South Australian Defence and Veteran Research Paper Day

The Military Health Outcomes Program: Monitoring the Health and Well-Being of the Australian Defence Force

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Protecting the health and welfare of serving and ex-serving members of the Australian Defence Force (ADF) is one of the most challenging tasks faced by the Department of Defence and the Department of Veterans' Affairs. The Military Health Outcomes Program (MilHOP) of studies, launched in May 2010, is helping to address this issue by investigating the health challenges faced by serving and ex-serving personnel across the three Services, with a specific focus on those deployed to the Middle East Area of Operations (MEAO).

Led by the Centre for Military and Veterans' Health (CMVH) and working with the Department of Defence and the Department of Veterans' Affairs, MilHOP consists of four integrated studies. Data from the MEAO Health Study and a Health and Well-being Survey will be combined to determine the health status of ADF personnel who have or have not deployed to the MEAO. In addition, the MEAO Prospective Study will investigate links between illness and deployment. These three initial studies will be discussed in more detail in the following presentations.

The MEAO Cancer and Mortality Study, the fourth MilHOP study, is due to commence in the latter half of 2011. It involves a secondary data analysis which will review the rates of mortality using the Australian Institute of Health and Welfare National Death Index and the incidence of cancers registered with State/Territory cancer registries for all personnel who have deployed to the MEAO since 2001.

Data from all of the MilHOP studies will add to the already extensive CMVH Deployment Health Surveillance Program health data for ADF members who have deployed to the Solomon Islands, East Timor and Bougainville. Among other important outcomes this comprehensive longitudinal database will assist in the monitoring of the health of veterans and ADF members into the future by identifying health indicators and exposures that are predictive of morbidity and mortality. In turn, this information could lead to early intervention and program change to minimise disability amongst both veterans and ADF members.

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The Military Health Outcomes Program: The Middle East Area of Operations Prospective Study

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The Middle East Area of Operations (MEAO) Prospective Study is part of the integrated Military Health Outcome Program (MilHOP). It is specifically designed to investigate the links between illness and deployment.

Changes in health outcomes between pre- and post-deployment and the exposures associated with those changes will be measured in a sample of ADF personnel (~2000) deploying to the MEAO after the first of June 2010, and returning to Australia before the end of November 2011.

Deploying personnel will be invited to participate in the study at two time points. The first, approximately three months prior to deployment to the MEAO (Time 1) and the second, approximately four months after returning from deployment (Time 2). At each time point, all participants will be asked to complete a self-administered questionnaire. Participants will be asked about their health, exposure to potential hazardous substances, and general insights into their deployment experiences.

A subset of deploying personnel (~n=750) will also be asked to take part in a brief physical assessment and provide a saliva and blood sample. A smaller group of these participants (~n=400) will also be asked to undertake a neurocognitive assessment. Both physical testing and neurocognitive assessment data will also be collected at Time 1 and Time 2 in order to gain insight into deployment related change.

This presentation will provide an overview of the methodologies used to collect data for the MEAO Prospective Study. Once completed, data from this MilHOP study will add to the already extensive CMVH Deployment Health Surveillance Program health

database for ADF members who deployed to the Solomon Islands, East Timor and Bougainville and ADF comparison groups.

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The Military Health Outcomes Program: The Middle East Area of Operations Health Study

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The Middle East Area of Operations (MEAO) Health Study is part of the Military Health Outcome Program (MilHOP). It aims to determine the health status of ADF personnel who have already deployed to the MEAO, and to identify possible factors that have protected the health of any individuals while on deployment.

All serving and ex-serving ADF members who deployed to the MEAO between 1 October 2001 and 31 December 2009 (~27,000) will be invited to complete an extensive self-administered questionnaire which asks about their deployment history, their physical and psychological health as well as deployment exposures. Currently serving regular ADF members (18,802) have already received their invitation to participate and approximately 2,000 ex-serving personnel and 6,000 reservists will be contacted in the latter half of 2010.

This presentation will provide an overview of the methodologies used to collect data for the MEAO Health Study and an overview of initial response rates. Once completed, data from this MilHOP study will add to the already extensive CMVH Deployment Health Surveillance Program health data for ADF members who deployed to the Solomon Islands, East Timor and Bougainville and ADF comparison groups.

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The Military Health Outcomes Program: Health And Well-Being Survey

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The Health and Well-being Survey is part of the Military Health Outcome Program (MilHOP). It was specifically designed to respond to the recommendations of the Dunt review of mental health care in the Australian Defence Force (ADF), which highlighted the need to have a more accurate estimate of the rates of psychiatric disorder in the ADF. The primary aim of this MilHOP study is to measure mental health problems and psychological distress in currently serving ADF members.

Data obtained from personnel who have not deployed to the MEAO (~30,000) will be combined with data from the MEAO Health Study to provide prevalence estimates of mental health in the ADF. In addition, this MilHOP study will provide validation (via in-depth interviews) of psychological screening measures and methodology including those currently administered to all ADF members post deployment as part of the Return to Australia Psychological Screens (RtAPS) and Post Operational Psychological Screens (POPS) processes. This will include an analysis of the impact of the different methods of survey administration conducted in the study in order to inform the development of an effective model of Mental Health screening in the ADF.

This presentation will provide an overview of the methodologies used to collect data for both the prevalence estimates and validation components of the Health and Well-being Survey. In addition, initial response rates from both components will also be presented. Once completed, data from this MilHOP study will add to the already extensive CMVH Deployment Health Surveillance Program health data for ADF members who deployed to the Solomon Islands, East Timor and Bougainville and ADF comparison groups.

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Management of Neck Injury in RAAF Fast Jet Aircrew

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Objective: To examine the types and effectiveness of various strategies used by Royal Australian Air Force (RAAF) fast jet (FJ) aircrew to self-manage flight-related neck injury and pain.

Methods: A six section, 18- question survey tool was distributed to all eligible FJ RAAF aircrew. Selective results from the sections evaluating aircrew demographics, flight-related neck injury and the self-management of these injuries are presented in this report.

Results: Ninety-five percent of respondents experienced flight-related neck pain. The most commonly sought treatment modality was on-base medical and physiotherapy services. Many respondents reported that currently provided on-base treatment, as well as ancillary services such as chiropractic, to be the most effective in alleviating symptoms.

Conclusions: Flight-related neck injury is a perennial occupational hazard among FJ aircrew in Australia. A variety of treatments are used by injured fast jet aircrew with on-base physiotherapy and medical treatment being the most common forms. Ancillary treatments, such as chiropractic, are accessible only on a case-by-case basis under the RAAF health service delivery model, even though they are reported as being the most effective form of management . Prevention of FJ aircrew neck pain would improve air combat capability and enhance health.

Recommendations: Further investigation into the effectiveness and safety of these alternative therapies needs to be performed to allow appropriate consideration of their place in the management of FJ aircrew neck injury. Exercise programs and aircrew techniques for the prevention of neck injury in fast jet aircrew require further validation and evolution.

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Real-World Attenuation of Foam Earplugs

A Smith

Purpose: Work-related exposure to hazardous levels of noise is a significant occupational threat around the world. In Australia, occupational hearing loss is a significant source of morbidity, accounting for up to 24% of all disease-related claims over the last 10 years. Sensorineural hearing loss and tinnitus are the two most common conditions compensated through Department of Veterans' Affairs. Foam earplugs are a common form of hearing protection, and are used widely across all sectors in Defence; however poorly-fitting earplugs can provide inadequate attenuation. This project aimed to document the attenuation of foam earplugs as worn by typical ADF aircrew, and to determine the extent to which training could increase the level of attenuation.

Method: A group of 43 aircrew were recruited for the study. They were asked to insert foam earplugs as they normally would – the technique used to insert foam earplugs was documented, and the attenuation afforded by the earplugs was measured using VeriPro. The study was repeated after each subject received one-on-one training to insert the earplugs in accordance with the instructions from the manufacturers.

Results: The earplugs used in this study had an attenuation rating of NRR 32 dB / SLC80 25 dB. Before training, the group-mean attenuation was only 15 dB - 57% of earplugs attenuated ≤ 15 dB of noise, and only 10% and 2% of earplugs reached the SLC80 and NRR (respectively). After training, the group mean attenuation increased to 25.5 dB – with only 8% of earplugs attenuating ≤ 15 dB, and 47% and 31% of earplugs now meeting or exceeding the SLC80 and NRR (respectively). 43% of subjects exhibited an improvement ≥ 15 dB (equivalent to 32-fold or greater reduction in noise-energy exposure). Before training, only 10% of earplugs were inserted deep enough to provide the wearer with optimum attenuation. After watching a short training video, 97% of earplugs were inserted deep enough to provide adequate noise attenuation. There was no significant advantage – in terms of attenuation achieved or technique followed - for those who had previously undergone training through Defence in how to insert earplugs.

Conclusions: The real-world attenuation of foam earplugs exhibited in this study is significantly lower than the factory-specified level of attenuation and can be attributed to inadequate formal training to insert foam earplugs correctly. Personnel wearing poorly fitting earplugs may be receiving inadequate protection from hazardous levels of noise. A brief training intervention significantly increases the level of attenuation wearers can achieve from their earplugs, and this has the potential to significantly reduce the risk of noise-induced hearing loss for Defence members.

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Does Obstructive Sleep Apnoea Affect Everyday Metropolitan Driving?

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Purpose: Obstructive sleep apnoea (OSA), affecting 10% of middle-aged Australians, is associated with excessive day-time sleepiness, cognitive abnormalities and increased motor vehicle accident (MVA) risk. It has been assumed that fall-asleep accidents occurring during prolonged (rural) drives are mainly responsible for the increased MVA risk. However, epidemiological studies have not defined the location (rural vs metropolitan) of MVAs in OSA. We postulated that sleepiness and slow reaction times in OSA patients could adversely affect city driving, and considered an investigation of metropolitan driving performance in untreated OSA patients was warranted.

Methods: Using a dual control vehicle, a 45min TransportSA accredited on-road driving test was administered by a certified assessor (blinded to subject status) to 15 untreated severe OSA patients (age 52.1±2.1yrs, BMI 31.0±1.1kg/m2, AHI 50.3±5.1events/hr) and 16 age matched controls (age 52.8±2.6yrs, BMI

25.1±0.7kg/m2, AHI 6.6±1.0events/hr). Subjective sleepiness was assessed using the Epworth Sleepiness Scale (ESS). The assessor utilized a standardized scoring log to record different driving skills (e.g. lane changes, indicating, mirror check) observed under three categories (left turns, right turns, general driving). Any faults and law points (e.g. speeding) that would attract a fine were recorded. All driving tasks were scored giving an overall percentage with a 70% cut-off for pass or fail. Any faults occurring during the drive were expressed as a percentage of the total tasks observed for each subject and group comparisons were statistically analysed using linear mixed models.

Results: OSA patients were significantly sleepier compared to controls (ESS 10.3±1.3 vs 4.9±0.7, p<0.01). Approximately 25% of subjects in both groups failed the test. An average number of tasks assessed were 60.0±1.6 for controls and 56.8±1.4 for OSA patients with half of these tasks assessed during general driving. There were no significant group differences in the percentage of driving faults observed during the assessment including approach, blind spot, car control, gear change, judgment, mirror checks, observation, position, safety, signals and turn execution. However, during general driving more OSA patients had tasks resulting in a law point compared to controls (11.0±1.8% vs 6.8±1.0% p=0.049), including speeding, lane position and disobeying traffic signs.

Conclusions: Overall, data suggest driving skills during metropolitan driving are not different between OSA patients and healthy drivers. However, a greater tendency to break the law in the patient group is suggestive of greater inattention or impulsiveness. Driving faults sufficient to be considered an indictable offence (speeding, failure to obey traffic signals) potentially carry a greater accident risk than lesser faults (incorrect gear changes, or failure to check the blind spot before lane change). There is a need for large epidemiological studies in OSA patients focusing on MVAs in metropolitan areas to better define the nature of MVA risk in these patients.

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A Flexible Deployment Framework Takes Aim at a PTSD Risk Factor

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Purpose: Characteristics of Army recruits predict better than average life outcomes, but on average, those sent on combat deployments experience worse than average outcomes. Stress associated with combat deployments may be one factor, but is not homogeneous within deployed forces, with individual differences between soldiers, and role based variations (cooks or mechanics in a forward operating base may experience considerably less combat stress than members of a security detachment escorting convoys along frequently mined and ambushed routes). Standard Australian deployments are eight months, regardless of role. Using Adversarial Scenario Analysis, a flexible, minimum-role-appropriate-length deployment framework was developed and the limitations of this approach were explored. Where applicable, the framework is intended to produce a force that is more effective and yields life outcomes closer to soldiers' pre-deployment potential.

Method: Adversarial Scenario Analysis begins with a simple scenario and a core strategy. This scenario proposes that people accumulate stress while on deployment; the strategy is minimising the length of deployment to reduce stress accumulation time, with time between deployments for stress dissipation. After the initial strategy is defined, an adversarial method is employed to select an additional scenario element challenging that strategy. Risk management processes are then devised to minimize or eliminate the impact of core strategy changes. This process is then iterated to deal with the complexity conundrum that besets scenario planning: managers want a single scenario but many scenarios are needed to deal with complexity; scenarios themselves are simple, covering a single element of the situation, and the complexity lies in developing a strategy that is robust against all scenarios; with no scenario likely to actually occur. The complexity of the situation is compressed into a single scenario in which all elements and their interactions can be considered.

Results: A concept is developed making deployments permanent but rotates units within them based on the principle of minimizing continuous time in theatre, subject to the needs of the role filled. This framework is expressed in the equation

(n-1)D = max(R,T)+2H+2J where:

- n = number of times the deployed force that is available to deploy;
- D = deployment duration, (n-1)D is the inter-deployment period;
- R = recovery time;
- T = training time;
- H = handover period; and
- J = time dedicated to re-entraining circadian rhythms to the time-zone.

It is assumed that training and recovery can be conducted concurrently.

Conclusions: The final concept is focused on stable long term commitments to small wars, insurgencies and peacekeeping operations within four time-zones of the deployment source and with forward bases near useable airfields. This has the positive effects of increased flexibility and reduction of a risk factor for PTSD at the cost of increased complexity in handover.

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Assessing Ballistic Insults and Protection Options: A Fit-For-Purpose Modelling Approach

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Purpose: The aim of this study was to develop a fit-for-purpose modelling tool for assessing the vulnerability of vital organs to ballistic and blast fragmentation.

Method: The Human Injury Assessment Tool (HIAT) was derived from the Visible Human Project and the current version provides a representation of the torso region and the vital organs. The model depicts soft and hard body armour, and the ballistic protection is modelled by overlaying a geometric representation of the armour on the torso. The ballistic impacts are calculated based on ballistic equations and numerical analysis. The injuries to the organs are at present represented in a geometric manner whereby a penetrating bullet or fragment will follow the geometric vector of entry and traverse the torso and organs.

Results: Initial modelling of ballistic insults to the torso for different armour system configurations from the same threat has produced useful insights into the size and positioning of hard armour plates, and informed current body armour system design activities. The inclusion of soft armour in the modelling has led to a more realistic assessment of protection required against fragments from explosive devices such as mortar shell or improvised explosive device (IED).

Conclusion: The authors have found that a relatively simple, fit-for-purpose model can be successfully developed and usefully applied to highly practical problems like the size and positioning of hard armour plates or the ballistic protection level required of soft armour against IED.

The next phase of the HIAT development will include the whole body and link clinical and other data for representation of ballistic damage to the head, the bones and musculoskeletal systems. The expertise of medical professionals will be required to build into the model a capacity for the prediction of the medical consequences of threat events.

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The Appropriate Use Of Inhaler Devices In Veterans: Perceptions and Practice

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Background: One-quarter of respiratory medicines dispensed to veterans include 3 or more medicines, and of these, 50% use three or more different inhaler devices. This patient population often has co-morbidities which may make device use difficult, resulting in sub-optimal delivery of medicines. Veterans are particularly vulnerable to these problems with many having poor eyesight, mobility difficulties, coordination difficulties or cognitive impairment. Regular patient training using the relevant package insert plus physical demonstration has been shown to significantly improve patient technique.

Purpose of study: To investigate veteran, GP and pharmacist perceptions and practice using respiratory devices.

Methods: A one page reply-paid response form was distributed to GPs, pharmacists and veterans in the Veterans' Medicines Advice and Therapeutics Education Services (MATES) programs on two separate occasions in March/April 2006 and March/April 2008. Descriptive analyses were undertaken for all questions.

Summary of results: 2006 survey responses were received from 1078 (10%) GPs, 320 (6%) pharmacists and 10,904 (38%) veterans. 2008 survey responses were received from 530 (6%) GPs, 717 (9%) pharmacists and 3,663 (20%) veterans. Over 85% of veterans indicated they used their inhalers well; however, 10% reported they missed a dose due to difficulty using their device and 11% were not confident in using their inhaler. By comparison, approximately half of GPs and pharmacists indicated that veterans do not use the devices well and over 85% believe patients require several lessons to learn. More than 90% of pharmacists and GPs indicated that they were confident in instructing patients how to use their devices. Veterans' inhaler technique, however, was not checked regularly. This is despite therapeutic guidelines recommending repeated assessment and demonstration of devices, as technique may begin to decline two months after patient education. Less than a third of GPs considered it practical to review their patients' technique every 3 months, while half of the pharmacists did not review inhaler technique

of veterans already using a device. Complicating the review is the finding that only 29% of veterans would ask their pharmacist about their inhaler medicines. 56% reported they would ask their doctor.

Conclusions: Health professionals are aware of the problems associated with the use of inhaler devices; however, this study indicates the need to be more proactive in checking inhaler technique. Regular physical demonstration of technique needs to be initiated by GPs or pharmacists as patients appear to be unaware that inhaler technique is difficult to maintain.

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An Elevated Neutrophil-Lymphocyte Ratio Independently Predicts Mortality in Chronic Critical Limb Ischaemia

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Purpose: Atherogenesis represents an active inflammatory process with leucocytes playing a major role. Critical Limb Ischaemia affects the older subset of the population. An elevated white blood cell (WBC) count has been shown to be predictive of death in coronary artery disease (CAD) patients. The aim of this study was to look at the predictive ability of neutrophil count and neutrophil/lymphocyte ratio for predicting survival in patients with chronic critical lower limb ischaemia (CCLI).

Methods: All patients admitted to a single vascular unit with CCLI were identified prospectively over a two-year period starting from January 2005. Patient demographics, clinical history, co-morbidity and risk factors for peripheral vascular disease were documented. The white blood count and differential cell count at admission was recorded. Overall patient mortality was studied as the primary outcome.

Results: One hundred and forty-nine patients were identified with a median age of 72 years (IQR 65.7-81). A neutrophil/lymphocyte ratio (NLR) of greater than, or equal to 5.25 was taken as the cutoff , based upon the Receiver- operating-characteristic (ROC). The median follow up was 8.7 months (IQR 3.1-16). During the follow up period there have been 62 deaths (43.4%). An elevated neutrophil/lymphocyte ratio and a high troponin level (>0.1) were found to be the only two factors independently associated with shorter survival on multivariate analysis using the Cox proportional hazards model.

Conclusions: This study suggests that an elevated neutrophil/lymphocyte ratio (NLR) can identify a poor-risk subset of patients among those being treated for chronic critical limb ischemia. This simple, cheap test may therefore add to risk stratification of these high-risk patients.

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Continuous Glucose Monitoring to Assess the Hyperglycaemic Effect of Glucocorticoids During an Exacerbation of Chronic Obstructive Pulmonary Disease

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Purpose of the study: Glucocorticoids (GCs) reduce inflammation and are used to treat a wide range of inflammatory and autoimmune conditions, including exacerbations of chronic obstructive pulmonary disease (COPD). While GCs are an effective treatment for COPD, their use is frequently associated with the development of hyperglycaemia, and this may impede patient recovery. Clinical observation suggests GCs predominantly increase postprandial blood glucose concentration, but the pattern of hyperglycaemia has not been well defined. We aimed to assess in detail the effect of GCs on glucose concentration in order to optimize management of GC-induced hyperglycaemia.

Methods: Patients with COPD admitted to the hospital were assigned to the following groups and underwent continuous glucose monitoring (Medtronic Gold, Medtronic Minimed, Northridge, CA) for up to 72 hours.

	Male (%)	Age (y)	Weight(kg)	Prednisolone dose (mg/day)
Group 1: acute COPD, no diabetes (n=40)	63	77±14	72±17	30±6
Group 2: not diabetic, have COPD, but admitted for other reasons (n=13)	62	75±13	69±15	0
Group 3: acute COPD, known diabetes (n=7)	71	84±9	69±15	26±9

Results: There were no significant differences in gender distribution, age, or weight between groups. While the glucose AUC between 0.00-12.00 hours for Group 3 (diabetic patients) was significantly greater than in the other two groups, Groups 1 and 2 did not differ for this period (Figure). However, the glucose area under the curve (AUC) between 12.00-24.00 hours for the groups receiving GC's (1 and 3) were both significantly greater than Group 2 (Figure). Significantly more subjects in Group 1 (53%, p=0.02) and Group 3 (100%, p=0.003) recorded a glucose of ≥11.1 mmol/L during CGMS than in Group 2 (8%), who were not receiving GCs.

Conclusions: GCs frequently cause hyperglycaemia in hospitalized patients, predominantly in the afternoon and evening. Treatment of GC-induced hyperglycaemia should be targeted at this time of the day.

Acknowledgement: This study was supported by grants from Foundation Daw Park, Faculty of Health Sciences Flinders University and the Novo Nordisk Regional Diabetes Scheme. CGMS were supplied by Medtronic.

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Is Endovenous Laser Ablation Possible While Taking Warfarin?

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Purpose: Elderly patients with varicose veins are most susceptible to developing venous ulceration, a debilitating complication placing significant limitations on quality of life. These patients, many of whom are on warfarin are often poor surgical candidates, making management challenging. Endovenous laser ablation (EVLA) is becoming increasingly popular, with minor trauma to the leg during the procedure. The aim of this study was to determine if endovenous ablation could be achieved with minimal complications while the patient remained anticoagulated.

Methods: A prospective cohort study was performed with patients presenting for EVLA while on long term warfarin.

Follow-up duplex scans were performed at 6 weeks, 3, 6 and 12 months.

Results: Twelve patients were studied, 7 men and 5 women (median age 58, range 42-83). Patients were taking warfarin for either AF (8 patients), prosthetic heart valves (2 patients), recurrent PE's (1 patient, no source found) or pacemaker with mural thrombus (1 patient). All patients underwent ablation of the long saphenous vein (LSV). Eleven patients had successful ablation of the LSV at 6 week follow-up duplex scan. One patient underwent a repeat EVLA 3 months after the original procedure with successful ablation at the 6 week follow-up duplex. All patients reported bruising at the venous puncture site, 1 haematoma was reported, but settled spontaneously, 1 patient reported erythema along the LSV track and 1 patient reported a saphenous nerve neuralgia, both resolved spontaneously. All patients have maintained an occluded LSV at 12 months follow-up, with a significant reduction in symptoms.

Conclusion: These early results have shown it is possible to perform EVLA successfully in elderly patients while on warfarin, without significant complications.

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The (Cost) Effectiveness of Self-treatment of Exacerbations on the Severity of Exacerbations in COPD patients: The COPE-II Study

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Purpose: COPD is a chronic disease with high prevalence and quickly increasing incidence rates. The effect of self-treatment of COPD exacerbations on the severity of exacerbations during one year was evaluated. In addition, a cost-effectiveness analysis was performed.

Methods: Patients were recruited from the outpatient department of pulmonary medicine of Medisch Spectrum Twente hospital at Enschede, the Netherlands and randomly allocated to four two-hour self-management sessions, with or without training in self-treatment of exacerbations. Patients in the self-treatment group received an action plan with the possibility to initiate a prednisolone course (with or without antibiotics). During follow up all participants kept a daily symptom diary. These provided the data to calculate the frequency of exacerbations, the number of exacerbation days and mean daily severity scores.

Results: Data were analysed of 142 randomised patients (self-treatment: n=70; control: n=72). The frequency of exacerbations was identical in both study groups (mean 3.5 (SD 2.7)). Patients in the self-treatment group reported fewer exacerbation days (median self-treatment: 31(interquartile range (IQR): 8.9-67.5); control: 40 (IQR: 13.3-88.2); p=0.064), the difference was significant in the group of patients with a high number of exacerbation days per year (>137 (= 90th percentile of the whole study population); p=0.028). The mean severity score of an exacerbation

day was equal in both groups. No between-group differences were found in health related quality of life. Cost-effectiveness analyses showed that applying self-treatment saved €154 (approximately 220 AUD) per patient, with a trend towards a lower probability for hospitalisations (number/patient/year: self-treatment: 0.20 versus control: 0.33 (p=0.388)) and a significant reduction of health care contacts (number/patient/year: self-treatment: 5.37 versus control: 6.51 (p=0.043)).

Conclusion: It was concluded that self-treatment of exacerbations incorporated in a self-management programme leads to fewer exacerbation days and lower costs.

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