

Susannah Fleming

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Education

- DPhil Biomedical Engineering, University of Oxford** **2005 – 2010**
Life Sciences Interface Doctoral Training Centre (DTC) and Institute of Biomedical Engineering
- MEng Engineering Science, University of Oxford** **1998 – 2002**
1st class honours
- Blackburn Sixth Form College, Lancashire** **1996 – 1998**
5 A-levels at Grade A in Mathematics, Physics, Chemistry, German and General Studies

Research Experience

Research Fellow, Nuffield Department of Primary Care Health Sciences, University of Oxford **2013 – present**

- Investigation of diagnosis and monitoring technologies for primary care
- Collaboration and interface with Department of Engineering Science
- Investigation of the accuracy of pulse oximetry devices
 - sourcing funding from RCGP
 - design and planning of study in collaboration with Respiratory Trials Unit
 - study planned for completion in 2014
- Leading systematic review into community based screening of high blood pressure
 - leading team of researchers to develop and carry out the review
 - developing follow-up research study
- Running internal departmental seminar series
- Contributed to successful application for a departmental Silver Athena Swan Award

NIHR SPCR Non-Clinical Fellowship, Department of Primary Health Care, University of Oxford **2010 – 2013**

- Investigation of diagnosis and monitoring technologies for primary care
- Collaboration and interface with Department of Engineering Science
- Supervision of clinical study into automated vital sign monitoring in Children's Emergency Department
 - collaboration with research nurses and clinical staff, including staff training
 - assisting with supervision of DPhil student
 - management and reconciliation of collected data
 - solving technical issues with research equipment
- Investigation into accuracy of over-the-counter devices
 - design of study and preparation of ethics documentation
 - supervision of undergraduate student
 - planning of further phases of research

- Leading systematic reviews into capillary refill time and blood pressure screening
 - developing search strategies and criteria for screening and quality assessment
 - leading collaborative team to screen large numbers of references and extract data from included studies
 - performing meta-analysis where appropriate
- Leading “non-clinical researchers” workgroup for successful departmental Athena Swan Bronze award
 - writing all-staff questionnaire to assist with identification of needs
 - developing appropriate actions to address needs of non-clinical researchers
 - leading new group to improve internal dissemination of research through seminars and poster sessions
 - member of mentoring steering committee: setting up new mentoring scheme for all staff
- Founding and running departmental journal club

**Post-Doctoral Research Assistant, Department of Engineering Science,
University of Oxford**

2009 – 2010

Data fusion for early warning of patient deterioration in the Emergency Department

- On-going clinical study to investigate data fusion methods for vital signs in the ED
- Management of data acquisition from patient monitors and paper records
 - reconciling data transcribed from patient notes into independent databases
 - matching data from patient notes with continuous vital sign monitoring
 - identifying and correcting transcription errors and incorrect bed assignments
- Planning and supervision of data analysis
 - defining sub-groups of patients and devising appropriate analysis plans for each group
 - co-ordinating and assisting with analysis of data, and reporting results to clinical collaborators
 - preparation of results for inclusion in publications
- Preparation for future phases of the study
 - Advising on ethics applications
 - Maintaining documentation of planned extensions to the current study
- Collaboration with Emergency Department consultants, Research Nurses, and industrial partners
- Organisation and manning of BioEngineering research theme stand at research council open day
 - co-ordinating and collecting information from multiple sub-themes
 - preparing poster and audio-visual presentations
 - preparing and presenting interactive demonstrations of new technologies
 - explaining research to visitors (clinicians, researchers and the general public)

DPhil Student, University of Oxford

2005 – 2010

Measurement and data fusion of vital signs for triage of illness in children

- Collaboration with MaDOx group in the Department of Primary Care
 - investigating automated monitoring of paediatric vital signs in primary care
 - developing methods for data fusion of vital signs for the identification of serious illness and infection
- Preparation and management of two clinical studies to collect paediatric pulse oximetry data
 - Studies carried out in a primary school and an out-of-hours GP surgery
 - assisting with the preparation of ethics applications and attending ethics boards
 - preparing hardware and software and training researchers in its use
- Development of patient monitor software for clinical trial in out-of-hours GP surgery (C# and C++)
 - identifying and sourcing appropriate patient sensors (pulse oximetry and axillary thermometry)
 - interfacing with patient sensor hardware, and collaborating with suppliers and software developers
 - designing and implementing graphical user interface for clinicians

- responding to feedback from clinicians and research nurse
- Development of signal processing algorithms to allow non-invasive monitoring of respiratory rate
 - assisting with protection of intellectual property through patenting of algorithms
 - validating algorithms and comparing them with published alternative techniques
 - developing and validating novel techniques for monitoring of paediatric respiratory rate
- Assessment of vital sign data fusion strategies to improve diagnosis of illness in children
 - investigating a variety of novelty detection and data fusion methods for vital sign data
 - evaluating the performance of the methods using approaches from medical statistics
- Meta-analysis of existing data on normal heart rate and respiratory rate in children
 - carrying out literature search and defining inclusion and exclusion criteria
 - arranging for translation of papers written in a variety of languages
 - assisting with development of novel analysis method to create centile charts
 - extracting and analysing data to obtain evidence-based centile charts
 - writing journal paper to report results
- Preparation and management of a clinical study to investigate complications during dialysis
 - writing C# software to allow collection of nursing notes during dialysis
 - assisting with installation and demonstration of technology to be used during the study
 - researching stand-alone peripheral temperature sensors, and sourcing an appropriate device
 - collaborating with clinicians, specialist nurses, technicians, and industrial partners
 - providing on-going technical support to research nurses and clinicians

IT Consultant, Oxford BioSignals

2007 – 2008

- Own research led to a potentially useful signal processing algorithm for remote monitoring of respiratory rate using existing ECG sensors
- Developed, implemented, tested and validated the results of the algorithms
- Prepared written reports describing the algorithm and explaining preliminary results
- Provided support to developers integrating the method into production software

Research & Development Engineer, BBC Research and Development

2002 – 2005

- Provided engineering research and development expertise to internal customers, as well as working on “blue sky” research projects
 - video compression software optimisation for encoding video of BSL signing for Deaf viewers
 - image analysis for camera calibration and location in special effects studio
 - leading an investigation and field trip into technologies causing interference to short-wave radio
- Collaborated with industrial and academic partners across the EU
- Demonstrated and explained research to non-technical audiences at departmental Open Days

Professional Qualifications

Associate of the Higher Education Academy

2008

Higher education teaching qualification for early career academics

Member of the Institution of Engineering and Technology (formerly IEE)

2002

Awards

British Science Association “Perspectives” Finalist **2009**

- Selected to present a poster at the 2009 British Science Festival
- One of five runners-up out of a field of 36 finalists, winning a £200 prize
- Presenting research to members of the public, requiring excellent communication and presentation skills

Institution of Engineering and Technology William James Award **2008**

- Awarded £200 on the basis of a piece of written work
- Recognising outstanding research in the field of biomedical engineering

Royal Academy of Engineering Research Student Development Fellowship **2008**

- Awarded £5000 for personal development activities based on budget and personal development plan
- Attended both engineering and medical conferences
- Obtained computing qualifications and purchased home study materials for further development
- Attended IET course to assist with progress towards CEng professional registration
- Covered expenses for shadowing clinical colleagues to gain greater insights into their needs

Teaching Experience

Supervision of students, University of Oxford **2008 – present**

- Dissertation supervisor for MSc student in Evidence-based Health care (2012-present)
- Supervision of second-year undergraduate medical students (Summer 2011 & 2013)
- Assisting with supervision of engineering DPhil student (2008-2011)
- Development and specification of suitable projects
- Providing assistance and training in relevant technical skills
- Monitoring progress and ensuring that deadlines are met
- Proof-reading written work
- Suggesting opportunities for publication and attendance at conferences

Undergraduate teaching, University of Oxford **2007 – present**

- Teaching and assessing practical electronics and computing for first year engineering undergraduates
- Providing tutorials on evidence-based medicine to clinical medical students
- Assisting students with specific learning needs (e.g. dyslexia, dyspraxia)

First Aid Trainer, St John Ambulance **2004 – present**

- Providing first aid training to new and existing members
- Planning and delivering weekly “class nights” for up to 20 divisional members of varying experience to ensure that all members were challenged but not overwhelmed
- Delivering and assessing structured training courses at levels from Trainee First Aider to Advanced First Aider

Other Relevant Experience

Committee member, IET Healthcare Technologies Network **2011 – 2013**

- Suggesting areas of interest for network priorities
- Planning activities for network members

Board Member, NHS Connecting for Health **2003 – 2011**

- Member of a number of high-level strategic boards, including the Care Record Development Board, HealthSpace Programme Board, and HealthSpace Strategic Board
- Collaborating with clinicians, social care providers, allied health professionals, ethicists, patient advocates, policy advisors and technical specialists
- Assisting with the preparation of a business case with an estimated cost in excess of £10 million
- Working as part of a team to provide governance and ethical guidance for the NHS electronic care record project
- Acting as an advocate for the needs of patients and carers in the decision-making process

EPSRC Centres for Doctoral Training Press Conference **December 2008**

- Invited to address an EPSRC press conference launching funding for a new group of PhD courses
- Presented an overview of my research and my experiences as a student on one of the pilot courses
- Interviewed for the Times newspaper and live on BBC national radio following the press conference

Volunteer First Aider **2001 – present**

- Providing medical cover at events with St John Ambulance and Oxford University First Aid Unit
- Carrying out patient treatment and arranging for transfer to appropriate further care
- Responsible for supervising junior first aiders and overseeing the first aid provision at events
- Providing first aid training to other members

Transferable Skills

Computing

- Extensive programming experience, including user and hardware interfaces; image and signal processing; and data manipulation
- Competent in a variety of languages including C, C++, C#, Java, Matlab, and Perl
- Confident with administration of common operating systems, including Windows and Linux

Public Speaking

- Guest speaker for Oxford University Springboard personal and professional development courses
 - 30-minute talks to groups of 30 women from across the university about my career and achievements
- Regularly give short fund-raising talks for a local children's charity
 - audiences of up to 100 people of all ages and backgrounds
 - 10-minute talks giving insight into the work of the charity and what a small donation could buy
- Invited speaker at Association of Children's Hospices Palliative Care Forum
 - interactive talk on the experience of being the sibling of a severely disabled child
 - successfully challenging the attitudes of a large audience of health care professionals
 - received very positive feedback and provided the text to be used as an on-line resource

Publications

Journal Papers:

- S. Fleming, P. Gill, C. Jones, J.A. Taylor, A. Van den Bruel, C. Heneghan, M. Thompson. *Validity and reliability of measurement of capillary refill time in children: a systematic review*. Archives of Disease in Childhood (under review)
- H.F. Ashdown, S. Fleming, E.A. Spencer, M.J. Thompson, R.J. Stevens. *Diagnostic accuracy study of three alcohol breathalysers marketed for sale to the public*. BMJ Open (in press)
- D. Nunan, S. Fleming, B. Hametner, S. Wassertheurer. *Performance of pulse wave velocity measured from a brachial cuff in a community setting*. Blood Pressure Monitoring 2014 (epub ahead of print)
- J. Howick, C. Friedemann, M. Tsakok, R. Watson, T. Tsakok, J. Thomas, R. Perera, S. Fleming, C. Heneghan. *Are treatments more effective than placebos? A systematic review and meta-analysis*. PLoS ONE 8(5):e62599, 2013
- S. Wilson, D. Wong, D.A. Clifton, S. Fleming, R. Way, R. Pullinger, and L. Tarassenko. *Track and Trigger in an Emergency Department: an observational evaluation study*. Emergency Medicine Journal 30:186-191, 2013
- C. Orphanidou, S. Fleming, S.A. Shah and L. Tarassenko. *Data fusion for estimating respiratory rate from a single-channel ECG*. Biomedical Signal Processing & Control 8(1):98-105, January 2013
- D. Nunan, S. Wassertheurer, D. Lasserson, B. Hametner, S. Fleming, A. Ward, C Heneghan. *Assessment of central haemodynamics and arterial stiffness from a brachial cuff – a community based feasibility study*. BMC Cardiovascular Disorders 12(1):48, 26 Jun 2012
- S. Fleming, M. Thompson, R. Stevens, C. Heneghan, A. Plüddemann, I. Maconochie, L. Tarassenko and D. Mant. *Normal ranges of heart rate and respiratory rate in children from birth to 18 years: a systematic review of observational studies*. The Lancet 377(9770), pp1011–1018, 19 March 2011

Conference Papers (Oral presentations):

- R. Stevens, H. Ashdown, S. Fleming, E. Spencer, M.J. Thompson. *Assessing accuracy of personal breathalysers and self-estimated alcohol consumption for driving decisions*. Society for Social Medicine Annual Scientific Meeting, September 2014
- D. Wright, S. Fleming. *The accuracy and reliability of over-the-counter blood pressure monitors*. SAPC Annual Scientific Meeting, July 2014
- S. Fleming, P. Gill, C. Jones, A. Van den Bruel, J. Taylor, C. Heneghan, M. Thompson. *Systematic review of the diagnostic accuracy of capillary refill time for serious illness in children*. . 2013 NAPCRG Annual Meeting, November 2013. (Selected as a NAPCRG PEARL for presentation at various clinical seminars)
- H. Ashdown, S. Fleming, E. Spencer, M. Thompson, R. Stevens. *Assessing accuracy of personal breathalysers and self-estimated alcohol consumption for driving decisions*. 2013 NAPCRG Annual Meeting, November 2013
- S.A. Shah, S. Fleming, M. Thompson, L. Tarassenko. *Respiratory rate estimation during initial assessment of children in hospitals*. MEDSIP 2012. 5th International Conference on Medical Signal and Information Processing, July 2012
- S. Fleming, S.A. Shah, M. Thompson, L. Tarassenko. *Feasibility of Bluetooth pulse oximetry in paediatric emergency department triage*. SWSAPC Annual Research Meeting, March 2012
- A. Ware, R. Stevens, and S. Fleming. *An investigation into the accuracy and reliability of over-the-counter blood pressure monitors*. SWSAPC Annual Research Meeting, March 2012
- D.A. Clifton, D. Wong, S. Fleming, S. Wilson, R. Way, R. Pullinger, and L. Tarassenko. *Novelty Detection for Identifying Deterioration in Emergency Department Patients*. IEEE SMC 12th International Conference on Intelligent Data Engineering and Automated Learning, September 2011. In Yin, H., Wang, W., and Rayward-Smith, V. (eds): Lecture Notes in Computer Science 6936 Springer-Verlag, Heidelberg, 2011, pp. 220-227.
- S. Fleming, M. Thompson, and L. Tarassenko. *How sick is this child? Predicting severity of illness in primary care using three vital signs*. SAPC 2011. 40th Annual Scientific Meeting of the Society for Academic Primary Care, July 2011 (Early career researcher prize)

- S. Fleming, M. Thompson, and L. Tarassenko. *Measuring respiratory rate using a pulse oximeter in children attending primary care*. SWSAPC Annual Research Meeting, March 2011.
- R. Pullinger, S. Wilson, R. Way, D.A Clifton, D. Wong, S. Fleming and L. Tarassenko. *Identifying Patient Deterioration in the Emergency Department using Data Fusion Systems*. Fourth Annual Conference of the Oxford School of Emergency Medicine, December 2010.
- S. Fleming, M. Thompson, R. Stevens, C. Heneghan, A. Plüddemann, I. Maconochie, L. Tarassenko. *Normal Ranges of Heart Rate And Respiratory Rate In Children From Birth to 18 Years: A Systematic Review of Observational Studies*. 38th NAPCRG Annual Conference, November 2010; PD33
- S. Fleming, R. Stevens, C. Heneghan, M. Thompson. *What heart rate is normal in children of different ages? New cut-offs obtained by systematic review and meta-analysis*. 39th Annual Scientific Meeting of the SAPC, July 2010
- R. Pullinger, S. Wilson, R. Way, D.A. Clifton, D. Wong, S. Fleming, L. Tarassenko and J. Birk. *Assessing the Implementation of Track-and-Trigger Systems in the Emergency Department*. 3rd Conference of the Oxford School of Emergency Medicine, December, 2009.
- R. Pullinger, S. Wilson, R. Way, D.A. Clifton, D. Wong, S. Fleming, L. Tarassenko and J. Birk. *Detecting Patient Deterioration in the Emergency Department using Integrated Vital-Sign Monitoring*. 3rd Conference of the Oxford School of Emergency Medicine, December, 2009.
- S. Fleming, L. Tarassenko, M. Thompson and D. Mant. *Data fusion for identification of serious illness in children*. CM2009. The Sixth International Conference on Condition Monitoring and Machinery Failure Prevention Technologies, June 2009; 138.
- S. Fleming, L. Tarassenko, M. Thompson and D. Mant. *Non-invasive Measurement of Respiratory Rate in Children Using the Photoplethysmogram*. EMBS 2008. 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, August 2008; 1886-1889.
- S.G. Fleming and L. Tarassenko. *A Comparison of Signal Processing Techniques for the Extraction of Breathing Rate from the Photoplethysmogram*. Proceedings of World Academy of Science Engineering and Technology, October 2007; 24:276-280. Also republished in International Journal of Biomedical Sciences, 2007; 2(4):232-236.
- Conference Papers (Poster presentations):**
- S. Fleming, R.J. Stevens, E. Spencer, M.J. Thompson, H.F. Ashdown. *Accuracy of personal alcohol breathalysers with and without regulatory approval claims*. Methods for Evaluating Medical Tests & Biomarkers Symposium, July 2013
- S. Fleming, P. Gill, C. Jones, A. van den Bruel, J. Taylor, C. Heneghan, M. Thompson. *Systematic review of the diagnostic accuracy of capillary refill time for serious illness in children*. Pediatric Academic Societies' Annual Meeting, May 2013
- S. Fleming, P. Gill, C. Jones, A. van den Bruel, J. Taylor, C. Heneghan, M. Thompson. *Systematic review of the diagnostic accuracy of capillary refill time for serious illness in children*. Evidence Live, March 2013
- H.F. Ashdown, S. Fleming, E.A. Spencer, M.J. Thompson, R.J. Stevens. *Assessing the accuracy of personal breathalysers*. SWSAPC Annual Research Meeting, March 2013
- H. Ashdown, S. Fleming, E. Spencer, R. Stevens, M. Thompson. *Assessing the accuracy of over-the-counter breathalysers*. National Primary Care ACF Conference, January 2013.
- S. Fleming, M. Thompson, and M. Lakhapaul. *Improving measurement of vital signs in primary and emergency care*. NIHR School for Primary Care Research Showcase, October 2012.
- S. Fleming, M. Thompson, and M. Lakhapaul. *Validation of evidence-based heart rate and respiratory rate centiles*. SWSAPC Annual Research Meeting, March 2012, and RCPCH Annual Conference, May 2012. Archives of Disease in Childhood 97(Suppl 1):A146, 2012
- S. Fleming, M. Thompson, and L. Tarassenko. *How sick is this child? Predicting serious infections using four vital signs*. Meningitis Research Foundation Conference: Meningitis and septicaemia in children and adults, November 2011; C26
- D. Nunan, S. Wassertheurer, D. Lasserson, B. Hametner, S. Fleming, A. Ward, and C. Heneghan. *Assessment of*

central haemodynamics and arterial stiffness in the community – are we there yet? ARTERY 2011, October 2011; P7.16

- D.A. Clifton, D. Wong, S. Fleming, R. Way, S. Wilson, R. Pullinger, and L. Tarassenko. *Identifying Patient Deterioration in the Emergency Department using Data Fusion Systems*. British Medical Journal International Conference of Quality and Safety in Healthcare, April 2011
- Y. Borhani, S. Fleming, D.A. Clifton, S. Sutherland, L. Hills, D. Meredith, C. Pugh, L. Tarassenko. *Towards a data fusion model for predicting deterioration in dialysis patients*. Computing in Cardiology, September 2010; PB3
- L. Hills, S. Sutherland, D. Meredith, Y. Borhani, D. Clifton, S. Fleming, A. Mosson, A. Thornley, L. Tarassenko and C. Pugh. *Integrated Vital Sign Monitoring of Haemodialysis Patients*. 39th EDTNA/ERCA International Conference, September 2010; P 043 (Best Paper Award)
- R. Stevens, S. Fleming, M. Thompson, R. Perera, C. Heneghan. *Meta-analysis of the continuous relationship between age and a diagnostic sign: heart rate*. Methods for Evaluating Medical Tests and Biomarkers symposium, July 2010.
- D. Meredith, Y. Borhani, S. Sutherland, L. Hills, S. Fleming, D. Clifton, A. Thornley, A. Mosson, L. Tarassenko and C. Pugh. *Monitoring of vital signs during haemodialysis sessions*. British Renal Society / Renal Association Conference, May 2010; P355
- S.A. Shah, S. Fleming, C. Orphanidou and L. Tarassenko. *Continuous measurement of respiration rate using the photoplethysmogram and the electrocardiogram*. The 5th UK & RI Postgraduate Conference in Biomedical Engineering and Medical Physics, July 2009; 11-12.

Doctoral Thesis

S. Fleming. *Measurement and fusion of non-invasive vital signs for routine triage of acute paediatric illness*. DPhil Thesis, Department of Engineering Science, University of Oxford. Trinity term, 2010.

Patents:

METHOD AND APPARATUS FOR MEASURING BREATHING RATE, L. Tarassenko and S. Fleming. (pending)

METHOD AND APPARATUS FOR MEASURING BREATHING RATE, L. Tarassenko and S. Fleming. International Patent Application No. PCT/GB2008/002043. Filed 13 June 2008

Other publications:

S. Fleming, A. Plüddemann, J. Wolstenholme, C.P. Price, C. Heneghan and M. Thompson. *Automated lung sound analysis for asthma*. MaDOx Horizon Scan 0016. July 2011.

S. Fleming, J.H. Stott and J.E. Salter. *The effects of power-line telecommunications on broadcast reception: second trial in Crieff*. BBC R&D White Paper WHP116. June 2005.

Grants and Funding:

RCGP Scientific Foundation Board SSFB 2013-27: *Assessment of the accuracy of commercial pulse oximeters* (PI)

NIHR Programme Grant RP-PG-1209-10051: *Optimising the diagnosis and management of hypertension in primary care through self monitoring of blood pressure*.

Peer Reviewing:

Journal of Biological Signals (2010)

IEEE Transactions on Biomedical Engineering (2012)

Computers in Biology and Medicine (2013)

SAPC ASM (2014)