

BIOGRAPHICAL SKETCH

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NAME: Kath Bogie

eRA COMMONS USER NAME (credential, e.g., agency login):KBOGIE

POSITION TITLE: Senior Research Scientist/Adjunct Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	Completion Date MM/YYYY	FIELD OF STUDY
University of Manchester Institute of Science and Technology, Manchester, UK	B.Sc.(Hons.)	06/1984	Metals and Materials Technology
University of Oxford, Oxford, UK	D.Phil.	08/1998	Biomedical Engineering

A. Personal Statement

My primary research interests focus on translational research, particularly in the field of the prevention and treatment of wounds. In my research I lead multidisciplinary teams including biomedical engineers, electrical engineers, clinicians, biologists and statisticians to develop and evaluate novel approaches from biomarkers for pressure ulcer risk to pressure ulcer prevention using intermittent gluteal stimulation. I have experience in all aspects of study oversight, including complying with regulatory requirements for both human and animal studies, monitoring budgets, and adhering to stated goals and timelines. I mentor students with a variety of backgrounds including biomedical engineers and clinician researchers.

B. Positions and Honors**Professional Experience**

1984-1985	Research Assistant, North Staffordshire Bio-Medical Engineering Unit, Stoke-on-Trent, UK
1989-1994	Associate Clinical Scientist, Queen Mary and Westfield College, University of London, London, UK.
1989-1992	Research Bioengineer, National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, UK
1992-1994	Consultant Bioengineer, Tissue Viability Clinic, National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, UK
1997-2001	Research Associate, Case Western Reserve University, Cleveland, Ohio
2001-2009	Senior Research Associate, Dept of Orthopaedics, Case Western Reserve University, Cleveland, Ohio
2004-present	Senior Research Scientist, Cleveland Dept of Veterans Affairs Medical Center
2009-present	Adjunct Assistant Professor (Primary), Dept of Orthopaedics, Case Western Reserve University, Cleveland, Ohio
2009-present	Adjunct Assistant Professor (Secondary), Dept of Biomedical Engineering, Case Western Reserve University, Cleveland, Ohio
2010- 2013	Research co-Director, Advanced SCIM Fellowship Program, Cleveland Dept of Veterans Affairs Medical Center
2010 - 2014	Site Director, DETECT (Diagnostic Engineering Technologies for Evaluating Connective Tissues), Wright Center for Sensor Systems Engineering, Ohio Third Frontier Wright Projects Program
2013	Director, Health Monitoring and Maintenance Research, Advanced Platform Technology Center, Cleveland Veterans Affairs Medical Center, Cleveland, Ohio

- 2013 Director, Biocompatibility Testing Lab, Cleveland Dept. of Veterans Affairs Medical Center, Cleveland, Ohio
- 2013 Director, Additive Manufacturing for Biotechnology Core, Case Western Reserve University

Other Experience and Professional Memberships

Grant Reviews: National: National Science Foundation, VA Rehabilitation Research and Development Service, National Institutes of Health, Lytmos Group, American Institute of Biological Sciences, Deployment Related Medical Research Program, Congressionally Directed Medical Research Program, James and Esther King Biomedical Research Program, VA Joint BLR&D and CSR&D Services, Paralyzed Veterans of America Research Foundation **International:** British Lung Foundation, Singapore National Medical Research Council, Romanian National Council for Development & Innovation, Hong Kong Health and Medical Research Fund

Journal Reviewer: Archives of Physical Medicine and Rehabilitation, Journal of Rehabilitation Research and Development, Journal of Bone and Joint Surgery, Neuromodulation, Medical Science Monitor, Clinical Orthopaedics & Related Research, Annals of Biomedical Engineering, Muscle and Nerve, Physiological Measurement, Journal of Spinal Cord Medicine, Journal of NeuroEngineering and Rehabilitation, JBJS Reviews, J Biomolecular Technology, JBJS Reviews, International Wound Journal, Physiological Reports.

Editorial Board: Journal of Tissue Viability, JSM Biotechnology & Biomedical Engineering, Journal of Rehabilitation Research and Development, PLOS One Rehab Channels

Conferences & meetings: Organizing Faculty, 6th Annual Conference of the International FES Society; Faculty, Workshop on “Scientific Basis of Neurorehabilitation for Spinal Cord Injury and Stroke, American Society of Neurorehabilitation; Course Director & Scientific Chair, 1st & 2nd International Evidence-based Practice in Wound Care Chair, Expert panel for development of PU implementation research agenda, VA HSR&D Quality Enhancement Research Initiative

Consultant: Sunrise Medical Ltd.(UK), Cleveland Medical Devices, Hill-Rom Medical, Guidepoint Global (Clinical Advisors) LLC, Neocure Group LLC, Avery Medical

Other: Judge, Internet Science and Technology Fair, Member, Wound Healing Society Education Committee, Faculty Member, Dept of Genetics Imaging Advisory Committee, CWRU, Subject Matter Expert, Rehabilitation Research(DEU), Dept of Veterans’ Affairs, Advisor, Neurotechnology for Brain Injury Fact Sheet, Contributor, Wound Healing Society White paper on Wound Care Certification, Subject matter expert reviewer Pressure Ulcer Prevention and Treatment Following Injury: A Clinical Practice Guideline, Consortium for Spinal Cord Medicine.

Honors

- 2004 Featured in PVA/SCRF annual report
- 2006 Who's Who in Medicine and Healthcare, 2006-2007 Edition.
- 2007 Featured in Case Western Reserve University 2006-7 Edition of *The Value of Research*
- 2007 Invited attendee, National Academies Keck Futures Initiative “The Future of Human Healthspan”
- 2009 Featured in lead article of US Medicine “*Pressure and Time: The Two Combined Can Equal Pressure Ulcers*”
- 2009 Invited keynote speaker. Hong Kong Association of Rehabilitation Medicine Annual Scientific Meeting, “*Pressure Ulcer Management: Before and After Tissue Breakdown*”
- 2010 Who's Who in America, 2010-2011 Edition.
- 2011 Invited speaker, Synergy Seminar, Austen BioInnovation Institute in Akron, Akron, Ohio *Challenges posed by chronic wounds*
- 2011 Invited speaker, 14th Annual Meeting of the European Pressure Ulcer Advisory Panel, Porto, Portugal, *The role of neuromuscular electrical stimulation in pressure ulcer prevention*
- 2014 Invited speaker, Shear and Tissue Integrity - the state of the science. ISO Standards group, London, UK. *Practical challenges in clinical assessment of soft tissue shear: where we are now and future potentials.*

C. Contributions to Science

1) **Chronic wound therapeutic interventions:** My translational research in the area of wound therapy has included studies of the physiological effects of electrical stimulation (ES) on chronic wounds. In a preliminary pre-clinical study to evaluate the physiological effects of ES. We have developed and tested a novel patent-pending Modular Adaptive Electrotherapy Delivery System (MAEDS). This technology provides all components of a single-channel, programmable current-controlled ES system within a lightweight, flexible, independently-powered portable device. We conducted a systematic and quantitative study of the efficacy of various

stimulation paradigms in a small animal model. We found that clinically appropriate ES can more than double the proportion of ischemic wounds closed by 3 weeks. However, lower currents actually inhibited ischemic wound healing, setting a lower bound on the effective therapeutic window.

- a. Ruedrich ED, Henzel MK, Hausman BS, **Bogie KM**. Reference gene identification for reverse transcription-quantitative polymerase chain reaction analysis in an ischemic wound healing model. *J Biomol Tech*. 2013 Dec;24(4):181-6. doi: 10.7171/jbt.13-2404-003
- b. **Bogie KM**, Garverick SL, Zorman CA, Howe DS, Integrated surface stimulation device for pain management and wound therapy. Patent WO 2013116013 A1/PCT/US2013/022139
- c. Graebert J, Henzel MK; Honda KS, **Bogie KM**. Systemic evaluation of electrical stimulation for ischemic wound therapy in a pre-clinical in-vivo model *Advances in Wound Care – Discovery Express* 2014, 3(6): 428-437
- d. Howe DS, Dunning J, Zorman C, Garverick SL, **Bogie KM**. Development of an integrated surface stimulation device for systematic evaluation of wound electrotherapy. *Ann Biomed Eng*. 2015 Feb;43(2):306-13. doi: 10.1007/s10439-014-1134-1. Epub 2014 Oct 2. PubMed PMID: 25274162.

2) Pressure ulcer prevention-tissue health assessment: The primary prevention of chronic wounds, such pressure ulcers, in at-risk populations is a challenging issue, due in no small part to the multiple factors that play into both the specific condition and the overall clinical profile of individuals at risk. Early in my career I developed a tissue viability clinic for the assessment of individuals with spinal cord injury. For both the newly injured and those returning for treatment of chronic non-healing pressure ulcers, it was clear that there was no straightforward answer to the problem of providing cost-effective pressure ulcer prevention. I developed a multivariate tissue health assessment tool that facilitated quantitative non-invasive evaluation of tissue health. This tool has been used by others to gain insight in to factors such as effective pressure relief (Coggrave & Rose, 2003). We have also developed a tool to obtain more useful information from interface pressure mapping and carried out a clinical study which found that a 10-minute assessment can reliably indicate tissue health and that tissue may adapt to applied load over time. I have led preliminary studies to determine approaches to determination of personalized risk for PU development and other secondary complications. Our particular relevance to the current application, I led a retrospective chart review study to develop the SCI Pressure Ulcer Database (SCIPUD), which includes multiple relevant intrinsic and extrinsic factors that may be associated with pressure ulcers prevention and healing in SCI. In preliminary analysis, we have observed that factors previously found to be predictive of initial pressure ulcer development may not, in fact, be predictive of repeated hospital admissions for ongoing pressure ulcer care.

- a. **Bogie K**, Wang X, Fei B, Sun J. New technique for real-time interface pressure analysis: Getting more out of large image data sets. *J Rehabil Res Dev*. 45(4) 2008
- b. Kim JH, Wang X, Ho CH, **Bogie KM**. Physiological measurements of tissue health; implications for clinical practice. *Int Wound J*. 2012 Jan 30. doi: 10.1111/j.1742-481X.2011.00935.x.
- c. Wu GA, **Bogie KM**. Not just quantity: gluteus maximus muscle characteristics in able-bodied and SCI individuals - implications for tissue viability. *J Tissue Viability*. 2013 Apr 21. doi:pii: S0965-206X(13)00029-6. 10.1016/j.jtv.2013.03.003. [Epub ahead of print]. PMID: 23615320
- d. Goodman BL, Schindler A, Washington M, **Bogie KM**, Ho CH. Factors in rehospitalisation for severe pressure ulcer care in spinal cord injury/disorders. *J Wound Care*. 2014 Apr; 23(4):165-6, 168, 170-2 passim. PMID: 24762380

3) Pressure ulcer prevention- dynamic intermittent gluteal stimulation (iGSTIM): I conducted innovative clinical feasibility studies using a percutaneous iGSTIM system. We showed that regular daily use dynamic iGSTIM has a positive impact on multiple indirect indicators of tissue health, including increased muscle thickness and blood flow together with reduced regional interface pressures. In addition to the long term changes in muscle characteristics, dynamic iGSTIM alters conditions at the seating support interface due to periodic changes in interface pressure facilitated by stimulated muscular contractions. We also examined the effects of sub-threshold 'sensory' stimulation and that it had no impact on quantitative measures of tissue health.

- a. **KM Bogie**, Triolo RJ. The effects of regular use of neuromuscular electrical stimulation on tissue health. *Journal of Rehabilitation Research and Development* 40(6): 469-475, 2003
- b. **Bogie KM**, Wang X, Triolo RJ. Long term prevention of pressure ulcers in high risk individuals: a single case study of the use of gluteal neuromuscular electrical stimulation. *Arch Phys Med Rehabil*, 87(4):585-91, 2006
- c. Kim J, Ho CH, Wang X, **Bogie K**. The use of sensory electrical stimulation for pressure ulcer prevention. *Physiother Theory Pract*. 2010 Nov;26(8):528-36. Epub 2010 Jul 22

- d. Wu GA, Lombardo L, Triolo RJ, **Bogie KM**. The effects of combined trunk and gluteal neuromuscular electrical stimulation on posture and tissue health in spinal cord injury. PM R. 2013 Mar 28. doi:pii: S1934-1482(13)00154-8. 10.1016/j.pmrj.2013.03.025. [Epub ahead of print] PMID: 23542776

4) **Multidisciplinary research in chronic wound management:** Throughout my career I have worked with multidisciplinary teams. I have written 8 chapters and 12 invited papers on the area, including both teaching and novel approaches. In conjunction with clinical colleagues, I developed an interdisciplinary meeting bringing together national and international experts to speak about their work and share ideas. As the Scientific Chair of the conference, in conjunction with this meeting I also obtained funding to convene a one-day 'think-tank' meeting of invited conference faculty and thought leaders to develop a consensus on the critical research gaps to be addressed to improve current evidence-based knowledge in pressure ulcer care and facilitate large scale implementation of advanced clinical practice. We developed a consensus paper that set priorities on four categories: risk factors, clinical management, education and environment of care. It was concluded that many critical multidisciplinary targets remain for primary PU research remain, which overlaps with my focus area on wound prevention.

- a. **Bogie KM**, Ho CH, Terris DD. Clinical evidence for new pressure ulcer treatment modalities. Long-Term Care Interface, 43-47, June 2005
- b. **Bogie K**, Ho CH. Multidisciplinary approaches to the pressure ulcer problem. Ostomy Wound Management. 53(10): 26-32, 2007
- c. Ho CH, **Bogie K.**, Integrating Wound Care Research into Clinical Practice Ostomy Wound Management. 53(10): 18-25, 2007
- d. Henzel MK, **Bogie KM**, Guihan M, Ho CH. Pressure ulcer management and research priorities for patients with spinal cord injury: Consensus opinion from SCI QUERI Expert Panel on Pressure Ulcer Research Implementation. J Rehabil Res Dev. 2011; 48(3):xi-xxxii.

5) **Wound measurement:** Throughout my research it has become clear that effective management of chronic wounds requires reliable quantitative measures of healing. Reliable wound measurement is a critical component of any comprehensive wound assessment protocol in both research and clinical care. In a pilot study to assess the accuracy of surface area measurement techniques we found that electronic devices are superior to manual techniques in achieving valid measurements of wound area. We then evaluated 3-D wound measurement as a reliable tool to provide quantitative assessment of changes in wound dimensions during healing. We found that a reliable measurement of wound status that can be obtained using this system by nursing personnel without having to depend on the limited resources of the specialist wound care nurse. Thus, the system could be implemented with high measurement reliability in healthcare settings. We are now carrying out a quality improvement study to provide telehealth care for veterans with chronic wounds. We have also used this advanced wound imaging data to develop a model for personalized prediction of chronic wound healing. We found that accurate monitoring of wound geometry can adaptively predict healing progression and that accuracy of the prediction curve improves with each additional evaluation.

- a. Haghpanah S, **Bogie KM**, Banks PG, Wang X, Ho CH. Reliability of electronic vs. manual wound measurement methods. Arch Phys Med Rehabil. 87(10):1396-402, 2006.
- b. Davis AJ, Nishimura J, Seton J, Goodman BL, Ho CH, **Bogie KM**. Repeatability and clinical utility in stereophotogrammetric measurements of chronic wounds. J Wound Care. 2013 Feb;22(2):90-2, 94-7. PMID: 23665664
- c. Xu Y, Sun J, Carter RR, **Bogie KM**. Personalized prediction of chronic wound healing: An exponential mixed effects model using stereophotogrammetric measurement. J Tissue Viability. 2014 Apr 18. pii: S0965-206X(14)00028-X. doi: 10.1016/j.jtv.2014.04.001. [Epub ahead of print] PMID: 24810677

Complete List of Published Work in MyBibliography:

http://www.ncbi.nlm.nih.gov/sites/myncbi/collections/public/1Rok1sZA_i4t782Z5SHM4VF5d/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

Kaigler (PI) 09/15 – 12/17 National Institute of Dental & Craniofacial Research

Customized craniofacial stem cell therapy for craniofacial bone defects

The project will investigate the hypothesis that defect-specific 3-dimensional (3D) scaffolds seeded with alveolar bone-derived mesenchymal stem cells (aBMSCs) predictably regenerate craniofacial defects.

Bogie (PI) 09/15-09/18 DOD CDMRP SCIRP
Toward personalized pressure ulcer care planning: development of a bioinformatics system for individualized prioritization of clinical practice guidelines
 The study will develop and test a multivariate structural model of risk factors occur associated with primary and secondary PU/DTI to provide clinicians with a tool for developing personalized care plans.

McDaniel (PI) 05/15-04/17 Department of Veterans Affairs
Exercise to improve blood flow and vascular health in the lower limbs of SCI
 The project will explore the cardiovascular, lower limb blood flow and tissue perfusion responses to lower limb passive movement and upper body exercise in in those with SCI.

Bogie (PI) 01/15-12/16 Craig H. Neilsen Foundation
Development of a personalized pressure ulcer /deep tissue injury risk tool
 The project will use an applied research case-control study design to develop and test a new outcome tool for pressure ulcer and deep tissue injury risk assessment for individuals with long-standing SCI.

Bogie (PI) 09/14-09/17 DOD CDMRP SCIRP
Development of a personalized model for pressure ulcer prevention acutely following spinal cord injury: Biomarkers of muscle composition and resilience
 The study will identify individual PU risk characteristics acutely following spinal cord injury as a basis for development of a clinical tool to optimize personalized pressure relief.

Triolo (PI) 01/15 – 12/20 Department of Veterans Affairs
Advanced Platform Technology Center of Excellence Role: Investigator
 The APT Center ensures that the most recent developments in micro-electronics, nanotechnology, and material science are applied to clinically relevant problems in the rehabilitation of veterans.

Recently Completed Research Support

Bogie (PI) 04/13 – 09/15 Department of Veterans Affairs
Development of a low-cost advanced modular pressure relief cushion
 This pilot study developed a wheelchair cushion using dynamically-responsive materials to create low cost customized seating, with a cushion to can be repaired rather than replaced, thus increasing durability.

Lavik (PI) 04/14-06/15 NIH New Innovators Program
Clinically Translatable Nanotechnology: Hemostasis and Neuroprotection Role: co-Investigator
 This Innovator project tested functionalized nanoparticles administered intravenously as a platform technology to manage hemostasis following trauma to the central nervous system.

Bogie (PI) 01/14- 09/15 Rural-SCI-D-Veterans-Telehealth-Outreach
Evidence based comparative evaluation of advanced wound imaging systems in clinical use
 This quality improvement study evaluated the use of 3D wound measurement systems in the clinic to facilitate improvements in systems of telehealth care for veterans with chronic wounds.

Wang (PI) 03/12-06/14 National Center for Research Resources
Device to mechanically interrogate tissue and skin across research environments Role: co-Investigator
 This project developed a low-cost, portable technology, the mechanical interrogation of tissue and skin device (MITS), to quickly and accurately quantify the mechanical properties of the tissue and skin.

Bogie (PI) 10/12-6/14 Department of Veterans Affairs VISN 10 Research Initiative Program
Heel ulcer prevention: Development of a multi-sensor tissue test device
 This pilot study will design and construct a heel testing device incorporating sensors for blood gas and blood flow measurement to assess the effects of controlled applied load.

Fening (PI) 2010 – 2014 Ohio 3rd Frontier WCSSE Phase 2 Program
Diagnostic Engineering Technologies for Evaluating Connective Tissues (DETECT) Role: Site PI
 DETECT focused on inventing, developing and commercializing advanced products to serve the societally important, large, and rapidly growing market for wound healing products, creating high-paying jobs in Ohio.

Brienza (PI) 10/07-06/13 National Institute on Disability and Rehabilitation Research
Effects of weight shifting on pressure ulcer risk status. Role: Task Leader
 This pilot study determined the effects of passive and dynamic weight shifting on pressure ulcer risk factors.

Triolo (PI) 01/10-12/12 Department of Veterans Affairs
A neuroprosthesis for seated posture and balance Role: Collaborator
 This project developed the specifications for initial clinical implementation of a new neuroprosthesis specifically designed to control seated position and balance.