolization performance. The impact of high doses of drugs on the DPPC monolayer was investigated.

Results. All the individual or combination spray dried powders of isoniazid, rifampicin, pyrazinamide, moxifloxacin and kanamycin were of inhalable size ($<5\ \mu\text{m}$). The aerosolization was significantly improved when co-spray dried with L-Leucine. Although it varied with drugs, the best aerosolization (~80%) for Moxifloxacin was achieved with 20% of L-Leucine (w/w). The aerosolization of pyrazinamide was also improved when it was co-spray dried with DPPC. When a hydrophilic drug (e.g. kanamycin) was spray dried with a hydrophobic drug (e.g. rifampicin), the aerosolization improved significantly (~90%). The aerosolizability of drugs from the combination powders remained stable. Surface analysis revealed that the surface of the combined powders was enriched with hydrophobic drugs or excipients. The delivery of a high dose of drugs such as isoniazid and rifampicin reduced the collapse pressure of lung surfactant monolayer.

Discussion. Spray drying can produce high aerosolization capacity powders for inhalation containing single or multiple drugs. The use of hydrophobic excipient or drug or surfactant can improve aerosolization stability by their enrichment on the surface.

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Hyaluronic acid based self-assembling nanosystems for cancer therapy

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¹University of Queensland Diamantina Institute, Translation Research Institute, Brisbane, QLD; ²Northeastern University, Boston, MA; ³Dana-Farber Cancer Institute, Harvard Medical School, Boston, MA

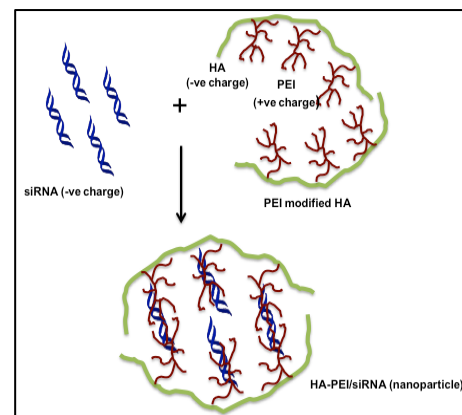
Introduction: Multi-drug resistance is a serious clinical challenge that significantly limits the effectiveness of cytotoxic chemotherapy. Since tumor cells are known to metabolize glucose by aerobic glycolysis and produce lactate, we hypothesized that down-regulation of genes over-expressed in aerobic glycolysis would have synergistic effect with cytotoxic chemotherapy in MDR model of ovarian cancer.

Aims: The aim of our study was to evaluate the effectiveness of combination therapy with siMDR-1 and siPKM-2 in human ovarian adenocarcinoma cell lines and xenograft models using HA-PEI based systems.

Methods: The nanoparticles with the siRNA were characterized for morphology, size, charge, encapsulation and transfection efficiency. In vivo studies included biodistribution assessment, gene knockdown confirmation, therapeutic efficacy and safety analysis.

Results: The self-assembling HA-PEI nanoparticles showed down-regulation of target genes (60-80%) following transfection. In vivo knockdown studies showed the targeted nanoparticles provided down-regulation MDR-1 (65%) and PKM-2 (65-70%) in SKOV-3 tumor bearing mice. Combination therapy showed improved tumor growth inhibition (TGI) and tumor volume doubling (TVD) time for all treatment groups compared to PTX solution.

Discussion: This study showed the encapsulation and delivery of siMDR-1 and siPKM-2 in HA-PEI based self-assembling nanoparticles improved the efficacy and cytotoxic effect of PTX in cancer cells. These delivery systems showed applicability in other types of cancers including lung cancer and pancreatic cancers.



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Medicines only work if you know what to take

Gerard Stevens, Webstercare

Medication has a value. To the PBS it is about \$9 billion a year(1) but to the individual the value could be a cure, symptom relief or prevention of an event. Yet it is often quoted that only 50% of prescribed medicines are actually taken, indicating non-adherence is the cause of massive waste within the healthcare system. One of the key questions to ask of the complex medication adherence puzzle is why there is such disconnection between what the doctor prescribes and what the patient takes.

Often the barrier is not that the patient doesn't want to take their medicines but a consequence of the complexity of their situation. There are more than 353,800 Australians(2) living with dementia and 100,000 people supported in the community by Commonwealth-funded home care packages(3) and we know loss of executive function skills and conflicting information can significantly impact medication adherence.

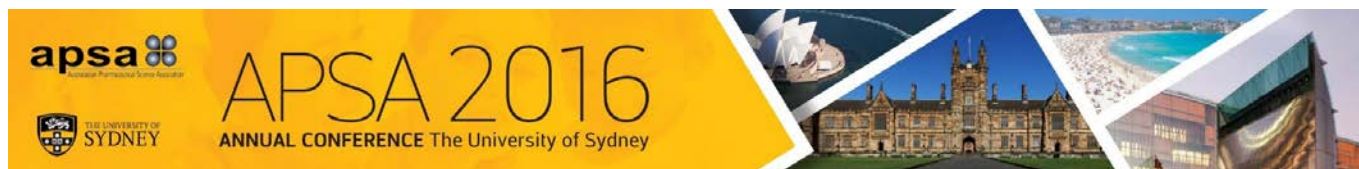
This is exacerbated by confusion between points of care as to what medicines the patient is actually taking at any point in time. There is no one 'source of truth' universally referred to. Doctors' databases only identify what has been dispensed, not what is actually being taken including over-the-counter medicines.

The first step in solving this puzzle is to examine how patients know what medicines they should be taking, and how this information is stored and communicated so it is accessible to all members of the healthcare team. Advances in technology see more computing power in an iPhone than the computers that put a man on the moon. It should not be beyond us to find out with confidence what medicines a vulnerable elderly person should be taking.

1. <https://www.pbs.gov.au/statistics/2014-2015-files/exp-prs-book-01-2014-15.pdf>

2. <https://www.fightdementia.org.au/about-dementia/statistics>

3. <https://agedcare.health.gov.au/aged-care-reform/home-care/home-care-packages-reform>



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Increasing Pharmacists' roles in improving medicine use

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Introduction. There is increasing evidence that Pharmacists can play a vital role in improving medicine use through education, health literacy, adherence support and other cognitive services. However, time is often cited as a barrier and sporadic service contracts can impact on the provision and continuation of care.

Aims. The aim of this piece of work is to bring together several studies conducted in New Zealand that show where pharmacists can have direct benefits for patients in assisting them improve their medication use.

Discussion. Within New Zealand (NZ), Medicine Use Reviews (MURs) are provided in several regions, a more advanced service Medicines Therapy Assessment (MTA) is also available but there can be a blurring of the lines of service when pharmacists intervene to improve medication therapy. Further, time has been cited as a significant barrier for many pharmacists to implement these services and this presentation will discuss the pilot and implementation of a Pharmacy Accuracy Checking Technician (PACT) role into the NZ pharmacy setting. This role has been created specifically to allow pharmacists more time to focus on clinical cognitive tasks. Lastly, the roles of Clinical Pharmacist Facilitators will be presented and the impact that these pharmacists within or attached to General Practice can have on improving medicine use, not only via patient education.

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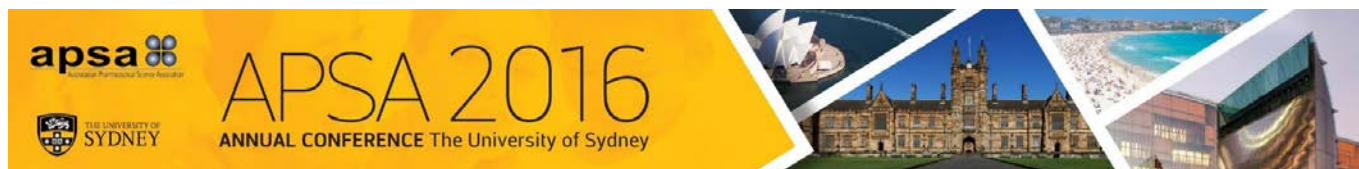
Optimizing medication use in older multimorbidity patients

Darrell R Abernethy, Johns Hopkins Univ. School of Medicine, Baltimore, MD, USA, and US Food and Drug Administration, Silver Spring, MD, USA

Introduction. Polypharmacy in older patients is the norm. This is associated with substantial adverse drug effect related morbidity and mortality. Efforts to optimize treatment in a patient specific manner have not achieved the desired results.

Aims. The context of the multimorbidity older patient will be characterized. The aggregate clinical phenotype often appears as a geriatric syndrome.

Methods/Results/Discussion. Common pathophysiological changes with age and disease occur across geriatric syndromes and result in vulnerability to adverse drug effects related to orthostatic hypotension, sedation and confusion, urinary retention, and impaired balance and mobility. Drugs with these on and off target effects may be indicated for specific diagnoses in a given patient. However the shifted risk/benefit profile in the older patient must be considered, and such drugs are candidates for very critical evaluation before prescribing, or candidates for deprescribing. These are drugs with anticholinergic effects, sedative effects, and vasodilating or diuretic effects that exacerbate orthostatic hypotension. When evaluating the patient, the medication inventory should highlight such medicines, and each medicine individually considered in the context of the individual multimorbid patient instead of the individual disease for which the drug is indicated. Implementing this approach in geriatric and general medical practice is optimally done in the context of the multidisciplinary health care team. The clinical pharmacist member has a key role as the team member with most expertise in pharmacotherapy. The limited workforce of trained geriatric clinical pharmacologists and geriatric clinical pharmacists represents both a challenge and an opportunity.



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Deprescribing in people with dementia

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In 2015, 46.8 million people worldwide lived with dementia, a number which is projected to increase to 131.5 million by 2050. The vast majority of people living with dementia are greater than 65 years old. As such, most people with dementia have additional age-related medical conditions, such as cardiovascular disease, diabetes, musculoskeletal disorders and chronic obstructive pulmonary disease. People with dementia are prescribed approximately five (community dwelling) to twelve (residing in aged care) regular medications to treat dementia symptoms and manage their other medical conditions. People with dementia have pharmacokinetic and pharmacodynamic alterations (additional to those associated with ageing) that may increase the risk and decrease the efficacy of medications. For example, people with dementia are at a greater risk of neurological side effects due to increased permeability of the blood brain barrier (BBB) and a possible decrease in P-glycoprotein activity at the BBB. Pharmacodynamically, reduced acetylcholine in the brain increases susceptibility to adverse cognitive side effects of anticholinergics.

Approximately 50% of people with dementia are prescribed an inappropriate medication. A multitude of challenges face health-care professionals aiming to optimise medication use in this population. People living with dementia are regularly excluded from clinical drug trials and they are generally not specifically considered in treatment guidelines for other conditions. General Practitioners report difficulties in establishing appropriate goals of care and as such identifying inappropriate medications is difficult. Enacting shared decision making about deprescribing can be perceived to be complicated due to reduced cognitive function and the involvement of carers as surrogate decision makers. However, we found that 85% of carers are willing to have one or more of their care recipient's medications ceased if their doctor said it was possible.

Current work is being conducted into developing drug-specific deprescribing guidelines for people with dementia. A focus has been placed on ensuring these guidelines can be successfully implemented into practice through the development of decision-making tools for both health-care professionals and consumers.

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Clinical trial data transparency as an enabler of precision medicine

Michael J Sorich¹. Clinical Pharmacology, Flinders University¹, Adelaide, SA

Introduction. Over the past 5 years there have been great advances in the sharing of patient-level data from clinical trials for secondary analysis by other researchers.

Aims. To highlight the recent advances in access to clinical trial data and the opportunities this enables for precision medicine.

Methods. Pooled analysis of patient-level data from multiple clinical trials of cancer medicines. Secondary analysis of the association between laboratory/clinical markers (pre-therapy or early following commencement of therapy) and key therapeutic/adverse outcomes of cancer medicine therapy.

Results. Most major pharmaceutical companies now provide mechanisms for requesting secure access to patient-level data, although the range of study data, the process of data requests and access, and the conditions of access differ. A range of case studies demonstrating the potential for this data to improve guidance of cancer treatment decisions will be presented.

Discussion. Although the ability to access clinical trial data has improved greatly in the last 5 years there are still many obstacles limiting both data access, data pooling and data analysis. Ongoing changes in policy of key institutions will likely result in further improvement in the availability of clinical trial data in the near future.

Sorich MJ et al. (2016) Br J Cancer. 114(12): 1313-7.

Sorich MJ et al. (2016) Int J Cancer. 138(9): 2293-9

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Cancer Treatment in the Era of Personalised Medicine and Biomarkers

Chris Karapetis, Flinders Centre for Innovation in Cancer, Adelaide

Improved understanding of cancer biology is transforming the approach to cancer treatment. The use of predictive biomarkers enables the treating physician to select patients for the most appropriate therapies. Efficacy can be enhanced in those predetermined to benefit and toxicity avoided in those with cancers expected to display resistance to therapy. The cost effectiveness of new cancer treatments is therefore optimised. The presentation will outline the history of personalised medicine in oncology through the application of biomarkers. Future directions and potential challenges will be explored.

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A novel nano-theranostic platform for detecting and targeting lymph node metastases with hybrid PET/MRI

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Introduction. The lymph nodes are usually the initial site of distal spread of tumour cells from a primary cancer. Lymph node metastases is a critical prognostic indicator of outcome and is thus crucial for cancer staging and treatment planning. To date, no reliable clinical techniques exist for detecting lymph node metastases or delivering targeted therapy.

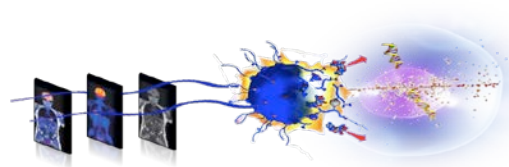
Aims. This project aims to develop a nano-theranostic platform that can passively target the lymph nodes and detect metastatic tumour cells therein using multimodal Positron Emission Tomography (PET) and

Magnetic Resonance Imaging (MRI), which combine high sensitivity and high resolution, respectively, in a single image. The nanoparticle platform can also deliver a therapeutic cargo to tumour cells in the lymph nodes.

Methods. Super-Paramagnetic Iron Oxide Nanoparticles (SPIONs) were characterised for MRI contrast. They were then radiolabeled with a PET tracer using a novel method, heat-induced radiolabeling, that eliminates the need for chelation. Phantom imaging studies were carried out to demonstrate the principle of a nanoplatform for hybrid PET/MRI. Additional studies were also carried out to assess targeted delivery of radionuclide therapy.

Results. Proof-of-principle of a nanoplatform for hybrid PET/MRI was demonstrated using different radiolabelled SPIONs. Results of simulation studies further demonstrate potential efficacy of targeted therapy with internally delivered radionuclide particles.

Discussion. These preliminary studies pave the way for pre-clinical studies. Importantly, our preliminary results indicate that the nanoparticle platform is robust to a variety of different SPION/radiolabel combinations which could potentially offer different advantages for different cancers.



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Torti SV and Torti FM (2013) Nat Rev Canc 13:342-355

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Precision nanomedicine for delivery of therapeutics to aggressive cancers

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²Australian Centre for NanoMedicine and ARC Centre of Excellence in Convergent Bio-Nano Science and Technology, UNSW Australia, NSW.

Cancer is a major cause of morbidity with approximately 44,000 people dying in Australia from their disease in 2011 alone. Disseminated disease and drug resistance are a major cause of treatment failure in cancer therapy. Our research has identified cytoskeletal and mitotic proteins that are altered in cancer and can mediate drug resistance. Suppressing these proteins using short-interfering RNA (siRNA) or short-hairpin RNA (shRNA) approaches led to increased drug sensitivity, tumour reduction and decreases in metastatic spread. Unfortunately, siRNA is not stable in serum and requires a delivery vehicle to shield it from degradation. Nanomedicine (engineered materials at the nano meter scale) can provide effective vehicles to encapsulate siRNA or drugs for delivery applications. We have been developing and evaluating dendrimer and star-based polymers for siRNA delivery. Specifically, we have shown both *in vitro* and in animal models of epithelial cancer that we can deliver and suppress expression of cytoskeletal and mitotic genes and reduce tumour growth. The opportunities and challenges of nano-based drug delivery will be presented.

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Kavallaris M. (2010) *Nat Rev Cancer*; 10: 194-204.

McCarroll JA, et al. (2010) *Cancer Res*; 70: 4995-5003.

McCarroll JA, et al. (2015) *Cancer Res*; 75: 415-425.

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Chemical and physical Stability of ceftaroline fosamile in an elastomeric device

Farah Almadfai¹, Rahul Patel¹, Syed Tabish R Zaidi¹, Troy Wanandy². Pharmacy, School of medicine¹, University of Tasmania¹, Pharmacy Department, Royal Hobart Hospital². Hobart, TAS

Introduction: Serious and life threatening infections such as endocarditis, cystic fibrosis, and osteomyelitis caused by multi drug-resistant bacteria such as Methicillin Resistant *Staphylococcus Aureus* often required prolong treatment with intravenous antibiotics (4 to 6 weeks). Due to unavailability of oral forms of many antibiotics, patients with such infections need to be admitted to the hospital for the entire duration of their therapy. An increase stay in hospital is associated with nosocomial infections, increase morbidity and mortality, and higher healthcare burden.

Elastomeric devices are non-battery operated infusion devices that deliver continuous infusion of antibiotics in a seamless manner allowing an earlier hospital discharge to patients who needed prolong duration of intravenous antibiotic treatment. Vancomycin is the most commonly used antibiotic to treat multi drug resistant infections, however poor lung penetration, serious adverse reactions, coupled with high resistance, led to a reduction the use of vancomycin. Ceftaroline, is a fifth-generation parenteral cephalosporin indicated for the treatment of systemic infections caused by resistant bacteria, can be used as an attractive alternative to vancomycin. However, the chemical and physical stability of ceftaroline in elastomeric devices is unknown and therefore, limits its administration using elastomeric devices.

Aims: to investigate the chemical and physical stability of ceftaroline in an elastomeric device (the Baxter infuser LV).

Methods: A total of 16 Baxter infuser LV devices consisting of 6mg/mL of ceftaroline were prepared. Eight elastomeric devices diluted with saline and another eight diluted with dextrose 5% were stored at three different temperatures 4, 25, and 30°C. An aliquot was withdrawn immediately at time (0 hour) and at various time points. Each sample was analyzed in duplicate for the concentration of ceftaroline fosamile using a stability-indicating high-performance liquid chromatography (HPLC) technique. Samples were also investigated for PH (PH meter), visual color changes, evidence of precipitation immediately after preparation and on each day of analysis, and particle content (microscopically).

Results: Ceftaroline was chemically and physically stable for 144, 24, and 12hours at 4, 25, 30°C respectively.

Discussion: ceftaroline is found to be chemically and physically stable at 4°C for 144 hours which means the treatment can be prepared in bulk and/or supplied in advance by hospital pharmacist. This will avoid the need for patients to travel to the hospital on daily basis to collect the required drug admixtures. ceftaroline is found to be stable for 12 hours at 30°C, that will allow it to be self-administered through a continuous infusion.



Figure 1: Elastomeric device.

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Combination dry powder formulation of moxifloxacin and ethionamide for treating drug-resistant tuberculosis

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Introduction: Drug-resistant tuberculosis (DR-TB) is an emerging global health problem. The current treatment of DR-TB includes both oral and parental delivery of drugs. High systemic exposure, side effects and lengthy treatment time are the problems of current treatment. Inhalation of drugs may be advantageous due to the direct delivery to the infection site, possibly reducing systemic exposure. On the other hand, monotherapy of drug may lead to the emergence of resistance; so synergistic combinations of drugs is an emerging strategy to treat drug-resistant TB.

Aims: This study aimed to develop a combination dry powder formulation of moxifloxacin HCl and ethionamide as this combination is synergistic against drug-resistant *Mycobacterium tuberculosis*. L-leucine (20% w/w) was added in the formulations to maximize the process yield.

Methods: Moxifloxacin HCl and/or ethionamide powders with/without L-leucine were produced using a Buchi Mini Spray-dryer. A next generation impactor (NGI) was used to determine the *in vitro* aerosolization efficiency. The powders were characterized for other physicochemical properties.

Results: All the spray-dried powders were within the aerodynamic size range of 2.3 to 2.9 μm except ethionamide-only powder (6.0 μm). The combination powders with L-leucine aerosolized better (%FPF: 80.7 and 79.9 for moxifloxacin and ethionamide, respectively) than moxifloxacin-only (%FPF: 30.8) and ethionamide-only (%FPF: 9.0) powders. The combination powders were spherical and corrugated whereas moxifloxacin-only powders were spherical and smooth and ethionamide-only powders were angular-shaped flakes. The combination powders had low water content (<2.0%).

Discussion: The improved aerosolization of combination powder formulation may be due to the changes in surface morphology and aerodynamic size. Further studies are required to understand the surface composition and mechanism for improved aerosolization. The improved aerosolization of the combination formulation may be helpful for the effective treatment of drug-resistant tuberculosis.

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Stability of Anidulafungin in Total Parenteral Nutrition (TPN) at Y- site.

Yusra Saleem¹, Tabish Zaidi¹, Troy Wannady² and Rahul P Patel¹. Pharmacy, School of Medicine, University of Tasmania¹, Pharmacy Department, Royal Hobart Hospital², Hobart, TAS.

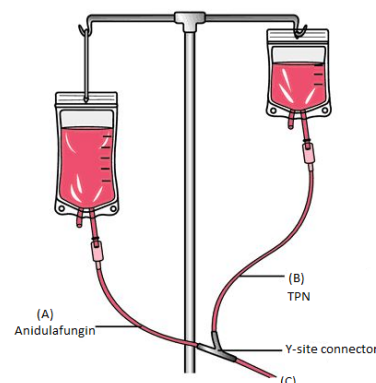
Introduction. Invasive candidiasis is a life threatening infection commonly occurs in cancer patients undergoing intensive chemotherapy. Available treatment options for invasive candidiasis include voriconazole, fluconazole, amphotericin B and echinocandins. Anidulafungin is a new class of echinocandin used intravenously in cancer patients suffering from invasive candidiasis. Also, cancer patients who are on intensive chemotherapy often develop chemotherapy induced oesophagitis, therefore, are unable to intake food by enteral route. In order to avoid malnutrition in such patients, total parenteral nutrition (TPN) composed of carbohydrates, proteins and lipids needs to be delivered intravenously on a daily basis. Required medications such as anidulafungin and TPN are required to be administered intravenously on a daily basis and access to multiple intravenous sites is a problem in such patients. One option to overcome this problem is to use a three-way Y-site connector. As shown in (fig.1) Y-site connector allows multiple fluids to infuse together

Aim. To determine the Physico-chemical stability of anidulafungin in total parenteral nutrition (TPN) at Y-site.

Method. Anidulafungin (0.77mg/mL) diluted with 0.9% normal saline or 5% dextrose was pumped through intravenous line (A). TPN (either pre-mixed or multi-chamber bag) was pumped through line (B). The mixture of line A and B was collected at site (C). The concentration of anidulafungin (t=0 and t=4 hours) was measured using a newly developed and validated at High performance liquid chromatography (HPLC). pH (using a pH meter), colour change (visually), particle content (microscopically) and lipid globule size (using dynamic light scattering DLS) were measured at times 0 and 4 hours. Figure.1 Y- site administration assembly.

Results. All the samples retained more than 96% of the initial anidulafungin concentration at all time periods. pH values did not change significantly over 4 hours. No particle presence was detected using microscope. There was no change in the lipid globule size from time 0 and after 4 hours.

Discussion. Anidulafungin in 5% dextrose and 0.9% saline was found to be stable in both pre-mixed and multi-chamber PN bags for more than 4 hours at room temperature. This information is useful for health care professionals. As it would allow the simultaneous administration of life saving anidulafungin and much needed TPN on a daily basis.



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Investigations into the physical and chemical stability of co-trimoxazole intravenous infusions

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Introduction. Intravenous (IV) co-trimoxazole (combination of 80 mg trimethoprim and 400 mg sulfamethoxazole per 5 mL) infusion is used to treat infections such as pneumocystis jiroveci pneumonia in critically ill patients. IV co-trimoxazole infusion is commonly prepared by diluting the recommended dose of co-trimoxazole to a minimum of 500 mL of diluent. This infusion may be administered up to four times a day and therefore patients may receive additional 1.5 to 2 liters of IV fluid per day. This may lead to severe complications including a life threatening pulmonary edema.

Aims. The purpose of this study was to investigate the stability of IV infusion of co-trimoxazole after diluting co-trimoxazole injection in 1:25 v/v, 1:20 v/v, 1:15 v/v or 1:10 v/v of commonly used diluent (dextrose 5%).

Methods. Four ampoules of IV co-trimoxazole were injected into an infusion bag containing 500, 380, 280 or 180 mL of 5% of dextrose solution. A total of two bags for each dilution (in total = 8 bags) were prepared and stored at 25°C. An aliquot was withdrawn immediately before (0 hour) and after 0.5, 1, 2 and 4 hours of storage. Each sample was analysed in duplicate for the concentration of trimethoprim and sulfamethoxazole using a stability indicating high-performance liquid chromatography method. Samples were also assessed for pH (using a pH meter), colour changes and evidence of precipitation (visually), and for particle content (microscopically) immediately after preparation and on each analysis time point.

Results. The concentration of sulfamethoxazole remained higher than 99% over 4 hours for all the dilution ratios. The concentration of trimethoprim was more than 98% in 500 mL (1:25v/v), 380 mL (1:20 v/v), 280 mL (1:15 v/v) or 180 mL (1:10 v/v) dilutions. There was no change in pH at time zero and at various time points. and there was no visible precipitation or visible change in colour. Microscopically, no particles were detected when co-trimoxazole was diluted in 500 mL or 380 mL. Approximately more than 1700 particles were detected after 150 minutes when co-trimoxazole was diluted in 280 mL.

Discussion. Co-trimoxazole is physically and chemically stable over 4 hours when diluted with 380 mL. It means that diluent infusion volume can be decreased from 2 litres to approximately 1520 mL. This means more than 280 mL can be decreased and the risk of life threatening oedema also will be decreased.

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Investigation of chemical and physical stability of voriconazole in elastomeric infusion pumps

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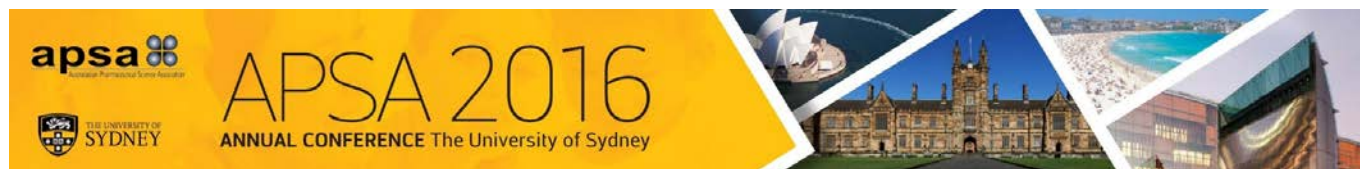
Introduction. Voriconazole is used as a first line treatment for invasive fungal infections such as invasive aspergillosis and is associated with less side effects as compared to other antifungal drugs including amphotericin B. Moreover, voriconazole can be administered intravenously using elastomeric infusion pump. These elastomeric infusion pumps deliver the drug into patient's body through the pressure generated on the walls of elastomer reservoir and do not require any external force for drug administration. So, the use of voriconazole in elastomeric infusion pumps will decrease the length of stay in hospitals as well as the overall cost associated with the treatment of various invasive fungal infections. However, there is no information available related to the physio-chemical stability of voriconazole in elastomeric infusion pumps. If voriconazole is chemically unstable then either less amount of drug or degraded products could be infused and if the drug is physically unstable then precipitates could be infused. However, if voriconazole is found to be stable both chemically and physically, patients suffering from fungal infections can be treated.

Aims. The aim of this study was to analyse the chemical and physical stability of voriconazole in elastomeric pumps at three different temperatures i.e. 4°C, 25°C and 35°C.

Methods. The voriconazole drug vial (n=6) was reconstituted with 19 mL of water for injection which was further diluted with 80 mL of 0.9% normal saline or 5% dextrose solution to achieve 2 mg/mL of drug concentration. The prepared solution was transferred to an Intermate SV elastomeric pump (n=6) (Baxter Healthcare corporation) and the pumps were stored at three different temperatures (4°C, 25°C and 35°C). The samples were drawn at pre-determined time intervals as follows; 0, 12, 24, 46, 72 and 96 hours for the pump stored at 4°C and 0, 1, 2, 3 and 4 hours for the pumps stored at 25°C and 35°C. However, the first sample (zero-minute sample) was kept from the prepared drug solution before transferring the drug solution into the pumps. The samples were diluted up to 5 µg/mL and were analysed using High Performance Liquid Chromatography (HPLC) to investigate the chemical stability of voriconazole. The drug was considered to be chemically stable if more than 90% of drug concentration was retained to the initial drug concentration. The physical stability of samples was analysed for alteration in pH (pH meter), color (visual analysis) and precipitation (microscopic analysis).

Results. Voriconazole was found to be chemically stable as it retained more than 90% of its initial concentration for at least 96, 4 and 4 hours at 4°C, 25°C and 35°C respectively. Moreover, voriconazole was found to be physically stable as there was no appearance of particles, no change in the color and pH in the samples.

Discussion. The results obtained from this study will be helpful in the usage of voriconazole in elastomeric infusion pumps as the elastomeric pumps can be prepared with drug solution and stored at 4°C. Moreover, the pumps can be used at home as these are stable at 25°C and 35°C. Another positive aspect is that it will improve the quality of life of patients suffering from different types fungal infection as it will decrease the length of stay in hospital and overall cost associated with the treatment of fungal diseases. Furthermore, it will be helpful in decreasing the additional burden on healthcare systems.



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Evaluation of the stability of linezolid in commonly used intravenous fluids.

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Introduction. Little is known about the stability of linezolid in aqueous solution and common intravenous fluids.

Aims. To evaluate the stability of linezolid in commonly used intravenous fluids and at selected pH values in aqueous solution.

Methods. A validated High Performance Liquid Chromatography (HPLC) method was used for analysis. Sodium chloride 0.9% solution, Hartmann's solution, Glucose 5% solution and Glucose 10% solution containing 2.0 mg/mL linezolid were stored at 25.0°C ($\pm 0.1^\circ\text{C}$) for 34 days. Linezolid's stability in 0.1 M sodium hydroxide at 48.0-70.0°C ($\pm 0.1^\circ\text{C}$), and at pH values 8.7-11.4 at 70.0°C ($\pm 0.1^\circ\text{C}$) were evaluated. Zyvox[®] intravenous solution was stored at 70.0°C ($\pm 0.1^\circ\text{C}$) for 72 hours to evaluate stability.

Results. Linezolid maintained > 95% of initial concentration in all intravenous solutions tested. The antibiotic followed first-order kinetics, had an activation energy of 58.22 kJ/mol and underwent specific OH⁻ catalysis within the tested pH range.

Discussion. Linezolid maintained its shelf life for 34 days at 25.0°C ($\pm 0.1^\circ\text{C}$) in selected intravenous solutions and could be used as an alternative to the Zyvox[®] intravenous solution. At 70°C ($\pm 0.1^\circ\text{C}$) solutions showed shelf life values from less than one minute to > 12 hours dependent on pH.

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Development of an integrated BPharm curriculum at the University of Auckland

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Introduction. In response to accreditation signals and consultation with the profession, the Auckland School of Pharmacy embarked on a major review of its BPharm curriculum in 2014. A Curriculum Committee oversaw the review and extensive consultation occurred with the profession and both internal and external stakeholders.

Aims. There were three major objectives for the review: i) to achieve a high degree of integration of subject content and assessment; ii) to increase experiential learning opportunities, both in duration and diversity; and iii) to place greater emphasis on the development of 'generic' skills such as communication, critical thinking, moral reasoning, and leadership.

Methods. A Graduate Profile was developed based on five broad domains of learning: 1. Applied Science for Pharmacy; 2. Science of Drug Delivery; 3. Clinical Pharmacy Practice; 4. Hauora Māori; 5. Personal and Professional Skills. The concept of the 'spiral curriculum' was used to inform the review and the Graduate learning outcomes were mapped to the individual courses of the integrated curriculum. As an example of an integrated course, PHARMACY 213 (60 points, Semester 2, Part II) comprises five modules: Dermatology (4 weeks), Infectious Diseases (4 weeks), Gastrointestinal (4 weeks), Clinical and Professional Skills (over 12 weeks), and Placement (day release over 10 weeks). The revised curriculum model was approved by all relevant University committees and submitted to the national Committee on University Academic Programmes (CUAP) in March, 2015 (CUAP approval is required in NZ to mount any new programme).

Results. CUAP approval was granted in August, 2015 and further development of the new courses followed. The new curriculum is being phased in with implementation of Part II in 2016, Part III in 2017, and Part IV in 2018 (note: entry to the Auckland BPharm is at Part II following a health sciences year).

Discussion. The Auckland BPharm curriculum review has resulted in major changes to the structure, content and delivery of the degree and the three initial objectives have been central in planning. There has been widespread support from students, staff and stakeholders for the planned changes and early indicators of success include excellent student achievement and positive evaluations.



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An international workshop that researched how a pharmacy curriculum may develop a commitment to lifelong learning

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Introduction. The most recent 'Accreditation Standards for Pharmacy Programs in Australia and New Zealand' require pharmacy education to produce graduates that engender a commitment to lifelong learning (LLL). The graduate learning outcomes for this however, are not defined in the standards, nor is there any guidance on how curriculum should be designed to achieve this outcome. Previous research has identified that embedding graduate outcomes in assessment can have a strong influence on what students will learn, but to what effect does this have on developing these skills in pharmacy graduates?

Aims. To develop a list of skills, attitudes and attributes of a lifelong learner in pharmacy and discuss how curriculum may influence or prevent development of LLL skills in graduates.

Methods. As one part of a mixed methods study design, a qualitative workshop was held at the Lifelong Learning in Pharmacy conference, Croatia, 2016. The participants were asked to develop a list of skills, attitudes and attributes of LLL and identify how curriculum could teach these skills.

Results. Participants were able to identify a number of skills, prioritising the most important outcome of the graduate lifelong learner as someone who is 'Motivated to Learn'. Teaching staff were also recognised as being an influential part of the curriculum, and were also identified as a barrier if they do not demonstrate LLL skills. Assessment and teaching should provide support, relevant learning and encourage collaboration and reflection.

Discussion. As LLL outcomes are considered to be an essential quality in pharmacy graduates then research that aims to develop guidance around this is crucial. Being 'Motivated to Learn' is an essential factor for future graduate learning. There are extrinsic influences which can develop the graduates need to learn and motivated educators, authentic curriculum designs are essential in the development of this attribute.

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Development of the Part II Experiential Learning Placement within the revised BPharm curriculum at the University of Auckland.

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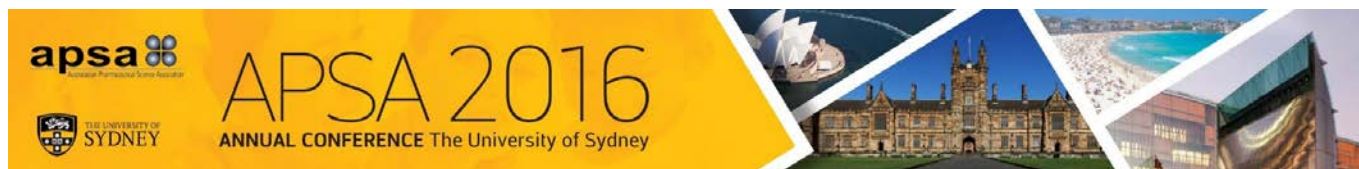
Introduction. One of the goals of the recent review of the Auckland BPharm curriculum was to increase experiential learning opportunities, both in duration and diversity. An Experiential Learning Framework was developed and the decision was made to introduce Experiential Learning at a 'Novice' level at Part II of the BPharm programme.

Aims. The development and implementation of the Part II Experiential Learning Placement is described.

Methods. As part of the development of the Experiential Learning Framework, the School convened two liaison groups representing the Hospital and Community Pharmacy sectors. These groups assisted in the development and implementation of the Placements. The first Placement was designed as a day-release programme in Semester 2, Part II. All students were free on either a Tuesday or a Thursday to undertake the Placement. The overall purpose of the first Placement was 'socialisation' into the profession with an emphasis on understanding the medicines pathway, the roles of pharmacists, and initial interactions with patients. This Placement was offered as three days in a hospital setting (in pairs), one day in an industry setting (in groups of ten), and six days in a community setting (individually). All sites were in the Greater Auckland area and sites went through a recruitment and selection process to become 'Recognised Training Sites of the University of Auckland'. Training was provided by the School of Pharmacy and there were 110 attendees at a Training Evening in July, 2016.

Results. There were 68 community pharmacy sites, five hospital sites, and one each of industry and wholesaler sites recruited. Each site provided an assessment of student engagement and students submitted an e-Portfolio for assessment. This component of the programme is a criterion-referenced assessment (Merit/Pass/Fail) and a global assessment is based on the various reports and e-Portfolio. The emphasis at this stage is on professionalism and engagement. If necessary, students may be required to undertake additional elements of the Placement to achieve an overall pass and proceed to the next Part.

Discussion. This first offering of a Part II day-release Placement in a variety of practice settings is yet to be completed but feedback to date from both preceptors and students has been excellent. The process of development has led to enhanced engagement between the School and the profession.



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Investigation of Sri Lankan pharmacy students' knowledge of antibiotics and antimicrobial resistance

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Introduction: Antimicrobial resistance (AMR) is a major challenge for global health care. Pharmacists play a key role in the health care setting as the custodians of the quality use of medicines. The education, training and experiences of pharmacists and pharmacy students are likely to have an impact on patterns of antibiotic use in community and hospital settings. Currently, there are limited data on antibiotic use and understanding of AMR by Sri Lankan pharmacists and pharmacy students.

Aim: This cross-sectional survey investigated the understanding of antibiotics, their use and AMR as well as associated factors among undergraduate pharmacy students at Sri Lankan universities.

Method: This study used a self-administered questionnaire based on the WHO AMR document 2015. The questionnaire was modified to capture demographic information and selected questions clarified after face validity assessment. The survey was conducted in 6 universities in Sri Lanka offering undergraduate pharmacy programmes. The study instrument comprised 5 major sections; demographic information, self-reported antibiotic use, knowledge of antibiotic uses in human health, knowledge of AMR and antibiotic use in agriculture. Data were entered into SPSS® 22 and analysed. Cronbach alpha test assessed the reliability of the questionnaire. This study was approved by the Institutional Ethical Review Committee, University of Peradeniya, Sri Lanka.

Results: 466 pharmacy students completed the questionnaire between January and April, 2016. The mean participant response rate was above 80% in all but one of the 6 universities; this exception provides distance learning. Participants commonly reported antibiotic use (75.8%) during the past year. Half the pharmacy student respondents (51%) incorrectly indicated that antibiotic use was appropriate for the management of cold and flu disease conditions.

Discussion: These findings identify some misconceptions about antibiotics among Sri Lankan undergraduate pharmacy students, which may potentially increase the irrational use of antimicrobial agents.

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Did it evaporate? 1st year chemical concepts in 2nd year students

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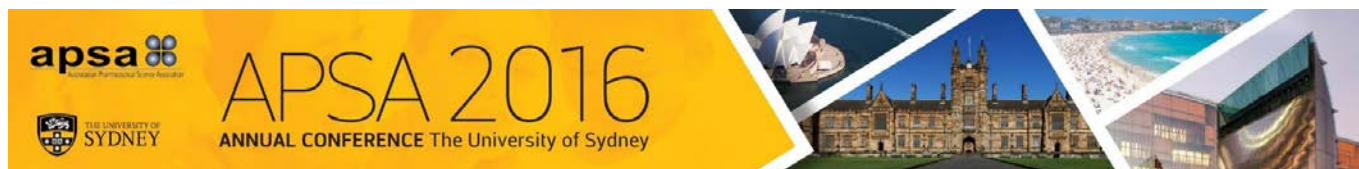
Introduction. Retention of chemistry concepts and the understanding of how it applies to medicines is an essential part of the pharmacists expert knowledge of medicines. Having this understanding of chemistry enables pharmacists to have an appreciation of the therapeutic components of medicines and their safe and efficacious use in a patient centred context. So, do second year pharmacy students value their chemistry knowledge? Furthermore, will they be confident in applying it?

Aims. To gain insight into chemistry retention in pharmacy students 1 year later, and analyse whether higher scores are aligned with high confidence

Methods. Students completed a questionnaire containing chemistry quiz questions, questions about confidence level for each of the answers given and their opinions on the relevance of chemistry content to pharmacy students.

Results. Chemical concepts such as acids and bases, and ionisation were retained at higher levels than expected. Students who valued chemistry knowledge more were shown to have either higher confidence in their answers or higher scores or both.

Discussion. Students retained a surprising amount of chemistry knowledge from 1 year earlier, but higher confidence in their answers was not always aligned with higher scores. Higher scores that were associated with lower confidence levels, were most likely due to multiple choice answers which were 'guessed,' however it is suspected that a portion of these may also be due to students with lower self-esteem and 'cautious' personality types. This is worth further investigation in the pharmacy student cohort especially considering the anecdotal evidence that pharmacists tend toward the more 'risk-averse' end of the personality spectrum. The link between greater confidence and greater interest in chemistry or the belief in its relevance indicates a need to re-enforce the 'real-world' link between concepts taught and student perceptions of concepts needed. A study of pharmacy student personality types may also offer greater insight into the learning style of pharmacy students.



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The capabilities that count for professional success in Pharmacy: A case study of graduates, employer and course teaching team perspectives

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Introduction. Clearly defined graduate attributes are essential for producing graduates with the skills necessary to be proficient employees and contributors to society (4). The demand for improvements in the sector requires universities to provide evidence of quality assurance and employability outcomes. With heightened focus on the employability capabilities of graduates, institutions are placing greater emphasis on curriculum reform.

Aims. To gather and evaluate the perceptions of employers, graduates and course teaching team regarding graduate capabilities required for early professional success in pharmacy and the extent to which capabilities are demonstrated in new graduates.

Methods. The Graduate Employability Indicator (GEI) survey was administered online to gather stakeholders' perceptions about Curtin University's Bachelor of Pharmacy. The GEI asks graduates the extent to which their course experience contributed to achievement of the capabilities and asks employers and course teams the extent new graduates demonstrate the capabilities.

Results and discussion. In total, 95 graduates, 109 employers and 42 members of the course team participated in the survey. Graduate comments on the best aspect of the degree identified the work placement in the final year and acquiring knowledge to facilitate their role as a pharmacist. Graduates preferred earlier professional placement in the course. Employers identified communication and professional skills as the most useful capabilities for new graduates. Members of the course teaching team identified benefits to the students, industry and university as the main incentives for developing graduate employability. The result from this study has facilitated in the curriculum review of the BPharm course with implementation of a renewed course structure to include earlier exposure to experiential learning.

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Asthma management experiences of Australians who are native Arabic speakers.

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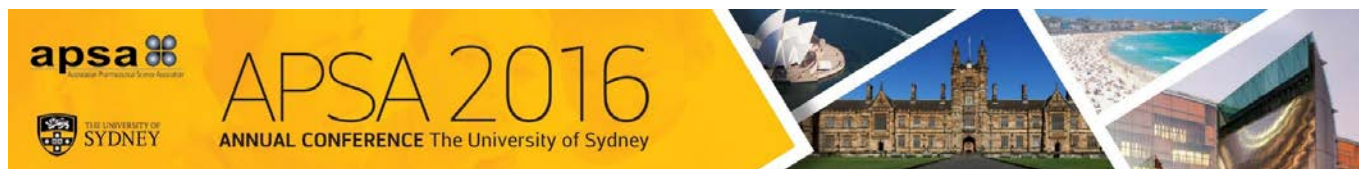
Introduction. Australia has one of the highest prevalence rates of asthma in the world (10%). It is likely the condition affects people across the highly multicultural fabric of Australian society. Arabic speaking people/migrants are a large group, however not enough data is available about Arabic speaking migrants with asthma in Australia. Coming from different countries with different languages, beliefs and cultures may have a significant impact on migrant health, which may lead to issues in asthma management.

Aims. The aim of this study is to explore asthma management issues in the Arabic speaking community in Australia. **Methods.** Qualitative in depth semi-structured interviews conducted with Arabic speakers with asthma (or carers of people with asthma) followed by verbatim transcription and thematic analyses.

Results. 24 Arabic speaking patients with asthma were interviewed (23 females, mean age 31). The data was rich in submerged themes (*italicised*). There was a lack of asthma awareness in this community; asthma control was suboptimal in many cases. The sample displayed a spectrum of *coping styles*, attached *stigma* to asthma and asthma medicine use and experienced access barriers in receiving asthma care. Recent migrants among the sample would rather follow their traditional folk medicine than consult with a general practitioner (GP) or pharmacist and *expectations* from health professionals are low and marred by *mistrust*. Many migrants do not trust their GPs and feel that they are uncaring and "hiding vital information". The cost of medications is another factor as many new migrants have lower income earning capacity and issues such as unemployment and/or stress also contribute to destabilising asthma control. In addition, fears and medicine related beliefs and low self-management skills affect adherence to medicine. Health system navigation was an issue as some were not conversant about local health care services/information sources.

Discussion The data is the first exploration of this culturally/linguistically diverse group of Australians with asthma. Clearly disparities in asthma management are likely given the myriad impediments stemming from the patient, their health professional or the system. Similar findings are evident in minority ethnic groups with asthma in other multicultural countries such as the US and UK. Our results demonstrate a need for interventions to optimise asthma management in this group.

Conclusion: There are many barriers hampering good asthma control in this population. Asthma educational programs in Arabic or interventions to empower patients to self-manage are needed. Cultural competence training for professionals may also improve care provision.



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Home Medicines Review (HMR) in patients with COPD: experiences from a cluster randomised trial

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Introduction. RADICALS[®] is an interdisciplinary model of care aimed at reducing the burden of COPD in Australian general practices. Home medicines review (HMR) by an accredited pharmacist is one of its components.

Aims. To characterise HMRs delivered as part of the RADICALS[®] cluster randomised trial and evaluate outcomes.

Methods. General practitioner (GP) clinics (n=38) were randomised to control/RADICALS[®]. Current/ex-smokers in RADICALS[®] with a COPD diagnosis and their GPs completed anonymous surveys on the HMR service received.

Results. Of the 238 participants recruited, 102 had an existing COPD diagnosis. HMRs have been completed in 59/145 (41%) of RADICALS[®] participants: mean age 66 years; newly diagnosed COPD (59%); median 10 medications, including two inhalers; current smokers (51%); unclear vaccination history (63%); and no short-acting bronchodilator (40%). A total of 358 medication-related problems (MRPs) have been identified, of which 165 were related to non-respiratory medications. In total, 467 recommendations have been made to the prescribers and/or patients to optimise management/medicine use. Suboptimal inhaler techniques were seen in almost 50% of users; the majority were able to improve their technique during the HMR. Following the HMR, consumer respondents (n = 41) reported total satisfaction with the pharmacist visit, better understanding about their medicines, increased confidence in how to use medicines, fewer concerns about medicines and better understanding of their illness. All GP respondents (n=6) thought that the HMR was useful in identifying MRPs, agreed that pharmacist recommendations were useful for improving their patients' care, and reported acting on the recommendations made.

Discussion. HMRs in patients with COPD identified a range of respiratory and non-respiratory MRPs. Pharmacist recommendations to address MRPs were generally appreciated and accepted by both GPs and consumers.

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The relationships between illness and treatment perceptions with adherence to diabetes self-care: A comparison between Arabic-speaking migrants and Caucasian English-speaking patients

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Aims. To compare illness and treatment perceptions between Arabic-speaking immigrants and Caucasian English-speaking people with type 2 diabetes, and explore the relationships between these beliefs and adherence to self-care activities.

Methods. A cross-sectional study was conducted in healthcare settings with large Arabic populations in metropolitan and rural Victoria, Australia. Adherence to self-care activities, illness and treatment perceptions, and clinical data were recorded. Bivariate associations for continuous normally distributed variables were tested with Pearson's Correlation. Non-parametric data were tested using Spearman's rank correlation coefficient.

Results. 701 participants were recruited; 392 Arabic-speaking participants (ASPs) and 309 English-speaking participants (ESPs). There were significant relationships between participants' illness and treatment perceptions and adherence to diabetes self-care activities. ASPs' negative beliefs about diabetes were strongly and significantly correlated with poorer adherence to diet recommendations, exercise, blood glucose testing and foot care. ASPs were significantly less adherent to all aspects of diabetes self-care compared with ESPs: dietary behaviours ($P = <0.01$; 95% Confidence Interval (CI) = -1.17, -0.84), exercise and physical activity ($P = <0.001$, 95% CI -1.14, -0.61), blood glucose testing ($P = <0.001$) and foot-care ($P = <0.001$). 52.8% of ASPs were sceptical about prescribed diabetes treatment compared with only 11.2% of the ESPs. 88.3% of ASPs were non-adherent to prescribed medication, compared with 45.1% of ESPs.

Discussion. Arabic-speaking migrants' illness and treatment perceptions were significantly different from the English-speaking group. There is a pressing need to develop new innovative interventions that deliver much-needed improvements in adherence to self-care activities and key health outcomes.



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Adverse Drug Reaction (ADR) Reporting and Follow Up in a Hospital Setting - A Patient's Perspective.

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Introduction. Adverse drug reactions (ADRs) are a common cause of negative health outcomes for patients, often resulting in increases in hospitalisation, length of stay and the overall cost. For this reason it is important to put in place procedures that minimise risk of inadvertent re-exposure to a drug that has caused the patient an ADR.

Aims. To assess the effectiveness of the ADR reporting system and follow up process at the hospital.

Methods. Cross-sectional survey, with interviewer administered questionnaire, of people who experienced an ADR.

Results. Of the 241 eligible cases reviewed by the ADRC between 2013 and April 2016, 108 (45%) consented to the phone interview with only 82% (89) having recollection of the event. Of these 55% (49) recalled receiving a temporary ADR warning card and 73% (65) remember receiving a permanent ADR warning card post-discharge. The ADR warning card was carried by 73% (65) of participants. 85.4% (76) had told their regular GP about their ADR [41% (31) used their ADR warning card]. Only 40% (36) had told a pharmacist about their ADR [50% (18) used their ADR warning card]. 85% (76) had a regular pharmacy and of those, 53% (40) believed it necessary to tell their pharmacy and 62% (47) considered it a good idea for the hospital to automatically notify their pharmacy. Overall satisfaction was relatively high with 89% (79) agreeing that this adverse drug reaction service as a whole was valuable to them and 92% (82) agreeing that it is a good thing that a letter was sent to their regular GP. Some participants (21% (19)) also made comments with follow up issues being the most common theme.

Discussion. Overall, there was a relatively high level of satisfaction with the ADR service, which provided support for this a model of care for patients who experienced an ADR. The current ADR warning cards were also found to be particularly useful for patients. There was potential for improvement, including increasing the number of patients remembering receiving a temporary ADR warning card prior to discharge. It is also evident that allowing patients to be responsible for communicating a new ADR to community pharmacists is not particularly effective so other means of notifying community pharmacists may need to be explored.

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Adverse drug reaction-related hospitalisation in older patients - A prospective analysis in two hospitals

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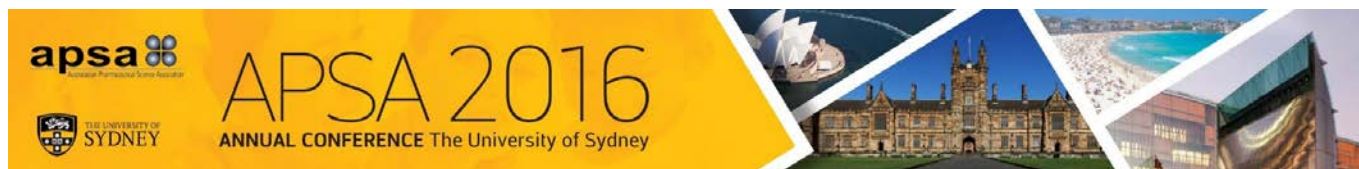
Introduction. Adverse drug reactions (ADRs) are a major cause of hospital admissions in older patients. Despite the magnitude of this problem, there is limited prospective data on ADRs as a cause of hospitalisation in elderly medical patients.

Aims. To ascertain the proportion of ADR-related hospital admissions in older patients admitted in Tasmanian hospitals; to identify the commonly implicated drugs; to describe the clinical manifestations and outcomes of these ADRs; and for each ADR, to determine the causality, preventability and severity.

Methods. We conducted a prospective cross-sectional study at the Royal Hobart (March 2014 - March 2015) and Launceston General Hospitals (September - December 2015) in Tasmania, Australia. A convenience sample of patients aged 65 years and older undergoing unplanned, overnight medical admissions was screened. ADR-related admissions were determined through expert consensus from detailed review of medical records and patient interviews. The causality between drug use and ADR-related hospital admission was evaluated using the Naranjo algorithm. The preventability and severity of each ADR admission were assessed using Schumock and Thornton criteria and Hartwig's criteria, respectively.

Results. The proportion of ADR-related hospital admissions was 19% of 1008 admissions. Most (89%) ADR-related admissions were considered preventable. Cardiovascular complaints (26%) represented the most common ADRs, followed by renal (20%) and nervous system disorders (15%). The drugs most frequently responsible were diuretics (20%), agents acting on the renin angiotensin system (20%), beta-blockers (8%) and psychoanaesthetics (7%). Application of the Naranjo algorithm found 6% *definite*, 70% *probable* and 24% *possible* ADRs contributed to the hospital admissions. ADR severity was rated moderate in 98% and severe in 2% of admissions. For most admissions (98%) the ADR resolved and the patient recovered.

Discussion. Hospitalisation due to an ADR is a common occurrence in older Australians. Improved medication management services to prevent these admissions are urgently required.



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The Impact of Medications on Charcot Marie Tooth disease: A patients' perspective

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Introduction. Studies on medication safety specific to patients with Charcot-Marie-Tooth (CMT) neuropathy and muscle atrophy are limited. Consequently, both patients and health professionals face limited access to reliable sources of information on drug toxicity, which potentially leads to symptom mismanagement and poorer health outcomes for patients.

Aims. Investigate patients' experiences of medication effects on their CMT symptoms and further explore patients' experience(s) in obtaining and understanding information on the safety of medicines.

Methods. Members of the CMT Australian Association were invited to participate in focus groups to discuss their concerns about medication safety. An opt-in approach was used to recruit both focus groups and/or interviews participants. Thematic analysis of interview transcripts was conducted using NVivo.

Results. Twenty-four adult CMT patients participated in focus groups or interviews. This study found CMT patients sought information primarily from their General Practitioners and/or Neurologist, as these health professionals were perceived as being more cognizant of the potentially neurotoxic effects of certain medications on CMT symptoms. Other findings revealed that those patients who faced uncertainty in obtaining and understanding medicines information turned to complementary and alternative medicines, internet resources and peer groups to self-manage CMT symptom exacerbations.

Discussion. This study highlights the need for better information services that empower CMT patients to discuss medication safety concerns with their health care providers. Understanding patients' perceptions on how medications impact the progression of their disease can improve patient outcomes and builds a body of evidence about medication safety and CMT. Further research is necessary for the development of evidence-based tools to enable health professionals to better manage a range of chronic health conditions in CMT patients.

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Pharmacists' cultural competence in a community pharmacy setting: an exploration of the issue of language proficiency

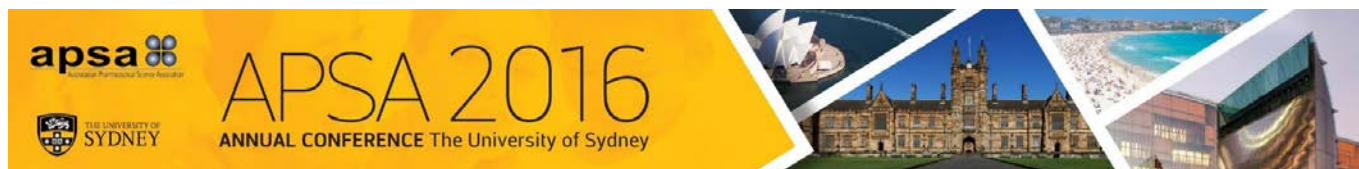
Annim Mohammad¹, Dr Betty Charar¹. Associate Professor Bandana Saini¹ Faculty of Pharmacy, University of Sydney¹, Sydney, New South Wales, 2006

Introduction. Over the last decade, the importance of healthcare professionals' cultural competency in ensuring patient safety and optimal medicines use in diverse patient populations has been increasingly recognised. The ability to communicate effectively is an essential aspect of culturally competent practice. There is a paucity of studies that have explored community pharmacists' cultural competency towards patients of culturally and linguistically diverse (CALD) background with low English proficiency (LEP).

Aims. To explore and describe the current practice/s of community pharmacists serving CALD community members who have LEP and report on factors affecting their ability to provide culturally competent care.

Methods. Focus group discussions were conducted with community pharmacists who practiced in areas of high cultural and linguistic diversity in metropolitan Sydney until thematic saturation was deemed to have been attained. Pharmacist participants were also required to complete a de-identified study questionnaire. Data was analysed using the constant comparison method and a Grounded Theory approach was used to explore patterns that emerged

Results. A total of six focus group discussions were conducted. Data analysis revealed themes that provided a wholesome snapshot of community pharmacists' current practice in relation to serving CALD patients with LEP. Specific themes identified were: 1) Issues with professional satisfaction 2) Concern for patient safety 3) Barriers to culturally competent practice 4) Improvisations to deliver care in light of the aforementioned barriers and 5) Support required. **Discussion.** There are a variety of barriers and facilitators to community pharmacists' ability to provide culturally competent care to patients with CALD backgrounds who have LEP. Addressing identified barriers that hinder community pharmacists' capacity to engage in culturally competent practice will improve provision of pharmaceutical care to such patients.



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Exploring community pharmacists' ethical reasoning: insights through a qualitative study

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Introduction. Community pharmacists have a professional obligation to practise ethically. A foundation of ethical reasoning is established during university studies and placements. However, practising pharmacists, on a continuous basis, need to develop this skill which should evolve with practice experience and exposure to challenging scenarios. Taking into consideration recent expansions of the role of pharmacists and the paradigm shift towards patient-centred care, it is timely to explore community pharmacists' attitudes towards the importance of pharmacy ethics and their ethical reasoning skills.

Aims. This study aimed to qualitatively explore experienced pharmacists', interns' and senior pharmacy students' 1) attitudes towards ethics, 2) ethical reasoning processes and 3) dilemmas experienced in pharmacy practice.

Methods. Two focus group discussions (96.6 and 87.3 minutes) run by an independent facilitator, and one interview (52.9 minutes) were conducted with 15 participants in Western Australia. Participants were purposively selected based on their gender, background experience and level of practice. Discussions were guided by a list of questions informed by a literature review and expertise of the researchers. Discussions were audio-recorded, transcribed verbatim and compared with available field notes. Transcribed data were imported into NVivo 10 to facilitate qualitative analysis.

Results. The diversity of participants' experience and practice roles provided a broad discussion of a wide range of topical ethical issues. Three main themes emerged that impact on pharmacists' ethical reasoning: 1) change in, or expansion of, pharmacists' roles, 2) changes to the healthcare and workforce environment, and 3) exposure and development of ethical reasoning at university-level, mentorships, practice environment and practice experience.

Discussion This study highlighted the importance of sound and structured ethical reasoning as pharmacists are faced with contemporary challenges involving ensuring the provision of high-quality healthcare in a business environment. The paradigm shift in pharmacy practice creates greater responsibilities, leading to more complex ethical dilemmas. Participants identified many factors which intertwined to affect their ethical reasoning and behaviour. This study has identified gaps that, once addressed, will strengthen sound ethical reasoning in the pharmacy profession.

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Pharmacists' attitudes towards practice change and role extension

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Introduction: While pharmacy as a profession continuously extends its scope of practice pharmacists' attitudes towards role extension are often regarded as potential barriers to practice change.

Aims: To systematically and critically review pharmacists' attitudes towards role extension and implementation of cognitive pharmaceutical services.

Method: A scoping review was performed after a systematic search of Medline, Cinahl and PsycInfo for studies describing pharmacists' attitudes towards role extension and practice change from 2000 to 2015. An interpretive synthesis of the selected literature was performed, comparing studies and context, forming the basis for a critical discussion and applying Theory of Planned Behaviour as a framework.

Results: The review included 47 articles exploring pharmacists' attitudes to a variety of newer, cognitive service models, e.g. prescribing, medication therapy management, pharmaceutical care or immunisation. Pharmacists' attitudes towards these extensions of their professional role and new pharmacy services were generally positive. While pharmacists perceived various benefits at an individual and professional level a number of internal and external barriers were identified. Considering pharmacists' attitudes and external barriers, e.g. workplace and organisational design and work flow, and framing them within the Theory of Planned Behaviour suggests that individual motivation needs to be underscored by systemic support for pharmacy practice change to succeed on a wide scale.

Conclusion: Pharmacists' attitudes towards role extensions was found to be generally positive. Addressing systemic and external barriers to changes of pharmacy practice would potentially facilitate the more rapid uptake of extended patient care roles by many pharmacists.

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Knowledge, perception and practice of pharmacists in screening, prevention and treatment of delirium in elderly patients

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Introduction. Delirium is a serious condition and medications are one of the risk factors. Adequate knowledge about delirium and participation of all healthcare professionals in delirium care can assist effective prevention and management. However, little is known about pharmacists' knowledge, perception and current involvement in delirium care.

Aims. This study aimed to assess the knowledge, perception and current practices of hospital pharmacists in screening, prevention and treatment of delirium in Australia.

Methods. A cross-sectional survey was conducted via a web-based questionnaire. The questionnaire was distributed, primarily, by a link to the survey in the newsletter of the Society of Hospital Pharmacists of Australia. Collected information included participants' demographics, knowledge and practices in the screening, prevention and treatment of delirium.

Results. One-hundred and six responses from participants were analysed. Nine of 11 basic knowledge questions, seven of eight questions relating to prevention strategies but only three of eight questions about risk factors for delirium were answered correctly by more than half of respondents. The majority of respondents indicated that delirium was a serious (74%) and an under-diagnosed (80%) syndrome. Most respondents believed that pharmacists could play a role in prevention (92%) and screening (62%) of patients for delirium. However, in practice only 8% of pharmacists reported that they had ever screened a patient for delirium using a validated tool and 79% indicated that pharmacists were never or rarely part of the delirium treating team in their setting.

Conclusion. Our study has highlighted that pharmacists have good basic knowledge about delirium and prevention strategies; however their knowledge about delirium risk factors could be improved. Pharmacists are underutilised in the screening and management of delirium. Efforts to improve pharmacists' knowledge about delirium risk factors, and strategies to increase their involvement in the screening and management of delirium should be implemented.

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Evaluation of the Western Australian pharmacy-administered immunisations: A qualitative study

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Introduction. In late December 2014, amendments were made to the Western Australian Poisons Regulations 1965 to allow trained pharmacists to administer influenza vaccines, without a prescription, to individuals 18 years and older.¹ All trained pharmacist immunisers in Western Australia (WA) must comply to the specifics as stated in the WA Pharmacist Vaccination Code.²

Aims. The study aimed to explore the perspectives and experiences of WA-trained pharmacist immunisers on their immunisation trainings, as well as the facilitators and challenges experienced in the preparation, implementation and delivery of pharmacist immunisation services.

Methods. During August 2015, pharmacists from pharmacies which participated in a previous survey were invited to participate in a semi-structured interview about pharmacist immunisation services. Pharmacists were selected based on the number of vaccinations delivered and the pharmacy types and locations. Interviews were audio-recorded, then transcribed verbatim. NVivo version 10 was used to organise qualitative data and thematic analysis of the data will be informed by the general inductive approach.³

Results. Interviews were conducted with 25 pharmacists, after which the point of data saturation was reached. Six main themes emerged: i) facilitators, ii) barriers and challenges, iii) positive impact of immunisation services in pharmacy, iv) needs identified, v) confidence of pharmacists, and vi) role of community pharmacists. Participants' personal experiences with the provision of immunisation services in community pharmacies were positive. Banner group-provided assistance was considered useful by some especially when dealing with administrative and logistical issues. The demand for immunisation services was reported to exceed expectations. It was evident that certain changes had to be implemented in the pharmacy to set-up the immunisation services and hence a whole-of-pharmacy approach with support from management was crucial for the successful implementation of the service. Discussion Convenience and accessibility of community pharmacies as well as flexibility in provision of services were identified as major factors that facilitated the demand and uptake of immunisation services. Overall the immuniser pharmacists were confident in providing immunisation services. Positive feedback from consumers, practice and experience and the presence of procedures and guidelines were identified as three major factors that affected confidence levels.

1. Government of Western Australia. Poisons Regulations 1965 (WA), Regulation 39AA.

2. Government of Western Australia. Pharmacist Vaccination Code, 2014.

3. Thomas DR. A general inductive approach for analyzing qualitative evaluation data. American Journal of Evaluation. 2006;27(2):237-46.



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A Shot in the Arm - Pharmacist Administered Influenza Vaccine

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Introduction. In NSW accredited pharmacists can administer influenza vaccine to people aged 18 years or older.

Aims. The aims of the study were to record the number of influenza vaccines administered by pharmacists who completed the Pharmacy Guild of Australia accredited vaccination training course during April and May of 2016, and to document the demographics of the people who received these vaccines.

Methods. Participating pharmacists received a template to record information relating to the person vaccinated, whether the person received the trivalent or quadrivalent vaccine, and whether any adverse events occurred.

Results. Of the 87 pharmacists who completed the courses during April and May 2016, 59 consented to participate in the study (68%). These pharmacists worked in 47 different pharmacies located both in metropolitan (73%) and rural (27%) areas. Data was collected for vaccinations administered between the start of April and the end of July 2016. During this time the pharmacists administered 2256 influenza vaccines. The age range of the people vaccinated was 18 to 95 years, and 377 were aged 65 and over. 61% of those vaccinated were female (of which 14 were pregnant), 27% received the trivalent vaccine and 73% the quadrivalent vaccine. Data relating to prior influenza vaccination was available for 918 people and 18% had not been vaccinated before. The number of vaccinations administered by individual pharmacists varied from 1 to 323, and no adverse events were recorded.

Discussion. Influenza vaccines administered by community pharmacists are not government reimbursed and the pharmacist charges a fee for the service. Of the people vaccinated, 377 were aged 65 and over, and 14 were pregnant. These people could have received their vaccine for free from their GP under the NIP, but they chose to pay. Reasons cited included convenience, no need to make a GP appointment and the concern of being infected by sitting in the GP waiting room with sick people. Where data was available, 18% of people had not been vaccinated before and possibly would not have been vaccinated without the community pharmacy program. 27% received the trivalent vaccine which may have been due to stock shortages and the increased price relative to the quadrivalent vaccine. The study clearly shows that as major public health initiative pharmacists can successfully administer influenza vaccine in the community pharmacy setting, and that this has wide public acceptance.

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New Opportunities and Challenges for Evidence Synthesis

Lisa A. Bero, Faculty of Pharmacy and Charles Perkins Centre, University of Sydney, Sydney, NSW

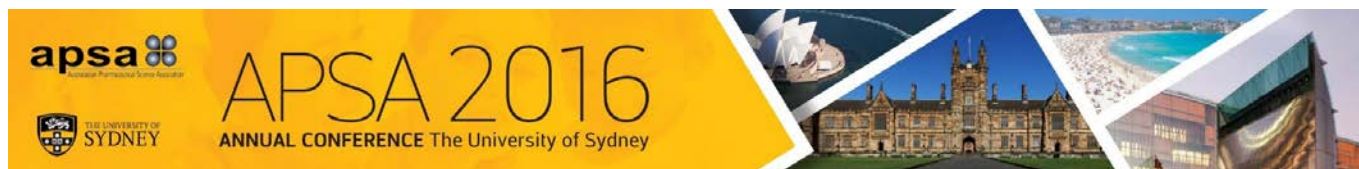
Evidence based medicine, a paradigm for teaching and practicing clinical medicine announced over 20 years ago, has evolved into evidence-based health. Systematic review methods are the foundation for evidence-based clinical decisions, but these methods are evolving for other health related applications. Evidence synthesis methods are now being applied in disciplines such as environmental science, animal toxicology, public health nutrition, policy implementation and genomics. Regulatory agencies and guideline producing bodies increasingly require "systematic reviews" as an evidence source. But, there have been obstacles to the expanding use of systematic reviews and there is a risk that the term is being corrupted. Reviews are not always conducted according to rigorous methods and the underlying evidence can be biased. This presentation will discuss ongoing initiatives to improve the quality and relevance of systematic reviews to make them applicable for a variety of health issues.

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Bioinformatic analysis that leads to changing health care for patients

Melanie Bahlo, The Walter and Eliza Hall Institute of Medical Research, Parkville, VIC

Next generation sequencing has made a significant impact in the diagnosis of Mendelian disorders, leading to the identification of causal variants. Success rates vary, depending on the disease. The understanding of the genetic cause can lead to a diagnosis, which can determine particular therapies. Much more work will be needed to determine which therapies will work best for particular patients. Genome-wide association studies have also yielded many genetic risk loci and allow the building of genetic predictors, which, in some diseases, achieve clinically relevant predictive power. This talk will provide an overview of genetic discovery methods currently yielding results, with applications to neurogenetics and an eye disorder, but will also highlight the chasm still present between finding genetic findings and finding treatments.



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Putting the balance back in diet: the nutritional geometry of health and ageing

Professor Stephen J Simpson, Charles Perkins Centre, The University of Sydney, Sydney, NSW

Macronutrients (protein, fats and carbohydrates) are fundamental dietary components, yet the question of what represents a balanced diet and how this maintains health and longevity remains unanswered. The talk will set out a powerful framework, Nutritional Geometry, for describing the multidimensional nature of nutritional requirements, the relative values of foods in relation to these requirements, the behavioural and physiological responses when feeding on diets of varying composition, and the health consequences of being restricted to particular diets. These models arose from the study of nutritional ecology and were developed initially using a wide variety of species in the laboratory and the field. I will use examples spanning insects to humans to address problems in ageing, obesity and cardiometabolic health.

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Effect of oxidative stress on mitochondrial morphology

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Introduction. Studies have demonstrated that oxidative stress may lead to mitochondrial fragmentation by causing an imbalance between fission and fusion processes. This may include upregulation of fission proteins (Opa1, Drp1) and downregulation of mitofusin.

Aims. Our aim was to determine the effect of the mitochondrial fission protein Ganglioside Induced Differentiation Associated Protein 1 (GDAP1) in the presence of oxidative agents.

Methods. COS7 and Neuro2a cells were treated with six different oxidative stress agents and cell viability assessed using the MTT assay; N-acetylcysteine (NAC) was also used to protect against oxidative damage. Changes to mitochondrial morphology were analysed using MitoTracker dye and fluorescent microscopy. Cell lines were then transfected with GDAP1 and treated with the oxidative stress agents; cell viability and mitochondrial morphology were assessed as previous.

Results. For all six stress inducing agents we observed a dose responsive decrease in cell survival. We found 40mM glutamate exposure inhibited cell proliferation resulting in 40-60% cell death for COS7 and Neuro2a respectively. Quantitative analysis of mitochondrial morphology revealed a shift in the number of cells having fragmented mitochondria (from 1% to 62%) after glutamate exposure. NAC treatment (1mM) counteracts cell death but did not rescue the mitochondrial network (~55% fragmented mitochondria). After transfection with GDAP1 we found the cell death induced by 40mM glutamate was reduced (75% and 66% cell survival in COS7 and Neuro2a respectively); mitochondrial morphology was largely fragmented.

Discussion. Our study confirmed that glutamate causes both toxicity and mitochondrial fragmentation. Interestingly NAC treatment protects against oxidative damage but does not prevent fragmentation. Despite independently inducing mitochondrial fission, the overexpression of GDAP1 protects against oxidative glutamate toxicity in the COS7 and Neuro2a cell lines. Our study will help us to understand the dynamics of the mitochondrial network in the presence of oxidative stress agents.

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Intracellular Kinetics of Adenovirus inner components: inspiring a better DNA vaccine Design

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Introduction. DNA vaccine is an emerging immunotherapeutic technology to train the immune system to seek and destroy metastatic cancer. Despite strong safety profile, DNA vaccines lack the needed clinical efficacy. This is primarily due to the poor delivery of DNA to the nucleus¹. In addition, methods to test different modalities of DNA vaccines still lacking.

Aims. To develop methods investigating nuclear import of DNA and DNA-complexes of adenovirus to inspire a better synthetic DNA vaccine design.

Methods. Using Microinjection and selective plasma membrane pore formation using digitonin import assay coupled with high resolution confocal microscopy and live imaging.

Results. We show that those methods can be successfully used to investigate the kinetics of BSA protein cross-linked with a nuclear localization signal and we also validate the import assay ability to be representative of nuclear pore transport. In addition, we isolated dissociated adenovirus using either partial (acid treated), core isolated (pyridine/ deoxycholate treatment) and complete removal of DNA-binding proteins. Using cellular kinetics methods, we find key differences in the ability of those different parts of the adenovirus to carry the DNA into the nucleus.

Discussion. A model of Adenovirus DNA nuclear delivery is proposed here where it highlights the importance of DNA binding proteins interaction with nuclear pore components in the delivery of its DNA. This highly suggests that to deliver exogenous DNA for a purpose of DNA vaccine and gene therapy, in vivo, one must include components interacting with nuclear-pore import machinery.

1- Nature Reviews Drug Discovery 5, 115-121 (February 2006) | doi:10.1038/nrd1960

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Pharmacokinetics and bioavailability of Mitragynine in Sprague Dawley (SD) Rats using microdialysis

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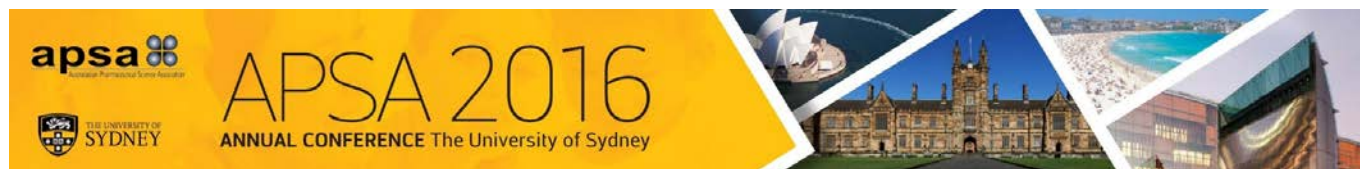
Introduction. Mitragynine, an active indole alkaloid is the most abundant active alkaloid found in leaves of *Mitragyna speciosa* (MS). MS or popularly known as "Ketum" in Malaysia is widely used traditionally for the purpose of pain relief, anti-diarrhoea, increases energy etc. Since the potential action of mitragynine is in the brain, it is important to study its pharmacokinetics in both plasma and brain compartments. To achieve this, microdialysis technique has been utilized.

Aims. This study aims to develop and validate the sensitive LCMS method to analyse mitragynine in dialysate and to study the pharmacokinetics of mitragynine in both brain and plasma of SD rats.

Methods. LCMS method was developed and validated for the analysis of mitragynine in dialysate. Six adult SD rats were used for the study. Rats received a single oral (p.o.; 40 mg/kg) or intravenous (i.v.) 10 mg/kg dose of mitragynine in 10 % tween-20 aqueous solution. Following the setting up of microdialysis system in the jugular vein and brain, the probes were perfused with ringer's buffer at a flow rate of 1µL/min. Blood and brain microdialysate samples were collected at intervals of 30 ± 2 min up to 7.5 h. All the microdialysate samples were then extracted and analysed using LC-MS within period of 24 h. The pharmacokinetic parameters were analysed by non-compartmental method using Phoenix WinNonlin version 6.1 software.

Results. The LCMS method was linear from 10 to 1000ng/mL and fully validated. Bioavailability of mitragynine was calculated to be 11% and the brain:plasma ratio for both IV and oral administration were 66 and 74%, respectively. The half-life calculated were range from 6 to 13 hours.

Discussion. To our knowledge, this is the first report of mitragynine pharmacokinetic profiling in brain and blood using a microdialysis technique in rats. In summary, the microdialysis system coupled to the LCMS is useful to quantify low concentrations of mitragynine in the dialysate. Mitragynine shows long half-life and not suitable to be given orally due to poor oral bioavailability. However, its lipophilic properties allow it to effectively permeate the blood brain barrier as seen in this study.



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Formulation development of triterpenoids to enhance its anticancer effects on glioblastoma cells

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Introduction. Glioblastomas are the most common and deadliest primary brain tumours, and novel ways of treating it are urgently needed. Ursolic acid (UA), a pentacyclic triterpenoid, has been recently reported to exhibit promising anticancer activity. With its multifaceted action, selective toxicity, chemo-sensitising effect and ability to penetrate the blood brain barrier, it is believed to have a potential role in the treatment of glioblastoma. However, up to date, the clinical application of UA has been greatly hindered by its limited aqueous solubility.

Aims. To develop novel formulations of UA with improved dispersibility, which will enhance its anticancer effect in glioblastoma cells.

Methods. UA nanoparticles (UA-NPs) were prepared as novel nanodrugs using anti-solvent precipitation technique with Pluronic F-127. β -cyclodextrin (β -CD) was employed as a drug carrier to form inclusion complexes with UA by kneading in a molar ratio of 1:2 with ethanol as solvent. These formulations were additionally characterised by dynamic light scattering, nuclear magnetic resonance and fourier transform infrared spectroscopy, and drug content was measured by high-performance liquid chromatography.

Results. UA-NPs and β -CD inclusion complex with UA were successfully synthesised as novel formulations. Both formulations have demonstrated increased dispersibility. The UA-NPs appear to have a higher dispersibility and drug loading rates than the β -CD inclusion complex.

Discussion. Our preliminary finding reveals that both types of formulations have improved dispersibility compared to UA, which suggests a potential enhancement in the anticancer effects of UA. Further biological evaluation will be tested on glioblastoma cells as an *in vitro* model for the pursuit of improvement in drug efficacy of UA.

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Possible involvement of Caveolin-1 in Alzheimer's disease via activation of β -Secretase in rat

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Introduction. Alzheimer's disease is ascribed with lack of memory coordination and deficits. There is an emerging evidence for physical association of caveolin-1 and cholesterol biosynthesis in proteolytic processing of amyloid precursor protein (APP) and thereby in production of amyloid- β (A β) *in vivo*.

Aim. The present study was aimed to investigate the role of caveolin-1 in progression of Alzheimer's like dementia in intracerebroventricular streptozotocin (ICV-STZ) model in rats.

Methods. Male Wistar rats (220-260 g) were divided into different groups, each comprising 8 animals (n=8). Streptozotocin (STZ) was given on day 1 at the dose 3 mg/kg was via ICV route to all the groups except NC, sham and minoxidil groups. ICV-STZ was given at its submaximal dose 1.5 mg/kg only to the animals of minoxidil group. Daidzein, a caveolin inhibitor at 0.2 & 0.6 mg/kg s.c. were given daily whereas minoxidil at 0.45 mg/kg, *i.p.* on alternative days for 28 days. Neurological deficits were assessed using morris water maze, elevated plus maze and balance beam test. Biochemical estimations were made in tissue homogenate for oxidative stress *i.e.* lipid peroxidation and glutathione. Statistical analysis was carried out using GraphPad Prism6 software.

Results & Discussion. ICV-STZ control animals exhibited neurological deficits in the form of impairment in memory retention on morris water maze, elevated plus maze, and in episodic memory and working memory on balance beam test in the form of latency to turn toward goal box, number of hind paw slips and tangential velocity. Administration of low and high doses of daidzein significantly restored neurological deficits. Minoxidil with sub lethal doses of STZ caused significant impairment in memory functions in behavioral performances on mazes. A similar observations were observed in different groups for oxidative stress markers in brain. A typical STZ pathology regardless non-pathological dose of STZ along with activation of caveolin-1 using minoxidil and restoration of deficits by inhibition of caveolin-1, is mechanized through APP microprocessing.

Conclusion. It may be concluded that caveolin-1 plays a significant role in progression of neurological deficits in Alzheimer's type of dementia in ICV-STZ treated animals.

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Chemical profile and anti-diabetic potentials of *Dendrobium* species from Australia and China

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Introduction. Lipid accumulation is one of the etiological factors of insulin resistance associated with type 2 diabetes mellitus. *Dendrobium*, the largest genus of orchid has been recently reported to have anti-cancer activity and anti-diabetic property. The aim of this study was to compare chemical profile and investigate antidiabetic potentials of *Dendrobium* species from Australia and China.

Method. Stems of *Dendrobium* including *D. speciosum*, *D. kingianum*, *D. officinale* and *D. nobile* were extracted with pure ethanol, and analysed by TLC. The samples were then extracted with hot water, and the solutions were deproteinized using Sevag reagent then precipitated with ethanol to obtain polysaccharide extracts. The HepG2 cells and Oil Red O method were used to test the accumulation of lipid. The K562 cells were used for evaluating mitosis inhibition.

Result. Blue spots on TLC under UV light indicated that *Dendrobium* spp contained some phenolic compounds, but the profiles were variable. *Dendrobiums* contained variable amount of polysaccharide. The preliminary results showed ethanol extracts of *Dendrobium* reduced lipogenesis and suppressed mitosis on HepG2 cells and K562 cells.

Discussion and conclusion. The TLC chemical profiling provides a method and quality comparison and phytochemical identification of *Dendrobium* herbs. The inhibition of lipogenesis and mitosis may be related to AKT signalling pathway which plays essential role of insulin resistance and cancer pathogenesis.

Ramakrishnan G et al (2014) J Biol Chem 289:9:6054-6066

Ng TB et al (2012) Appl Microbiol Biotechnol 93:1795-1803

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Shared decision making in the pharmacological management of schizophrenia: Perspectives of health care professionals and consumers

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Introduction. Shared decision making (SDM) has gained increasing importance following the emphasis on patient-centred care in current practice. It can play a major role in optimizing outcomes in schizophrenia, where medication adherence is key. Understanding of health care professionals (HCP) and consumers' perspectives is essential to facilitate SDM.

Aim. To explore HCPs and consumers' views on the application of SDM in managing medications in schizophrenia.

Methods. A systematic literature search of Medline, EMBASE, PubMed, CINAHL and PsycINFO was performed to identify studies published up to April 2016 using terms related to "shared decision making", "health care professional" or "consumer", "views", "pharmacological" and "schizophrenia". Only primary research studies, reporting views on SDM in schizophrenia, and published in English were included. Cross-referencing of the identified articles was also conducted.

Results. Fifteen articles, reporting on 14 quantitative and qualitative studies, were included. Consistent findings of HCPs and consumers in favour of SDM were reported, but consumers' perceived application was lower compared to HCPs. Many factors affected preferences of HCPs and consumers, including consumer characteristics, decision types, age and attitudes towards medications. Increased medication adherence was perceived as a major benefit of SDM. Despite some facilitators, impaired decisional capacity of consumers and the lack of commitment from HCPs and consumers presented barriers in implementing SDM.

Discussion. Following the increasing role of SDM in schizophrenia management, strategies to address the challenges in implementation needs to be explored. The lack of consumer outcome evaluations highlights the need for further investigations of the impact of various interventions on SDM in schizophrenia.

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Mental Health First Aid training and its application in a tertiary setting benefits staff and students

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Introduction. The University of Western Australia (UWA) has a student population of over 25,000 and a staff population of over 3,700. According to statistics from the National Survey of Mental Health and Wellbeing, 2007, this translates to nearly 7000 university staff and students in any one year who may potentially be managing significant issues relating to mental health. Currently, there is limited research into the application of Mental Health First Aid (MHFA) in a tertiary setting.

Aims. To assess mental health literacy, confidence and application of skills post MHFA training in a tertiary setting.

Methods. A questionnaire was developed and validated by a MHFA research team. All UWA staff and students trained in the standard MHFA course during the previous 30 months were invited, via email, to participate in the online questionnaire to assess their literacy, confidence and skills application.

Results. Of the 485 questionnaires distributed 107 were completed. Participants agreed their mental health literacy (76%) and confidence (85%) had improved post training. MHFA was applied by 65% of participants with 22% specifically applying their skills to students. Of those who applied MHFA, 33% of participants reported assisting specifically in a crisis, most commonly panic attacks (21%), suicidal thoughts and behaviours (20%), self-harm (16%) and after a traumatic event (16%).

Discussion. Over 60% of the MHFA trained participants had the opportunity to apply their MHFA skills. This means they were in a position to provide assistance to those developing a mental illness or in a mental health crisis. With 22% of participants applying their MHFA training to fellow students this means a positive impact is made in the university environment. By having staff and students trained in MHFA, they are able to help preserve life and provide help to prevent mental health problems from escalating further and can promote recovery of existing illness.

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The risk of hip fracture in older people using selective serotonin reuptake inhibitors (SSRIs) and other psychoactive medicines concurrently

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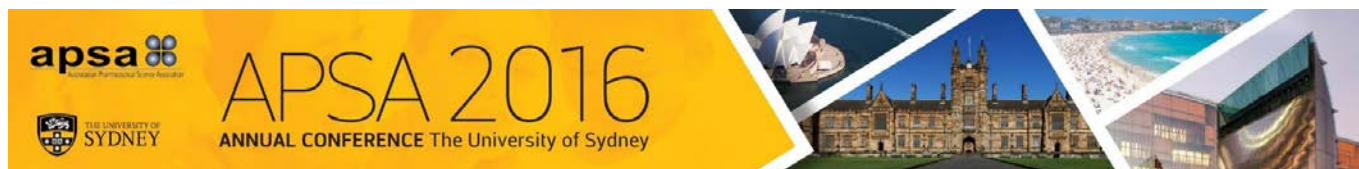
Introduction. Few studies have assessed the risk of hip fracture following concurrent use of psychoactive medicines, and none have investigated combinations with selective serotonin receptor inhibitors (SSRI).

Aims. To assess the risk of hip fracture in older people following concurrent use of SSRIs and other psychoactive medicines.

Methods. A matched case-control design was employed. Cases were Australian Government Department of Veterans' Affairs (DVA) beneficiaries aged over 65 years who experienced a hip fracture between 2009 and 2012. Each case was matched with up to four randomly selected controls of the same age (± 2 years) and gender. Medicine-hip fracture associations were estimated via multivariate conditional logistic regression. The relative excess risk due to interaction (RERI) was calculated to determine whether combined effects differed from the sum of individual effects.

Results. There were 8,828 cases and 35,310 age- and gender-matched controls. The median age of subjects was 88 years and 63% were women. When analysed individually, the risk of hip fracture was elevated for all medicines assessed, most notably SSRIs (initiation: odds ratio [OR]=2.7, 95% confidence interval [CI]=[2.1, 3.6]) and opioids (initiation: OR=2.3, 95% CI=[1.9, 2.9]). Combinations associated with increased odds of hip fracture included the addition of benzodiazepines to continuous SSRI therapy (OR=3.0, 95% CI=[1.9, 4.8]; RERI=0.9, 95% CI=[-0.5, 2.3]), continuous use of both opioids and SSRIs (OR=2.2, 95% CI=[1.9, 2.6]; RERI=0.1, 95% CI=[-0.3, 0.5]), addition of opioids to continuous SSRI therapy (OR=3.2, 95% CI=[1.8, 5.5]; RERI=0.1, 95% CI=[-2.0, 1.7]) and simultaneous initiation of benzodiazepines and SSRIs (OR=4.7, 95% CI=[1.7, 13]; RERI=1.3, 95% CI=[-3.8, 6.3]).

Discussion. In older people, SSRIs and psychoactive medicines were associated with increased risk of hip fracture individually and in combination with one another. While the RERI results showed no excess risk beyond the sum of individual effects, most combination medicine effects equalled the sum of the individual effects.



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Metabolic monitoring of hospital inpatients receiving antipsychotics: multisite quality improvement study

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Introduction. The National Quality Use of Medicines mental health (MH) indicator "Percentage of patients taking antipsychotic medications who receive appropriate monitoring for the development of metabolic side effects" measures adherence to best practice recommendations for monitoring of metabolic adverse effects that occur with regular antipsychotic use.

Aims. To undertake performance assessment, benchmarking and implementation of strategies to improve metabolic monitoring in hospital patients and train MH clinicians in quality improvement (QI) methodology.

Methods. Invitations for participation were sent to Australian hospitals. A multidisciplinary steering group was established to oversee project design and provide advice. Health and research ethics approval for a low/negligible risk study and individual site specific authorities were obtained. Each site formed a multidisciplinary local advisory group (LAG) to guide data collection, implement QI strategies and identify barriers to best practice adherence. Site details (patient populations, routine healthcare resources and infrastructure) were collated to enable benchmarking. Baseline audit, intervention and post-intervention audit phases will be undertaken.

Results. Sixteen sites across 3 Australian jurisdictions caring for a range of patient populations (acute adult, adolescent, paediatric, forensic and psychogeriatrics) are participating. All LAGs contain at least one pharmacist and, psychiatrists (13) and registered nurses (11) in most. Baseline results from 10 sites range from 0%-42% (mean, 15%). Feedback from sites include the disparities between electronic pathology requests and reports, deficient electronic recording systems, and the need for systems-based approaches to monitoring e.g. waist measurement.

Discussion. Multisite studies are a useful means of providing benchmarking data to drive QI and developing skills in collaborative improvement strategy development and implementation. Baseline results provide evidence of consistent poor adherence across the participating sites with common barriers emerging.

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'Culture is more than what we do around here': influence of basic assumptions on psychotropic medicine use in nursing homes

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Introduction. Psychotropic medicines have limited efficacy in the management of behavioral and psychological symptoms of dementia and are associated with significant adverse events, however they are commonly used in nursing homes. Studies suggests that organizational culture may influence the use of psychotropic medicines. Schein's theory elucidates that organizational culture is more than 'how we do things around here' but that it comprises of a deeper layer called the basic assumptions. Basic assumptions are the unsaid, taken for granted beliefs and values driving organizational members' behavior and practices.

Aims. To identify the basic assumptions of culture influencing psychotropic medicine use in nursing homes.

Methods. A qualitative study using semi structured interviews was conducted with staff from eight nursing homes in Sydney, Australia. Purposive sampling was used to recruit 40 participants representing a broad range of disciplines and roles. Thematic analysis was used to derive key concepts.

Results. Two basic assumptions were identified: locus of control and the necessity for efficiency or comprehensiveness. Locus of control pertained to whether on-site and visiting staff believed they were helpless to do the right thing by the resident when facing negative work experiences. The necessity for efficiency or comprehensiveness was related to on-site and visiting staff rationing how much time and effort was spent on a given task. Basic assumptions held by on-site and visiting staff were not compatible with the appropriate use of psychotropic medicines when staff believed they were helpless to make changes to their work environment and believed it necessary to be efficient to manage resident load.

Discussion. Basic assumptions of on-site and visiting staff shifted the responsibility from oneself for carrying out non-ideal actions in an environment characterized by staff shortages, time pressure, and complex interactions which subsequently led to the inappropriate use of psychotropic. This study highlights the requirement to recognize that every staff member undertaking resident care shapes the culture and has a responsibility to enhance the quality use of psychotropic medicines.

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Investigation of Hospital Opioid Prescribing among Opioid Naïve Surgical Patients

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Introduction. Opioids are commonly used to treat post-operative pain following acute hospitalisation. However, prescribing of opioids can lead to a range of short and long-term adverse effects, and at present it is unclear how post-operative opioid usage contributes to the wider patterns of opioid use, particularly among opioid naïve patients.

Aims. To investigate the utilisation of opioids after hospital discharge amongst opioid naïve surgical patients, and the association between opioid use, pain management and opioid related difficulties experienced in this setting.

Methods. A prospective observational study of opioid naïve patients undergoing elective surgery admitted to the Pre-Admission Clinic at a tertiary hospital in Sydney is being conducted. Data on socio-demographics, medical history, and pain levels using the Brief Pain Inventory (BPI) are obtained at recruitment before their operation. Medications prescribed at discharge are recorded from patients' discharge summaries. Patients are being contacted at 1-week, 1, 3 and 6-months after discharge to assess patterns of opioid use, pain levels and patient-reported problems and concerns using the Prescribed Opioid Difficulties Scale (PODS).

Results. At present, 127 patients have been recruited; 42.5% (n=54) were female with a mean age of 61.7±16.1 years. On preliminary analysis, 40.0% (n=32) of patients have been discharged with an opioid, either oxycodone when required (90.6%, n=29), a fixed combination of oxycodone/naloxone (43.8%, n=14), or both (34.4%, n=11). The baseline mean BPI pain severity was 1.5±2.3 (range: 0-10) and mean pain BPI interference score was 1.5±2.4 (range: 0-9.7). Of those who have completed the 1-week follow up (n=41), 39.0% (n=16) of patients had taken opioids within 1-week, and of 14 followed up within 1-month, 21.4% (n=3), reported using an opioid. A total of 37.5% (n=6) of patients experienced a high level of opioid related difficulties and concerns after 1-week.

Discussion. Our preliminary finding suggests that opioid naïve patients generally experience very little pain preoperatively, but are prescribed opioids frequently after surgery. Use of newly prescribed opioids within 1-week and 1-month following hospital discharge is common among surgical patients. Future studies need to evaluate factors associated with opioid prescribing in this setting.

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How can pharmacists provide medication services to mining sites?

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Introduction. Our previous research has revealed employees of remote-area resources industries in Western Australia are at risk of insufficient and delayed access to pharmaceutical services. Numerous anecdotes reporting preventable medication-related errors, medication supply issues and sharing of medicines were reported.

Aims. This research aimed to qualitatively explore potential roles for pharmacists to service remote mining sites.

Methods. Interviews were conducted with 20 pharmacy stakeholders connected in some way to the mining industry, identified via advertisements and contacts. Interviews explored pharmacists' professional experiences relating to mining workers, and scoped three potential service models: a fly-in/fly-out metropolitan-based pharmacist, a drive-in/drive-out rural-based pharmacist, and tele-pharmacy (video-linked) services from a metropolitan base. Interviews were recorded with consent and professionally transcribed. Content analysis described and compared the scope of practice, barriers, facilitators and remuneration for each model.

Results. Participants comprised rural pharmacy owners, hospital and poisons information pharmacists, accredited pharmacists and representatives of professional bodies. Despite their experience with mining workers, knowledge of on-site medical services was low, and none of the participants knew of mining companies employing pharmacists. Some pharmacies provided scheduled medication and ancillary medical supplies to mining companies, despite regulatory barriers in doing so. Most in community practice had supplied non-prescription sedatives and/or emergency medicines to mining employees. While there was no consensus in the present study about the ideal service model, the drive-in/drive-out model appeared most practical to overcome regulatory issues around medication supply and improve quality use of medicines on-site. Concerns were raised for all models around inability to develop rapport with transient clientele, indemnity if the pharmacist's role extended recognised scopes of practice, and lack of precedents for remuneration by the government or employers.

Discussion. Due to the identified barriers, further research is required to develop pharmacists' roles to address the medication needs of remote mining workers. Pioneering rural pharmacists are encouraged to build upon any current medication supply services to mining workers to explore the potential for formally-contracted services.

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The feasibility of a pharmacist-led osteoporosis screening program in a Malaysian primary care clinic

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Introduction. Many women with osteoporosis remain undiagnosed until they sustain a fragility fracture. Therefore, osteoporosis screening which aids in the early detection of osteoporosis is the most effective way to prevent these fragility fractures which are associated with increased morbidity and mortality.

Aims. To determine the feasibility of a pharmacist-led osteoporosis screening programme in Malaysia.

Methods. Postmenopausal women aged ≥ 50 years without osteoporosis were recruited via convenience sampling. We measured scientific outcomes [the number of patients who went for a bone mineral density (BMD) scan, who were started on osteoporosis medications and who modified their lifestyle to improve bone health], process outcomes [response rate, follow up rate], resource outcomes [coordination of intervention] and management outcomes [data entry workload]. Patients' osteoporosis knowledge and satisfaction were assessed at months 0 and 2. All patients were assessed for their osteoporosis risk, and were counseled on prevention methods. Patients who were at moderate to high risk were referred to the doctor for a BMD. There were two follow ups at month 0 and 2.

Results. Fifty patients were recruited [response rate=90.9%]. A total of 26/50(52.0%) went for a BMD, 2/50(4.0%), were started on osteoporosis medications and 9/50(18%) modified their lifestyle to improve bone health. Osteoporosis knowledge significantly increased from baseline to month two (46.3 ± 21.4 vs 79.1 ± 14.3 , $p < 0.001$). Patients were highly satisfied with the screening program provided (89.8 ± 12.4). As for process outcomes, the follow-up rates were 83.9 and 100% at months 0 and 2, respectively. The resources and management outcomes were determined to be viable based on the researchers' experience whilst running the feasibility study.

Discussion. Our study found that the pharmacist-led osteoporosis screening program within a primary care setting in Malaysia was found to be feasible. However, before it can be implemented in clinical practice, a randomized controlled trial needs to be conducted to assess the impact of this intervention.

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Stakeholder's experiences of providing remunerated professional pharmacy services under Community Pharmacy Agreements

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Introduction. Since 1990, Community Pharmacy (CP) in Australia has provided a range of Professional Pharmacy Services (PPS) funded under Community Pharmacy Agreements (CPAs). These services are unrelated to the delivery of PBS medicines which forms the foundation of the consecutive agreements. However, with an over-reliance on the dispensing model, and the impact on profitability of Price Disclosure, the viability of CP may be threatened. It is therefore important to investigate the extent to which PPS has impacted on the dispensing volume driven business model.

Aims. To explore stakeholders' views, and experiences of providing PPS funded under the CPAs, including factors influencing the extent to which these services have benefited the operation of CP.

Methods. In-depth, semi structured interviews were conducted with a range of CP stakeholders from practitioners to policy makers between December 2014 and August 2015. Interviews were recorded, transcribed verbatim and analysed for emerging themes. Ethics approval was obtained from the University of Sydney.

Results. A total of 27 key informants participated. Stakeholders recognised the importance and the advantage of delivering PPS in CP. In addition, they viewed that PPS were widely adopted in the last CPA (the 5th) showing a high level of awareness of the growing need to focus on a service model. However, most respondents perceived the limited funding for PPS as a proportion of the overall CPA package contributed to reluctance for CP to change their business model. Moreover, the capping policy for some PPS and the massive expansion of the discount pharmacy model, resulted in concerns about the sustainability of a CP service model. Several participants criticised the lack of evidence surrounding the implementation of PPS suggesting the need to invest in quality assurance of the CPA.

Discussion. While shifting towards provision of PPS is an emerging trend, CPs in Australia still viewed dispensing as the primary business model for CP. Therefore, there is a need for more investment in PPS to ensure reliable provision of PPS under the CPAs. Furthermore, the CPAs need to facilitate the collection of clear and robust evidence showing the value to the health of the community of CP delivering PPS.

Pharmaceutical Society of Australia (2014)

Cross, P., & Annabel, B. (2015). *AJP* 96: 12-16

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Community pharmacist-led interventions and their impact on patients' medication adherence and other health outcomes: A systematic review.

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Introduction. Medication adherence can be defined as the extent to which ones' medication taking behaviour follows that agreed upon by the prescribing physician. The degree to which a patient is adherent can have downstream effects on treatment effectiveness, patient health outcomes, and health care system costs. Increasing evidence has highlighted the positive contribution community pharmacist-led interventions can have on improving patients' adherence and health outcomes.

Aims. To provide an overview of the published literature on interventions that have been implemented in the community pharmacy setting and their effectiveness in improving adherence and health outcomes.

Methods. A search strategy was developed, aiming to retrieve published reports of community pharmacy interventions worldwide. Medline, EMBASE, International Pharmaceutical Abstract (IPA), and Google Scholar databases were searched. Articles meeting the inclusion criteria were collated, relevant data extracted, and a risk of bias assessment undertaken.

Results. Twenty one studies were included in the analysis, and their outcomes were reported in 25 peer-reviewed journal articles. Community pharmacist-led interventions have been shown to improve patients' adherence and contribute to better blood pressure control, cholesterol management, chronic obstructive pulmonary disease (COPD) and asthma control. Studies in this review however, did not report statistically significant effects of interventions on diabetes and depression control.

Discussion. Community pharmacist-led interventions have been shown to contribute to improved adherence and better disease control. Many of the interventions had multiple elements, therefore future research should attempt to better understand which components make the greatest contribution towards improving adherence and health outcomes, for patients with different medical conditions.

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Hospital clinical pharmacy services in Vietnam

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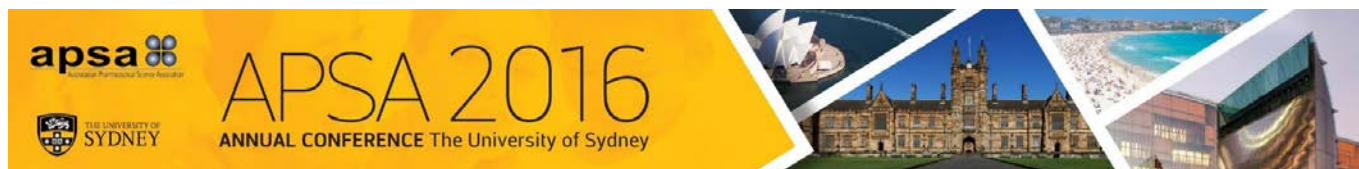
Introduction: Clinical pharmacy is key to the quality use of medicines. While there are different approaches in different countries, international perspectives may inform health service development. The Vietnamese Ministry of Health (MOH) introduced policy guidelines to require clinical pharmacy services in December 2012.

Aims: To describe the services, and to explore reported difficulties and enablers in implementing clinical pharmacy activities in Vietnamese hospitals after issuing the MOH policy guidelines.

Methods: An online questionnaire was sent to 39 hospitals in Hanoi, including 22 provincial-level and 17 district-level hospitals. Next, focus group discussions were conducted in ten of these hospitals. The questionnaire and discussions focused on four areas: facilities, manpower, policies and clinical pharmacy activities.

Results: 34/39 (87%) hospitals had established clinical pharmacy teams. Most activities were non-patient specific (34/39 hospitals, 87%) while the preliminary patient-specific clinical pharmacy services were available in only 8/39 hospitals (21%). The most common non-patient specific activities were providing drug information (97%), reporting adverse drug reactions (ADRs) (97%), implementing drug use protocols (51%), and training in drug use (56%). The patient-specific activities varied widely between hospitals and were ad hoc. The main challenge reported were: lack of manpower (0.77 clinical pharmacist FTE/hospital).

Discussion: This was the first mixed-method study to describe clinical pharmacy activities in Vietnam since introduction of the policy guidelines. While most hospitals had hospital-based pharmacy activities, the direct patient care was limited. Training, education and an expanded work forces are needed to improve clinical pharmacy services.



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Moving beyond the four walls: pharmacist roles in New Zealand primary care

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Introduction. Recognition of the benefits of collaborative practice models in primary care and the need to optimise use of pharmacists' skills and knowledge is leading to the emergence of new roles for pharmacists in primary care internationally. In New Zealand, little is known about the extent of this emerging workforce.

Aims. To explore the emerging roles of pharmacists working in New Zealand primary care.

Methods. An electronic survey tool was used to collect quantitative data about the roles undertaken, employment situation and location of work of pharmacists in New Zealand primary care. The survey tool was piloted by two practising pharmacists. Pharmacists working in primary care were invited to participate using an e-mail invitation sent via the Pharmaceutical Society of New Zealand mailing list.

Results. The response rate was 16% (n=467). Most respondents (74%) work solely in community pharmacy; 12% work in a single non-community pharmacy location and the remaining 14% work in a combination of locations. Of respondents who spend time physically located in a general practice (7% of all respondents), a very small proportion (7%) are employed directly by a general practice. Primary Health Organisations (PHOs) are the most frequent employer of these pharmacists (48%). PHOs are funded at a regional level to support the provision of essential primary health care services through general practices. Pharmacists spending time in general practices provide a range of cognitive services. The three most common are: responding to questions about medicines from health professionals (100%), provision of educational activities for health professionals (79%), and transition of care services (79%). Other frequent activities are drug utilisation evaluation or audit (75%) and medication review (64%). Five percent of responding pharmacists spend time in patients' homes; the average time is 5 hours per week.

Discussion. Our findings indicate that pharmacists in New Zealand primary care are involved in work outside the traditional realm of the community pharmacy. PHOs are the most frequent employers of pharmacists undertaking general practice-based work which includes a range of cognitive services. Further research is needed to gain greater understanding of the collaborative practice models in operation, their impact on patient care, and to identify the features of success.

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How do Australian and UK consumers receive and use information about their over-the-counter medicines?

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Introduction. Information availability, receipt, and use can vary between the contexts in which over-the-counter (OTC) medicine(s) are purchased and/or used by consumers, impacting medication safety. Limited research has explored OTC medicine information receipt and use at different points within the self-management continuum by Australian and UK consumers.

Aims. To explore Australian and UK consumers' receipt and use of spoken and written OTC medicine information.

Methods. Semi-structured face-to-face interviews were conducted between April 2013 and April 2014 with 37 Australian and 39 UK consumers. Participants were asked about: (i) information received with their most recent OTC medicine purchase from a pharmacy, and (ii) how information was used at different times after the medicine was purchased. Interviews were audio-recorded with consent, and transcribed verbatim. Verbatim transcripts were thematically analysed.

Results. The majority of recent OTC medicine purchases made by the participants were repeat purchases. Overall, it was uncommon for consumers to actively seek spoken information about their OTC medicines. Furthermore, minimal spoken information was reportedly provided by pharmacy staff for OTC medicines. Leaflets were not always received or wanted with OTC medicines. OTC medicine information use varied between first-time and repeat purchases. Consumers tended not to read OTC medicine labels or leaflets if they were already familiar with the product. Leaflets also had a less prominent role as an OTC medicine information source for repeat purchases. When labels were consulted, directions for use were commonly read. OTC medicine information in general was infrequently revisited by consumers.

Discussion. Minimal spoken information was reportedly sought and/or received by consumers in Australia and UK. Moreover, familiarity with an OTC medicine resulted in consumers tending not to seek information from medicine labels or leaflets. Minimal spoken information provision by pharmacy staff together with limited consumer use of written information may adversely impact OTC medication safety in consumer self-management.

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Consumers' use of social media for health purposes: a focus group study

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Introduction. The interactive and participatory nature of social media (SM) has afforded consumers not only with the opportunity to access health related information but also to provide and share information. Consequently online patient communities with a common health problem are becoming popular [1].

Aims. This project aimed to investigate how health consumers use SM and other online forums for health purposes and its impact on their health decision making behaviour.

Methods. Five focus groups with 36 participants from Sydney metropolitan area were conducted. All discussions were recorded, de-identified, transcribed verbatim, and thematically analysed.

Results. Consumers accessed SM using several electronic devices (computer, tablets, and smartphones) at home, work, or while traveling. Some preferred to be anonymous and use an alias when using SM for health purposes. A variety of platforms were accessed, such as blogs, disease specific groups on Facebook, organisations' Facebook pages, Wikipedia, and Youtube. Consumers learned about their disease states and treatment options. They also found emotional support and hope from others facing the same health issue. SM use empowered patients by increasing their knowledge, and improved face-to-face interactions with healthcare professionals. Consumers not only reported being more prepared for clinical consultations but also considered that online peer interaction positively impacted their decision-making process. Most participants reported resistance from HCPs or even hostility to their SM use. On the other hand a few reported support and even recommendation of online sources by their HCPs.

Conclusions. SM has expanded consumers' ability to communicate with one another about health. This has improved their knowledge, their social wellbeing and their health-related decision making process. HCPs should be aware of the new digitally informed patient and be prepared to support them in this new health frontier.

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Does consumer medicines interest reflect medicines use?

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Introduction. Cost-effective information provision should be targeted to the medicines of greatest concern to the consumer.

Aim. To examine characteristics of callers to National Prescribing Service (NPS) *Medicines Line*, an Australian medicines call centre (MCC); and to determine whether medicines interest corresponds with medicines utilisation.

Methods. Consumer questions were explored between 1 January 2006 and 30 June 2010. Patterns of consumer medicines interest were examined using frequency data for individual medicines and medicines classes involved in MCC calls. These statistics were compared with drug utilisation data, expressed as defined daily dose (DDD), extracted from the Australian Statistics on Medicines (ASM) for the same period. ASM data was first available in January 2006. Medicines were class-matched in accordance with the Anatomical Therapeutic Classification (ATC) of medicines, level 2.

Results. The profile of MCC callers was female, median age 48 years, help-seeking for themselves (71.7%), a child (13.3%) or their partner (5.5%). A third of calls related to safety (34.7%), 24.1% to efficacy and 14.9% to interactions. There were 85,416 calls made to the MCC over this 4.5 year period, with 124,177 counts of individual medicines involved in consumer questions. These distilled to 976 unique 'medicines of interest'. However, approximately half of these individual medicine counts (61,810) were represented in questions by just fifty unique medicines. Nervous system medicines (antiepileptics, psycholeptics, analgesics) and antibacterials consistently ranked highest for medicines interest in relation to their use. In contrast, agents acting on the renin-angiotensin system (RAS), 'statins' and drugs for acid related disorders ranked low for interest despite widespread use. **Discussion.** Medicines use correlates poorly with the medicines of interest to the consumer. To maximise benefit, clinicians should target their education to the relatively small number of medicines of real concern to patients.



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Evaluation of unplanned medication related readmissions within 28 days of discharge

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Introduction: Currently, no data exists as to the nature and frequency of medication related readmissions at Fiona Stanley Hospital, given it was only commissioned in early 2015. The findings of this study will provide an insight into the incidence and causes of unplanned hospital readmissions, due to medication related complications, adverse reactions and other misadventure. This information will form the basis on which strategies to minimise such readmissions can be developed, and will add to the body of research relating to hospital readmissions in Australia.

Aims: The study aimed to evaluate the frequency and nature of medication related unplanned readmissions within 28 days of discharge at Fiona Stanley Hospital, and the factors that contribute to these readmissions.

Study Design and Methods: Retrospective cross-sectional study of patients readmitted to Fiona Stanley Hospital (Murdoch, Perth, Western Australia) within 28 days of discharge between 4 February 2015 and 14 February 2016, for whom the admission was unplanned. Data were collected from patients' electronic medical records (BOSSnet).

Results: Of the 518 readmissions reviewed, 155 readmissions were deemed medication-related unplanned readmissions. We found that most of the patients readmitted were 65 years or older, were taking six or more medications and more than 10 doses per day, were on high-risk medications, had comorbidities, lacked pharmacist involvement at discharge for previous admission, and had shortfalls in GP and/or patient advice at discharge for their previous admission. The majority of the readmissions were due to side effects of medications (74%), with antineoplastic agents, opioid analgesics and anticoagulants being the major medication classes causing the side effects. The likelihood of readmission was due to medication was evaluated as "Probable" for nearly half of all readmissions reviewed. Just over two-thirds (67.1%) of readmissions were deemed potentially preventable, with a lack of documentation confirming pharmacist involvement at previous discharge found to be a major contributor. However, it should be noted that pharmacist involvement cannot guarantee that adverse effects would not occur.

Conclusions: Knowledge of the factors that contribute to medication related readmissions can be used as the basis for the development of strategies to minimise medication related readmissions.

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N-of-1 trials for assessing the effects of deprescribing medications on short-term clinical outcomes in older adults: a systematic review.

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Introduction. Deprescribing research, the investigation of the effects of supervised discontinuation of treatments, is a growing field. Most studies have been randomised controlled trials (RCTs), however methods more applicable to clinical practice that can provide rigorous data on causation and reversibility have been recommended. The N-of-1 methodology may allow this and provide evidence on individual responses to medications – and inform patient-centred care.

Aims. To determine the feasibility of using the N-of-1 method for deprescribing trials in older adults.

Methods. A search was conducted between May 31st, 2016 and September 23rd, 2016 in Embase, PubMed, Informit, Scopus, International Pharmaceutical Abstracts, PsychINFO, Cochrane Central Register of Controlled Trials (CCTR) and CINAHL for studies conducted in older adults (≥ 50 years), deprescribing any long-term treatment conducted over less than a year using the N-of-1 trial method. Two authors independently reviewed all articles for eligibility and extracted data. The review was conducted according to PRISMA guidelines. Quality assessment of trials has been carried out using the PEDro scale.

Results. Six studies of deprescribing any treatment using the N-of-1 method in older adults were found (e.g. theophylline, digoxin, pacemaker use). These trials all investigated the efficacy of treatments for treating diseases including cardiovascular disease, asthma, chronic airflow limitation and skeletal muscle cramps. Four trials resulted in a significant number of patients (44-64%) discontinuing their medication due to non-significant benefits of treatment. Two studies determined that the respective treatment was effective, and the majority of patients continued their treatment.

Discussion. The ability of the N-of-1 method to effectively determine the individual efficacy of long-term treatments was powerful, resulting in strong patient-specific outcomes impacting on care of adults. However, use of the N-of-1 method has rarely been reported in deprescribing trials, although it has been used in other fields.

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The effect of medications used by Charcot-Marie-Tooth patients on neuropathic symptoms

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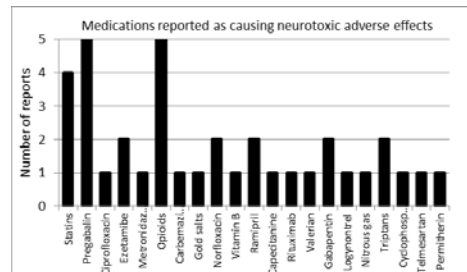
Introduction. Charcot-Marie-Tooth (CMT) is an inherited neurodegenerative disorder causing peripheral neuropathy as the disease progress. As a chronic condition CMT patients experience other common diseases for which they may require treatment and/or preventative therapies (such as cardiovascular disease, psychological disorders etc). Some medications used to treat these common diseases carry a risk of neurotoxic side effects and this may present an increased risk of disease progression in CMT patients. Unfortunately there is limited evidence based data outlining which medications may carry the highest risk(s) to CMT patients.

Aims. Identify the perceived risk of medication adverse effects on neuropathy in Australian CMT patients.

Methods. Members of the CMT Australia Association were invited to complete an online survey. This survey collected information on comorbid chronic disease, perceived medication adverse effects, and the medicine safety information resources utilized by CMT patients.

Results. 161 participants completed the survey and 60% regularly had concerns about the safety of medications on their CMT. 92 participants reported comorbid diseases including hypertension or cardiovascular diseases (44%), osteoarthritis (38%) and depression (36%). Various medications were self-reported as worsening neuropathy related symptoms; pregabalin, statins and opioid medications were the most commonly reported (see figure). For 64% of the drugs reported the patient did not believe adverse symptoms had been reversed when the drug was ceased.

Discussion. Some medications can be neurotoxic but the risk is usually minimal or rare when used in the therapeutics range. However these medications might have an increased relative risk of neurotoxicity in CMT patients. Future research is required focusing on the mechanism of toxicity and how this alters CMT patient risk of worsened neuropathy; this will help provide prescribing guidelines tailored for CMT patients.



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Does size really matter? Using big data to examine the patterns and predictors of opioid utilisation in Australia

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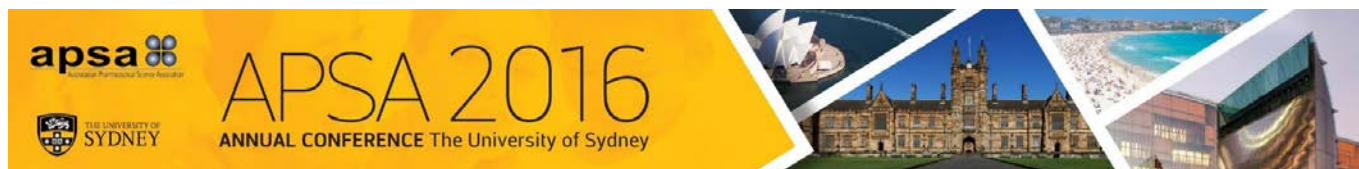
Over the last decade, the use of opioids has increased dramatically in a number of developed and high-income countries, including Australia. Although previously opioids were used primarily for the management of acute and cancer pain, they now also play an important role in the management of chronic non-cancer pain. Coinciding with increases in rates of opioid use, are concerns about potential misuse, diversion and harms. To date, most Australian data quantifying opioid utilisation have been based on pharmaceutical claims processed through the Pharmaceutical Benefits Scheme (PBS). However, these data exclude sales of over-the-counter (OTC) codeine and unsubsidised items or quantities dispensed 'privately'. Wholesale data is a unique data source that overcomes some of these limitations. This presentation will highlight how big data, and in particular, wholesale data, can be used to increase our understanding of opioid use in Australia. The specific focus will be on how these data can be used to quantify the extent of use nationally, examine the impact of remoteness on rates of use, and determine the geographic and socio-demographic factors associated with higher rates of use of different types of opioids.

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Big data for precision medicine: Moving beyond the buzzwords

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There is a growing recognition of the importance of observational studies using big data to examine the use and impact of prescribed medicines in routine clinical care. Australia is replete with world-class registries, bio-repositories and whole-of-population administrative data to advance this agenda. In her presentation, Sallie will discuss the state of play in Australia in terms of our capacity to harness big data to examine the ever-changing prescription medicine marketplace, highlight our challenges in undertaking high quality pharmacoepidemiological research and discuss some of the contradictions that exist in the current landscape.



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Using (big?) data to improve the quality use of medicines in residential aged care.

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Across health, eHealth is quickly becoming standard practice, generating massive volumes of administrative and health related data aka 'big data'. Such data is providing new opportunities to support clinical and policy decision making within healthcare. To date the implementation of eHealth and the availability of administrative health data in the residential aged care sector has lagged behind that in many other health systems. Yet despite this, big data is being used in residential aged care, not only to understand medication use and identify medication related problems, but also being imbedded in initiatives to improve the quality and safety of the way medicines are used. Residential aged care populations are at high risk of medication related harm due to high medication use, complex comorbidities and aged related physiological and functional changes. Big data represents an opportunity to understand current practice and identify problem areas in this high risk population but also to improve the quality and safety of medicine use. This presentation will focus on the use of administrative data to identify medication related problems and drive quality improvement in residential aged care.

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From Big Genomic Data to Personalized Medicine

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For the past two decades, familial linkage analysis has successfully identified mutations in high penetrance genes that are associated with disease risk, for example mutations in *BRCA1/BRCA2* genes are associated with hereditary breast and ovarian cancer syndrome. Nevertheless, mutations in these genes are not common in the general population and most probably account for only 5-10% of disease cases. The common disease-common variant hypothesis postulated the cumulative effects of common genetic variations, represented by single nucleotide polymorphism (SNP), are associated with the susceptibility of complex diseases, responsiveness to drugs and likelihood of adverse drug reactions. With the advancement of biotechnology and the development of tagging SNP algorithm, it is now feasible to evaluate the associations of SNPs across the genome by genome-wide association studies (GWAS). Common genetic variations are known for its small effect size and required a large-study population in order to identify significant signal in a study, hence, GWASs are the initial phase of big data establishment in genomic research. With the emergence of next generation sequencing that aim to evaluate all the genetic variations (rare, intermediate and common variations) in the genome have subsequently contribute to the rapid establishment of big genomic data. In this symposium, I will illustrate the utilization of GWAS and next generation sequencing to identify genetic markers that are associated with the susceptibility of breast cancer and pharmacogenomics studies of drug-induced toxicity in breast cancer patients from the Japanese population. In addition, I will also discuss the challenges in curating big genomic data that could be translated towards personalized medicine.

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Rapid identification of bacterial pathogens in clinical samples

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Introduction. Bacterial antibiotic resistance has been termed an uncontained 'catastrophic threat' that is 'comparable to global warming'. (Davies *et al.*, *Lancet*, 2013, 381, 1606–1609) Easy to use, rapid, reliable, and cost effective methods for the detection of multi-resistant organisms are required as part of an organism-specific approach to the prevention and control of infection.

Aims. We sought to address some of the limitations with current chromogenic methods through the synthesis of fluorogenic substrates, which would result in greatly reduced times to bacterial detection due to their significantly enhanced detection sensitivities.



Figure 1

Methods. We have synthesized and assessed some novel substrates as probes for the identification of *P. aeruginosa*, which is responsible for approx. 20% of nosocomial infections. (Váradi *et al.*, *RSC Advances*, 2016, 6, 58884–58889) These fluorogenic probes are substrates for β -alanine aminopeptidase (BAP), so that the fluorescence resulting from their hydrolysis is indicative of the presence of BAP-producing organisms such as *P. aeruginosa*.

Results. Fluorescence measurements showed that one of these coumarin substrates, 7-{4-(β -alanyl-amido)}benzoyloxy-3-ethoxycarbonylcoumarin trifluoroacetate, was as reliable as a commonly used aminocoumarin analogue, β -Ala-7-AMC, for the detection of BAP producers in agar media, Figure 1, and gave similar times to detection (4–7 hours) in liquid media. The fluorescence signal from the hydrolysis of β -Ala-7-AMC declined over time and this could lead to false negative results. In contrast, there was no decline over time in the fluorescence resulting from the hydrolysis of the novel substrates.

Discussion. 7-{4-(β -Alanyl-amido)}benzoyloxy-3-ethoxycarbonylcoumarin trifluoroacetate has advantages over β -Ala-7-AMC as it is retained by bacterial colonies in solid agar applications, and results in similar times to detection, stronger fluorescence intensities, and no decrease in signal over time in liquid media.

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Patient Centred Antimicrobial Stewardship

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Introduction. Antimicrobial stewardship (AMS) is an effective, systematic approach to improving the use of antimicrobial agents. This leads to reducing the inappropriate antimicrobial use (which can be up to 50%), improving patient outcomes and reducing adverse effects of antimicrobial use (including antimicrobial resistance, toxicity and unnecessary costs). Evidence-based AMS strategies include providing audit and feedback to prescribers and restricting the use of antimicrobial agents.

Aims. To describe how AMS strategies are used in the Australian healthcare system in order to provide optimal, patient centred-care.

Methods. A novel, prospective audit and feedback round was evaluated based on 5 key performance indicators including the documentation of: (1) indication (reason for use); (2) evaluation at 48–72 hours; (3) a planned duration or review date; (4) whether adequate diagnostic tests were done, including microbiology; (5) appropriateness compared to evidence-based guidelines.

Results. To date, over 1800 patients have been reviewed. Of these, 710 (38%) patients on 949 antimicrobial agents were included in the AMS audit and feedback rounds. The average duration of therapy at the time of audit was 4.7 days. 42% (300/710) of patients were admitted under a surgical team. Over 1000 recommendations were made with the majority being to cease the antimicrobial agent.

Discussion. This system is effective in conducting prospective audit and feedback on the prescribing of antimicrobial agents in settings with an Infectious Diseases physician and a pharmacist. It also provides a means for reporting and providing governance over antimicrobial use.

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Duguid M and Cruickshank M (eds) (2010). *Antimicrobial stewardship in Australian hospitals*, Australian Commission on Safety and Quality in Health Care, Sydney.

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Antimicrobial therapy of respiratory infections by inhalation drug delivery

Hak-Kim Chan, Advanced Drug Delivery Group, Faculty of Pharmacy, University of Sydney, NSW

According to the World Health Organisation, bacterial resistance has become a real global issue. With the emergence of the multidrug resistance (MDR) bacteria but no antibiotics coming to the horizon in the near future, new strategies are necessary to tackle the MDR issue. For respiratory infections, administration of therapeutic agents directly to the respiratory tract will significantly increase the local concentration in the airway fluid with minimal systemic exposure to reduce unwanted toxicity. As a result, antibiotics which have significant systemic side effect but are effective in bacterial killing can be re-purposed for use in respiratory infections. A good example is colistin which is a last-resort antibiotic effective against Gram-negative bacteria, but with serious toxicity to the brain and kidney¹. Currently marketed inhaled antibiotics have been administered in relatively large doses of about 100 mg and required multiple dosing per day, which may reduce patient compliance. To overcome the problem, antibiotics such as ciprofloxacin and amikacin are being developed as controlled-release liposomal formulations for once-only daily dosing using nebulisation². Bacteriophage therapy is the use of bacteriophages (phages) which are specific viruses to target and kill bacteria³. The benefits of phage therapy include specific targeting of the bacteria host and being effective against MDR bacteria and biofilms. Thus far, phage research for respiratory infections has mostly been confined to nebulization. However, dry powder inhalers are more convenient for patients to carry and use. Phage powder formulations have been produced either by spray-drying or by freeze-drying, both with a significant loss in biological activity (ranging 1 - 3 log₁₀ titer loss), while freeze-dried powders usually are not dispersible into an inhalable aerosol. Dry powder phage formulations have been processed successfully by spray drying, but long-term stability of these formulations has not been established^{4,5}.

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2. Cipolla D, Gonda I and Chan H-K (2013) Inhalation of liposomal formulations. *Therapeutic Delivery* 4:1047-1072.
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4. Matinkhoo S, Lynch KH, Dennis JJ, Finlay WH and Vehring R (2011) Spray-dried respirable powders containing bacteriophages for the treatment of pulmonary infections. <http://www.ncbi.nlm.nih.gov/pubmed/22020816> *J Pharm Sci* 100:5197-205.
5. Leung SSY, Parumasivam T, Gao FG, Carrigy NB, Vehring R, Finlay WH, Morales S, Britton WJ, Kutter E, and Chan HK (2016). Production of Inhalation Phage Powders Using Spray Freeze Drying and Spray Drying Techniques for Treatment of Respiratory Infections. *Pharmaceutical Research* 33: 1486-96

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Polishing the tarnished silver bullet – crowdsourcing new antibiotics

Mark A. T. Blaskovich, Johannes Zuegg, Alysha G. Elliott, Karl A. Hansford, and Matthew A. Cooper, Community for Open Antimicrobial Drug Discovery, The University of Queensland, Brisbane, QLD.

Introduction. The antibiotic pipeline is broken, with a dearth of new antibiotics accompanied by a collapse in pharmaceutical company research. Antibacterial drugs occupy a unique property space that is vastly different to drugs developed for other therapeutic areas. We desperately need to discover new antibiotics by seeking out novel chemical diversity.

Aims. To discover new antibiotics by ‘crowdsourcing’ chemical diversity from academic chemists around the world.

Methods. We have created a Wellcome Trust-supported not-for-profit Open-Access pipeline, The Community for Open Antimicrobial Drug Discovery (CO-ADD), as a global screening initiative to uncover rich chemical diversity held outside of corporate screening collections. CO-ADD provides unencumbered free antimicrobial screening for any interested researcher.

Results. In the last 18 months, over 150 collaborators in 35 countries have submitted nearly 130,000 compounds to CO-ADD, with >50,000 of these tested for their ability to inhibit any one of five bacteria and two fungi.

Discussion. While many antibiotics have been discovered from natural product screening in the past, there is an untapped resource contained in the laboratories of organic and medicinal chemists: synthetic compounds prepared for other projects that have never been tested for their antimicrobial potential. These compounds may have been synthesised to validate new synthetic routes, develop new methodologies, create unusual structures or act on a different therapeutic target, but were not screened for activity against microbes. This presentation will discuss the properties of antibiotic-like compounds, how the organic chemistry community can contribute to solving an imminent threat to public health, and the success of CO-ADD’s crowd-sourcing approach to date.

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Cooper MA A community-based approach to new antibiotic discovery *Nat. Rev. Drug. Discov.* 2015, 14, 587-588.

