Institution: King's College London

Unit of Assessment: C26 – Sport, Exercise, Leisure and Tourism

a. Overview:

King's College London (KCL) is a multi-faculty research-led University ranked in the top 20 worldwide (QS World Rankings). It has more than 24,000 students (including 10,000 postgraduates) and more than 6,100 employees. It is a member of the Russell Group and a partner in the Francis Crick Institute (www.crick.ac.uk), a world-leading biomedical research institute opening in 2015.

King's Health Partners (KHP, www.kingshealthpartners.org) links KCL to three local NHS Foundation Trusts and is one of five accredited Academic Health Sciences Centres in England. KCL also hosts two National Institute of Health Research (NHIR) Biomedical Research Centres. KHP partners, through Clinical Academic Groups and the King's Bioscience Institute, perform a complementary role co-ordinating basic bio-science across the KCL Health Schools.

The Centre of Human and Aerospace Physiological Sciences (CHAPS), formed in 2010, is a Research Division within the School of Biomedical Sciences (BMS). Its hub is on the Guy's Campus, with research groups on the Waterloo, King's College and St Thomas' Hospitals campuses. CHAPS was formed following re-structuring within BMS and evolved from components of the former Division of Applied Biomedical Research (DABR). DABR was returned to UoA12 (Subjects Allied to Medicine) in the 2008 RAE. Our research focus, outlined below, now makes UoA26 the most appropriate unit of return.

CHAPS comprises three interlinking research groupings, which operate under the overarching strategic theme of ***Human Physiological Function and Adaptation*** which encompasses a molecule to whole body systems approach. Our focus is on understanding physiological function in regard to exercise, health and disease, ageing, performance in sport and in unique physical environments. Through the Drug Control Centre our work includes the development of state-of-the-art bioanalytical methods for the detection of prohibited substances taken by athletes.

Our strategic theme has enabled close collaboration between basic scientists and clinical researchers, with a strong focus on the end-user. The research programmes integrate closely with the broader basic biomedical and clinical sciences environment existing within KCL and KHP.

Our strategic theme is underpinned by the three overlapping research groupings depicted below.

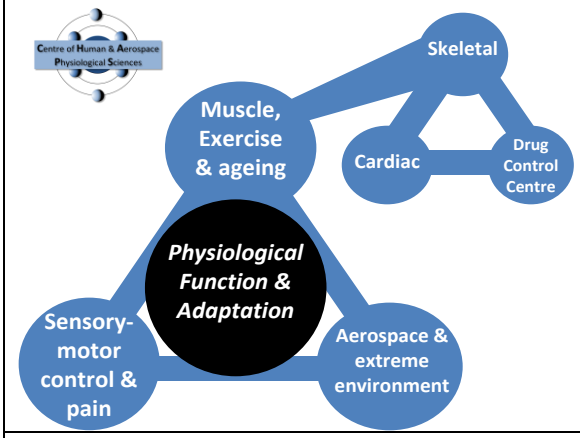

Fig. 1. Research structure overview

Our research is closely integrated with the delivery or our unique MSc programmes run in conjunction with the Department of Physiology:

- *Human & Applied Physiology*
- *Space Physiology & Health*
- *Aviation Medicine*

b. Research strategy

Our growth since 2010 has been achieved by recruiting new members of staff who are existing or emerging leaders in their respective fields, as well as the integration of those from other Divisions within KCL, whose research aligns with our themes. It has also been achieved by active interaction and collaboration with other Research Divisions within KCL, KHP and with other national and international groupings relevant to our core interests.

I) MUSCLE, EXERCISE & AGEING is the largest of the three themes within CHAPS and comprises three sub-groups.

(i) Skeletal Muscle; exercise and ageing *(Edwards, Ellison, Harridge, Ochala, Newham, Rafferty & Rowlerson).* Within this group there are substantial ongoing programmes focused on human skeletal muscle function, adaptation and repair. Exercise and ageing are crosscutting themes. The research focuses on: *i) Muscle stem cells:* We have shown that the regenerative potential of these cells is maintained in later life and identified the transdifferentiation of muscle specific fibroblasts as the source of adipocytes in muscle. *ii) Actin-myosin interactions:* We have used single fibre, in vitro motility assay, X-ray diffraction and magnetic resonance spectroscopy techniques to probe mechanisms underlying muscle weakness in diseases such as nebulin and tropomyosin related myopathies, as well as during fatigue. *iii) Exercise studies:* We have undertaken studies with diverse populations. These include individuals with spinal cord injury (to investigate how muscle function and cycling performance can be improved by electrically evoked cycle training) and master athletes (used as model to study the physiology of optimal ageing*). iv) Metabolic exercise studies:* A number of approaches are taken and key findings include showing that high-fat diets reduce thermodynamic efficiency during exercise in sedentary humans and that this effect is mitigated in trained athletes. *v) Clinical exercise and functional studies:* These involve active collaboration with clinical colleagues on topics including muscle fatigue in respiratory diseases, developing techniques for the measurement of muscle function in clinical settings and identifying mechanisms underlying the loss of muscle mass in critically ill patients.

(ii) Drug Control Centre (DCC) *(Cowan, Kicman, Edwards & Harridge)*. Under the direction of Professor David Cowan, this group has developed a number of cutting-edge bioanalytical approaches for the detection of prohibited substances in sport. This culminated in the successful delivery of the anti-doping analysis at the London 2012 Olympic and Paralympic Games. Examples include the use of gas chromatography-tandem mass spectrometry to refine the upper limits for 19-norandrosterone, a novel “total data capture” approach of screening samples based on ultra-high performance liquid chromatography coupled high resolution mass spectrometry, permitting the retrospective detection of “designer drugs” by data mining and artificial neural networks. This builds on earlier work of the Centre in the development and application of the first tests for amphetamines, anabolic steroids and the first controls of human chorionic gonadotrophin. With funding from the World Anti-Doping Agency (WADA) and Partnership for Clean Competition, a number of studies for the detection of human growth hormone (hGH) administration have been undertaken to explore the use of secondary detection biomarkers. This has led to the development of a new biomarker test used by WADA to detect this synthetic hormone over a longer time than the original test based on GH isoforms, and which is able to incorporate ethnicity, age and exercise as confounding factors. These studies are integrated into our broader physiological research programmes aimed at understanding physiological mechanisms such as the regulation of muscle IGF-I by GH.

(iii) Cardiac muscle *(Clark, Edwards, Ellison, Ochala & Shattock).* This group works on cardiac physiology in regard to mechanisms of adaptation, regeneration and repair. This involves the application of fundamental physiological and molecular techniques to investigate the myocardial response to the stresses of ischaemia, reperfusion, exercise, damage and hypertrophy. They have demonstrated: *i)* How the expression, structure, activity, and location of key ion translocating proteins in subcellular and sarcolemmal membranes influence the outcome of myocardial stresses. *ii)* How the activation of both protective and detrimental signalling pathways may govern these stresses. This includes fundamental studies on the role and function of p38-mitogen-activated protein kinase in cardioprotection/injury, the physiological mechanisms and adaptations involved with heart failure and the application of novel techniques for measuring cardiac haemodynamics and contractility. *iii)* The role of tissue-specific stem cells in the homeostasis and regeneration of cardiac muscle. Work includes studies on cardiac cell homeostasis and response following injury; the role of resident, endogenous cardiac stem cells in adaptive response to physiological exercise; the effects of ageing and pathological status on cardiac stem cell biology; the identification of mechanisms that govern stem cell fate; activation of endogenous tissue-specific repair and regeneration processes using growth factors and cytokines. *iv)* The mechanisms by which ischemia tolerance develops in cardiomyocytes using computational metabolic modelling.

III) SENSORY MOTOR CONTROL & PAIN *(Green, Pavlou, Newham & Thacker).* This group studies the underlying mechanisms of inappropriate sensori-motor control and pain processes and the development of novel therapies in patients with clinical disorders e.g. vestibular disorders, stroke, traumatic brain injury and recurrent falls in older adults. Our programmes focus on: i) the nature and functional significance of neuroimmune interactions involved in nociceptive processing. ii) postural control strategies in patients with vestibular disorders, stroke, and older adult fallers. iii) the effect of multi-factorial balance rehabilitation protocols incorporating dual-tasking on physiological responses i.e. visual dependency, trunk acceleration and postural control during urban gait, subjective symptoms and quality of life.

III) AEROSPACE & EXTREME PHYSIOLOGY & MEDICINE *(Clark, Edwards, Gradwell, Green & Harridge).* This group draws from, and also informs, the work of the other two groups via extensive collaborations with the Royal Air Force (RAF), Space Agencies (including ESA and NASA), unique expeditions in extreme environments e.g. Xtreme Everest and White Mars, and leading international academics in these fields. The group focuses on understanding the challenges to human performance in the aerospace environment and also in developing, testing and refining countermeasures e.g. exercise strategies, to ameliorate such effects. The cross-fertilisation of understanding of aerospace knowledge with terrestrial applicability and vice versa is a driving theme. Examples include i) Novel modelling of the cephalic fluid shift associated with orthostatic (un)loading. ii) Development of an arterialised earlobe blood collector for use in space and terrestrially. iii) Evaluating how cerebral blood flow and oxygenation are affected by exposure to the high Gz forces experienced by pilots flying the Typhoon jet fighter (with QinetiQ). iv) Identifying that current American Heart Association guidelines are potentially unsuitable for performing CPR in hypo- and micro-gravity environments v) Undertaking exercise efficacy studies with the gravity loading countermeasures skinsuit (GLCS) which have led to it being flown and worn on the International Space Station in 2015.

Developments and objectives for the next 5 years: As the country struggles to cope with an ageing population and increased incidence of lifestyle-related diseases e.g. obesity, type II diabetes and cardiovascular disease, the work of CHAPS will become increasingly important and relevant to a broad cross-section of society. Physical inactivity is at the very centre of these diseases. Our expertise, coupled with our internal and external collaborators, ideally positions us to undertake fundamental research to increase understanding of the therapeutic role of exercise in the maintenance of health. We are uniquely placed to exploit the opportunities resulting from the UK's growing interest in human space flight and the emergence of space tourism. CHAPS is a founding and lead partner of the UK Space Biomedical Consortium. Major Tim Peake, the UK's first ESA astronaut, has a visiting appointment. We engage actively with collaborators in ESA and NASA and are regular invitees to the annual Space Medicine Summit in Houston – an invitation only meeting of leaders in the space medicine field.

Over the past 3 years we have grown rapidly into a coherent critical mass. With four new recent research-focused academic appointments, the Centre stands at 13.8 FTE. Our work also benefits from the interaction of distinguished emeritus Professors and visiting scientists. CHAPS is in a strong position to continue this progress, with the three research groupings forming a robust platform upon which to build. Our expertise places us at the nexus of basic mechanistic and applied human and clinical research. We are well positioned to make important and wide ranging research contributions with applications in a range of fields from sport and exercise science, though regenerative medicine and rehabilitation, to space tourism.

c. People:

i. Staffing strategy and staff development: CHAPS is led by Professor Stephen Harridge and comprises a full-time tenured staff 5 Professors (Cowan, Gradwell, Harridge, Newham & Shattock), 5 Senior Lecturers (Ellison, Green, Kicman, Rafferty, Rowlerson), 5 Lecturers (Clark, Edwards, Ochala, Pavlou & Thacker). They have multidisciplinary backgrounds including medicine, physiology, physiotherapy, cell biology, analytical chemistry and sport/ exercise science. New staff are appointed on the basis of their fit with our research groups. Each has affiliation to an academic teaching department e.g. Physiology. Newly appointed staff actively

engage with our mentoring programme, being assigned an experienced senior colleague who advises and guides them on all aspects of academic development and career progression. Institutional staffing policy actively promotes equality and diversity (11:4 males to females) and we are proactive in regard to the Athena Swan scheme, with our own co-ordinator.

In addition to HEFCE funded staff returned here, our research benefits from the work of distinguished visiting Professors: Lazarus (Harridge group), Woledge (Newham group) and Nadal-Ginard (Ellison group). One recent appointee is the UK's first Professor of Aerospace Physiology and Medicine (Gradwell). Having recently left the RAF, he is not returned here but his research bridges human physiology with the health issues pertaining to the commercial air travel industries. Prof Thais Russomano is Director of the micro-G centre at PUCRS University, Porte Alegre, Brazil and has a 0.25 FTE appointment. We are also supported by a number of individuals in our collaborating institutions with visiting appointments including: Evetts and Peake (ESA), Hodkinson and Green (RAF), Mark (NASA) and Bergmann (MIT, USA).

ii. Research students: The development of the next generation of scientists is a top priority. We currently have 5 externally funded post-doctoral research assistants and consistently have ~15 FTE PhD students registered at any one time (Table 1), including a number from overseas. All have graduated within 4 years or part-time equivalent.

2008-9	2009-10	2010-11	2011-12	2012-13
14.5	17.5	15.4	14.9	13.6

Table 1. FTE of postgraduate research students enrolled on doctoral programmes per year

Each student has a first (lead) and 2nd supervisor and our post-graduate co-ordinator (PGC) has overall responsibility for student welfare. Students are monitored through individual meetings and an online system of quarterly progress reports, which are agreed by students, supervisors and PGC. The upgrade from MPhil to PhD registration, which normally occurs at 9 months FTE, involves a written report and oral examination by independent KCL academics and the PGC.

Students and researchers are located in designated rooms, with an allocated desk, PC and storage facilities. They run their own journal club and interact closely with other journal clubs, laboratory meetings and peers from other Divisions within the School and College e.g. Randall Institute, Wolfson Centre for Age Related Diseases, Division of Health and Social Care, Centre for Stem Cell and Regenerative Medicine, where there is relevant research. Annually they present a seminar to our Centre and at the School Research Day 1st and 2nd year students present a poster and final year students give an oral presentation. Research staff and students are actively encouraged to participate in national and international meetings.

At the Divisional level, training is further facilitated by interaction with our MSc students whose projects offer the chance to work alongside and be partly supervised by research staff and students, a valuable experience for both parties. Further training opportunities are provided by acting as demonstrators for BSc and MSc practical classes and also giving tutorials.

At the School and College levels the Researcher Development Unit (RDU) in the Graduate School has responsibility for the provision of central training and development for PhD students, post-doctoral staff and PhD supervisors (www.kcl.ac.uk/study/pg/school/training). It also provides a College lead on policy and strategy on personal, professional and career development for researchers at all levels. The RDU is implementing the Concordat for the Career Development of Research Staff and has obtained the HR Excellence in Research badging from the European Commission (www.kcl.ac.uk/study/pg/school/training/other-info/Concordat.aspx). Support for researchers includes a Careers Adviser, Royal Literary Fund Writing Fellows, e-learning provision and one-to-one coaching. The RDU provides a programme of >300 free workshops annually. Training for new PhD supervisors is compulsory and provided by half-day sessions run several times each year. All experienced supervisors are required to refresh their knowledge of KCL policies and procedures at least once every 5 years via a webinar or face-to-face training session. New programmes include training for new Principal Investigators on management issues and developing leadership skills. The RDU also hosts the Vitae London Hub (www.vitae.ac.uk and is thus directly involved in shaping national policy on researcher development.

d. Income, infrastructure and facilities

Research Income: The total research income awarded to current CHAPS investigators as PI or co-applicant (including both pre and post appointment at KCL) since 2008 is over £8.1m. We have received funding from a wide range of sources: Research Councils (EPSRC & BBSRC), National (UK and Irish Sports Councils), European (EU Framework VII) and International (World Anti Doping Agency, United States Anti Doping Agency/ Partnership for Clean Competition) agencies. We have also received funding from Medical Research Charities including the British Heart Foundation, BUPA Foundation, Dunhill Medical Foundation, Guy's & St Thomas's Charitable Trust, Inspire, Rosetree and Spurell Trusts. Each year we have been awarded at least one of the competitive PhD studentships jointly funded by the School and MRC and have a number of non-EU government funded PhD students.

Infrastructure & Facilities: Our facilities on the Guy's campus provide excellent laboratories for human exercise and whole body functional, as well as cellular, molecular and animal studies. Additional laboratories are located at King's College and St Thomas' Hospitals and the Waterloo Campus. State-of-the-art analytical chemistry facilities exist at the WADA-accredited DCC.

Whole body human physiology: Laboratories are equipped for a range of *in vivo* and *in vitro* studies: cardio-pulmonary exercise testing (cycle ergometery, metabolic carts, venepuncture); motion analysis and motor control (3D motion analysis, force plates, EMG) systems; cardiovascular function (Finometer, Finopres, tilt tables, pulse oximetry, Near Infra-Red spectroscopy); neuromuscular function (isometric, isokinetic and isoinertial dynamometry); electrical, magnetic and direct current stimulation, various cognitive test batteries and ocular/visual function testing. There is a suite for taking human muscle biopsies and the Centre is accredited by the Human Tissue Authority. Our environmental chamber (temperature and humidity controlled) has been upgraded to include a hypoxic capability. At King's College Hospital we have a comprehensive suite for respiratory assessments including flow, volume and pressure. For collaborative experimental work there is ready access to additional facilities including ESA (Cologne, short arm centrifuge), Qinetic (long arm centrifuge) and Centre of Aviation Medicine at RAF Henlow (hypobaric chambers)

Animal, cellular & molecular: Our laboratories house advanced analytical tools and equipment for research on the biology of cardiac and muscle tissue, stem cell biology and molecular physiology. These include new cell culture facilities, Thermoshandon cytospin, nanodrop spectrophotometer, fluorescence platereader, immuno-magnetic bead cell sorting, qRT-PCR, Western Blotting, Chromatin immunoprecipitation (CHiP) and image analysis systems in addition to standard basic science wet laboratory equipment. We utilise analytical flow cytometers and cell sorters (BD FACS Aria II and CytomationMoFlo) and for small animal mechanistic studies we have purpose-built procedure rooms with equipment for behavioural and conditioning studies. These include rodent exercise and training systems; motorised treadmills coupled with metabolic analysis capabilities. There are two suites with surgical tables and dissecting microscopes, including induction of myocardial infarction and denervation for muscle damage-regeneration studies. These suites house high-resolution rodent ultrasound (Visualsonics Vevo 770) and two Pressure Volume systems (Millar/ADI and Scisense). Advanced experimental tools include retrograde perfusion /Langendorf systems for temperature and pressure controlled retrograde perfusion of buffers and enzymes through the coronary tree of mouse, rat and pig hearts.

Mass Spectrometry and Proteomics (DCC): Cowan and Kicman were key in establishing the Centre of Excellence for Mass Spectrometry (CEMS) (founding and current chair of steering committee respectively) which is enables research and analysis, both qualitative and quantitative, of both small molecules and larger biomolecules. Instruments include liquid chromatography (LC) coupled tandem mass spectrometry, LC coupled high resolution MS, LC coupled tandem high resolution MS, gas chromatography coupled MS, Matrix Assisted Laser Desorption Ionisation - Time of Flight MS and Inductively Coupled Plasma MS. The small molecule applications include substance identification from complex matrices, profiling and metabolomics, metabolite identification and quantification. The proteomics platform provides services from the simplest protein identification to very complex large scale biomarker discovery and verification studies in a

wide range of biological matrices. CEMS is further underpinned by the facilities of the DCC, which has a wide array of gas chromatography and liquid chromatography coupled simple, high resolution and tandem mass spectrometers.

Other excellent KCL core research facilities are utilised by CHAPS researchers:
NIKON Microscopy Imaging Centre: This is one of only 8 worldwide and provides cutting edge microscopy and imaging equipment including: A1R Si Confocal, A1R Multiphoton, AZ100 Multizoom, Biostation IM-Q, Inverted Spinning Disk, N-SIM Super Resolution, N-STORM Super Resolution microscopes and two Eclipse Ti-E Live Cell Imaging Systems.

Magnetic Resonance and PET Imaging: We have access to 1.5T and 3T GE Signa HDx Twin Speed MRI scanners. Within the Preclinical Imaging Unit there is an Agilent 7T horizontal MR scanner fully equipped to study various aspects of disease including anatomical, metabolic, functional and experimental models. The KCL Imaging Scanning facility also includes Bioscan Mediso nanoSPECT/CT and nanoPET/CT scanners as well as two prototype magnetic-field compatible single slice PET scanners (for both 9.4T and 3T MR systems) which enable simultaneous acquisition of PET scans and MRI images/spectra from either small animals or isolated perfused organs. We also have access to Dual X-Ray Absorptionometry (DXA) within the Osteoporosis Unit at the nearby Guy's Hospital for whole-body composition measurements.

Genomic facilities: These comprise equipment and services to cover all aspects of genomics research, including transcriptomic and gene expression projects using microarray technology and SNP Genotyping, as well as germ-line genetics using microarray and sequencing technology.

Library Facilities: These provide essential, high-quality support, housing >1.25 million books, thousands of electronic journals, >280,000 ebooks, >600 databases and other online resources. A range of support services are provided both within and outside our six Library sites. A team of 10 information specialists provide subject specific support including training on information retrieval and management, including bibliographic software and data management; one-to-one support for graduate students and research staff in subject specific information retrieval; advice on literature reviews, including systematic reviews; advice and support with disseminating research and evaluating research using bibliometrics. Library Services have been central to the development of a new Research Information System and institutional repository that collects and showcases the research outputs and activities of King's researchers to the world. Library Services support Open Access via the institutional repository, and with advice on paid open access publishing and by administering the central open access publishing fund.

e. Collaboration or contribution to the discipline or research base:
CHAPS actively collaborates with colleagues within KCL and KHP e.g. Wolfson Centre of Age-related Diseases, Randall Institute, Institute of Psychiatry and the Departments of Geriatric and Thoracic Medicine. Our investigators are affiliated with the newly opened Centre for Stem Cell and Regenerative Medicine.

We have extensive collaborations with external scientists. National ones include those with in the fields of biomedical, sport and exercise research at Imperial College London, Royal Veterinary College, University College London and the Universities of Oxford, Brunel, Liverpool John Moore's, London South Bank, Manchester Metropolitan, Nottingham and Southampton.

International collaborative work is undertaken with colleagues at numerous institutions: St John's Medical College, India; Örebro University, Sweden; Institute of Aerospace Medicine (German Space Agency), Cologne; University of Graz, Austria; MIT, Boston, USA; Magna Graecia University, Italy; Tokyo Women's Medical University, Japan; Mayo Clinic, Rochester, USA; University Medical Center, The Netherlands; McMaster University, Canada; University of Sydney, Australia and the Sports Medicine Research Unit at the University of Copenhagen, Denmark.

Our non-academic collaborators include: QinetiQ (Farnborough) where we utilise the UK's only man-carrying centrifuge; ESA (Cologne) in a number of projects with the Crew Medical Support Office with regard to novel exercise interventions for optimising astronaut health and safety; RAF Centre of Aviation Medicine where a two week collaborative research project is undertaken

annually by MSc students designed to tackle a specific physiological / medical operational requirement of the RAF. Collaborations extend to studies on the physical training of fighter pilots aimed at reducing the incidence of musculo-skeletal problems. We have extensive collaborations with GlaxoSmithKline, ranging from their role in anti-doping with the DCC, to being industrial partners on research council grant applications and CASE studentships as well as partnering us on our outreach programmes.

We are one of the founding partners of the UK Space Biomedical Consortium, formed to co-ordinate and develop the activities of UK academic and industrial institutions with an interest in the challenges of human space flight. It sourced pump-priming funding from the UK Space Agency and has worked successfully in lobbying government to subscribe for the first time to ESA's European Life and Physical Sciences (ELIPS) programme.

Our staff contribute substantially to the wider research base both nationally and internationally though invited high profile conference presentations, work on research committees, editorships, learned societies and organisation of prestigious scientific meetings and symposia as well as public outreach as summarised below.

Clarke: Associate Editor, Extreme Physiol & Med. ***Cowan:*** Editorial Board, Drug Testing & Analysis. Board member, World Association of Anti-Doping Scientists. Former President and current Chair of Technical Committee. Royal Pharmaceutical Society: Pharmaceutical Scientist of the Year Award 2013. Member of Home Office Expert Advisory Committee on Drug Driving. ***Ellison:*** Associate Editor of BMC Cell Biol. Executive Board member of the EU FP7 CARE-MI consortium. Member, Scientific & Organising committee, European College of Sports Science Annual Congress (ECSS), Liverpool 2011. ***Gradwell****:* Vice-President of the Aerospace Medical Association. Director & Chair of the Scientific Committee of the International Academy of Aviation & Space Medicine. Chair, UK Space Biomedical Consortium. ***Green:*** Chair, UK Space Biomedical Association. Member, Royal Aeronautical Society Aerospace Medicine Committee. Scientific Advisor to Mission X. Elected Member, International Academy of Astronautics. Member, QinetiQ Ethical and Scientific Committee. Organiser, Physiological Society Symposium "From space station to terrestrial health: The physiology of manned space flight" (2012). ***Harridge:*** Editor in Chief: Scand J Med Sci Sports. Editor, Exptl Physiol. Scientific Committee Member, ECSS. Convener of Human & Exercise Physiology Special Interest Group, Physiological Society. Organiser, Physiological Society Themed Meeting "The Ageing Musculo-skeletal System" (2010) and "Biomedical Basis of Elite Performance" (2012, co-organiser). ***Kicman:*** Associate Editor, Drug Testing & Analysis. Contributor to Government Advisory Committee on Misuse of Drugs - enquiry into anabolic steroids (Report 2010). Head of Special Interest Group in Clinical and Forensic Mass Spectrometry, British Mass Spectrometry Society. ***Ochala:*** Senior Editor, Am J Human Pathol. Review Editor, Frontiers in Striated Muscle Physiology. ***Newham:*** Editorial Board; Eur J Appl Physiol, J Sports Sci, Manual Therapy. Deputy Chair, Research Awards Council, Research into Ageing. Member, Executive Committee, Allied Health Professionals Research Network. Scientific Strategy Committee, Arthritis Research UK. Fellow of the Chartered Society of Physiotherapy. ***Pavlou****:* Vice-chair, Chair & Research Officer, Association of Chartered Physiotherapists Interested in Vestibular Rehabilitation. Editorial Board, J Neurol Phys Therapy. Member of Advisory Group for the Department of Health publication "Provision of Adult Balance Services: a good practice guide". ***Rafferty:*** Chair, Association for Respiratory Technology & Physiology Working Group on Respiratory Muscle. Member, American Thoracic Society workshop "Evaluation of respiratory mechanics & function in the pediatric and neonatal ITU". ***Shattock:*** Elected Fellow of Royal College of Physicians, Am Heart Assoc & Eur Soc Cardiol. Member, Wellcome Trust Basic Science Interview & BHF Project Grants Committees. Guest Editor, J Mol Cell Cardiol, Spotlight Issue on Na regulation (2013). Editorial Board, Exptl Physiol, Can J Physiol Pharmacol, Cardiovasc Res, Cardiol Revs. Meeting organiser, 6th International FXYD Symposium 2008. ***Thacker:*** Education Curriculum lead for Physical Therapy: International Association for the Study of Pain (IASP). Physiotherapy representative on HM Government 'Pain Summit' committee. Editorial board, Pain & Pain Med.