## BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: O'Malley, Alistair James

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

POSITION TITLE: Professor of Biostatistics, Department of Biomedical Data Science and The Dartmouth Institute for Health Policy & Clinical Practice, Geisel School of Medicine at Dartmouth

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 *(if applicable)* | Completion Date MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| University of Canterbury, New Zealand | BSc (Hons) | 04/1994 | Statistics |
| Purdue University, West Lafayette, Indiana | MS | 08/1999 | Applied Statistics |
| University of Canterbury, New Zealand | PhD | 12/1999 | Statistics |
| Harvard Medical School, Boston, Massachusetts | Postdoctoral Fellow | 08/2001 | Biostatistics |

### A. Personal Statement

I am happy to join the investigative team for the BASIC trial as one of the multiple principle investigators (along Drs Brown and Loftus) with the particular responsibility of leading Aim 3 and as the senior statistician for the entire grant. In leading Aim 3 I will apply my expertise in healthcare cost, utilization and outcomes research to conduct robust statistical analyses of the net cost of the proposed interventions compared to status quo and to one another. This will entail careful measurement of the expenditure required for a hospital to introduce each intervention and of the savings from reduced overnight hospital stays due to the transmission of SSIs owing to an intervention(s). A challenging but important part of the analysis will be accounting for each source of uncertainty, including that in the measurement of the various costs and that in the estimated differences in pairwise differences in the net cost between interventions. I have over 19 years of experience as a faculty-level academic statistician working on a variety of methodological and applied problems in medicine. The recent focal points of my research encompass methodological and applied research including causal inference and comparative effectiveness research; methods for longitudinal, multilevel, and multivariate data; and social network analysis. I also work actively in several areas of medicine and health policy through collaborations with physicians, medical specialists, social scientists, and health services researchers. Recent application areas of focus include the study of peer effects of body-mass-index and obesity; mental health including depression and schizophrenia; and the measurement and reporting of quality in vascular surgery, cardiology and long-term care. My work is especially relevant to the proposed BASIC trial through my prior research in the areas of hierarchical modeling and causal inference of observational data, particularly the sub-component of this work that has involved modeling cost or expenditure outcomes. I have also previously worked with Dr. Brown on a randomized study evaluating the impact of a bundled intervention on the infection transmission rate (the AKI study). In addition to the relevance of my current and past research, I have also been principal investigator of multiple Federally-funded projects and have mentored several junior colleagues, post-doctoral fellows, and PhD students. This will all combine to help me to be an effective multi-PI, collaborator and mentor on this project.

1. **O'Malley AJ**, James P, MacKenzie TA, Byun J, Subramanian SV, Block JP. Modeling a Bivariate Residential-Workplace Neighborhood Effect when Estimating the Effect of Proximity to Fast-Food Establishments on Body Mass Index. Statistics in Medicine, 2019, 38(6), 1013-1035. doi: 10.1002/sim.8039

2. Martinez-Camblor P, MacKenzie TA, Staiger D, Goodney PP, **O'Malley AJ**. Adjusting for bias introduced by instrumental variable estimation in the Cox Proportional Hazards Model. Biostatistics, 2019, 20 (1), 80-96. PMID: 29267847
3. **O'Malley AJ**, Frank RG, Normand S-LT. Estimating Cost-Offsets of New Medications: Use of New Antipsychotics and Mental Health Costs for Schizophrenia. Statistics in Medicine 2011, 30, 1971-1988. PMID: 21520217
4. Hadley J, Reschovsky JD, **O'Malley AJ**, and Landon BE. Relative reimbursement rates and geographic variation in cost per episode of care for three medical conditions. Health Economics Review, 2014, 4:8, http://www.healtheconomicsreview.com/content/4/1/8. PMID: 24949281

**B. Positions and Honors**

**Positions and Employment**

| | |
|---|---|
| 1997-1999 | Teaching Assistant, Department of Statistics, Purdue University, West Lafayette, IN |
| 1999-2000 | Statistician, Cardiovascular Data Analysis Center, Beth Israel Deaconess Medical Center, Boston, MA |
| 2000-2001 | Statistician, Division of Clinical Biometrics, Brigham and Women's Hospital, Boston, MA |
| 2001-2006 | Assistant Professor of Statistics, Department of Health Care Policy, Harvard Medical School, Boston, MA |
| 2006-2013 | Associate Professor of Statistics, Department of Health Care Policy, Harvard Medical School, Boston, MA |
| 2013- | Professor, The Dartmouth Institute for Health Policy & Clinical Practice, Geisel School of Medicine at Dartmouth, Lebanon, NH |
| 2013- | Professor, Institute of Quantitative Biomedical Science, Geisel School of Medicine, Hanover, NH |
| 2014- | Member, Cancer Control Research Program, Norris Cotton Cancer Center, Geisel School of Medicine, Dartmouth-Hitchcock Medical Center, Lebanon, NH |
| 2014- | Professor of Biomedical Data Science, Geisel School of Medicine, Lebanon, NH |

**Other Experience and Professional Memberships**

| | |
|---|---|
| 1993-2003 | Statistician, New Zealand Government, Department of Corrections |
| 1997 | Statistical Consultant, Health Benefits New Zealand, Corporate Services |
| 2001-2011 | Statistician, Harvard Clinical Research Institute |
| 2003-2006 | Assistant Editor, Health Policy Statistics Section, American Statistical Association |
| 2006-2008 | Member, International Biometric Society Eastern North American Region (ENAR) - Scientific Planning Committee |
| 2007-2009 | Chair-elect, Chair, past-Chair, Health Policy Statistics Section, American Statistical Association |
| 2009-2015 | Member, Methods Council, AcademyHealth |
| 2009- | Associate Editor, Statistics in Medicine |
| 2010- 2014 | Associate Editor, Health Services and Outcomes Research Methodology |
| 2011 | Co-chair, International Conference on Health Policy Statistics |
| 2011-2013 | Faculty Advisor, Harvard Clinical Research Institute |
| 2011-2014 | Faculty Advisor, Eastern Caribbean Health Outcomes, Research Network Grant, Yale University |
| 2012 | Elected Fellow, American Statistical Association |

**Honors**

| | |
|---|---|
| 2011 | Mid-career Excellence Award, American Statistical Association Health Policy Statistics Section |
| 2012 | Elected Fellow, American Statistical Association |
| 2019 | ISPOR (International Society of Pharmacoeconomics and Outcomes Research) Health Economics and Outcomes Research Excellence in Methodology Award |

**C. Contribution to Science**

1) Multivariate Mixed Outcomes and Analysis of Cost Data. I have developed methods for the analysis of medical expenditure expenditure and cost data emanating from clinical trials and observational settings. In collaboration with Dr. Brian Neelon, I wrote two-part tutorial on the analysis of data with two-part distributions (zero-modified counts and mixed semi-continuous). As reflected in multiple publications with Dr. Neelon and others involving cost data, the outcome distribution often has two-parts: an abundance of 0 observations

reflecting no utilization and a close to continuous distribution over positive values. Important insights can be drawn from accounting for the fact that each component of the outcome (e.g., the likelihood of any cost at all, the magnitude of the cost conditional on non-zero cost) may have different relationships to the predictors, including key predictors such as those reflecting the intervention settings in a randomized trial.

My work on the analysis of cost or other types of data that are analyzed using two-part models stems from 1999, when I began developing methods for the analysis and design of medical device clinical trials with particular focus on coronary-artery stents. As with cost data, the important outcomes are binary (e.g., clinical events) and interval or continuous (e.g., angiographic measurements). The trial designs used Bayesian multivariate hierarchical models and incorporated historical control data, which allowed greater efficient than existing designs because information could be shared between correlated endpoints within a trial and borrowed across trials while adjusting for observed confounding variables and accounting for between-trial variation. The importance and novelty of the work is described in the editorial of the issue of Statistics in Medicine in which it was published: “We believe that this is a major paper for the approval process dealing with equivalency and non-inferiority of new devices. The issues and methods employed are very instructive for our thinking in the drug and biological field.” As a result of his work I received invitations to speak to the Advanced Medical Technology Association (AdvaMed), the FDA, the Medical Technology Learning Institute, and at several other venues.

Together with relevance to rudimentary methods for modeling cost data, more advanced statistical models for analyzing costs have often resported to the use of Bayesian methods. The use of Bayesian modeling is an often for the estimation of models and other analyses involving cost data in the BASIC study.

a. Neelon BH, **O’Malley AJ***, Normand S-LT. A Bayesian two-part latent class model for longitudinal medical expenditure data: Assessing the impact of mental health and substance abuse parity. Biometrics 2011, 67, 280-289. PMID: 20528856. Presented in special Biometrics showcase section at 2012 Joint Statistical Meetings. (*=primary mentor).
b. Grabowski DC, **O’Malley AJ**, Barhydt, NR. The Costs and Potential Savings Associated with Nursing Home Hospitalizations. Health Affairs 2007, 26, 1753-1761. PMID: 17978395
c. Neelon B, **O’Malley AJ**, Smith VA. Modeling Zero-Modified Count and Semicontinuous Data in Health Services Research, Part 1: Background and Overview. Statistics in Medicine, 2016, 35 (27), 5070-5093. doi: 10.1002/sim.7050. PMID: 27500945
d. Neelon B, **O’Malley AJ**, Smith VA. Modeling Zero-Modified Count and Semicontinuous Data in Health Services Research, Part 2: Case Studies. Statistics in Medicine, 2016, 35 (27), 5094-5112. doi: 10.1002/sim.7063. PMID: 27500973

2) Analysis of Multilevel Covariance Structures. I have made several contributions to profiling quality of health plans, hospitals, or physician groups using survey data. His primary methodological contribution centered on multilevel (hierarchical) covariance structure analysis for survey data to estimate the dimension of quality in a health care system and the optimal way of measuring each dimension of quality. An important first paper developed Fay-Herriott methods for estimating multivariate generalized variance functions (GVFs) of the relationship between the sample variance/covariance estimates and the sample means and response rates. The multivariate GVFs account for the joint response patterns across the survey items, stabilize variance estimates, and allow sampling variances to be imputed from estimates of means as opposed to being re-estimated, a substantial computational reduction. This was followed by development of a Bayesian multivariate hierarchical model for estimating the relationship between items at the domain (e.g., health plan, hospital) level, distinct from the survey-respondent level. Published in JASA and nominated for the 2009 Mitchell prize for Bayesian analysis, includes novel contributions on the use of truncated multivariate distributions for random effects, Bayesian exploratory factor analysis, and data-augmentation MCMC procedures. The Bayesian approach allows inferences about the factor structure (e.g., the number of factors, the assignment of items to factors) to be obtained from an exploratory factor analysis, believed to be the first approach of its kind.

The methods have been used to enhance the Hospital Consumer Assessments of Health Providers and Systems (CAHPS) survey, a national survey for reporting the quality of care and services at every hospital in the United States. In addition to helping to streamline the survey, the methods yielded the key finding that the correlations of a quality measure across services (medical, surgical and obstetric) are smaller than correlations between composite items within a service, implying that differences between services are at least as important to recognize as differences between items. Consequently, HCAHPS reports are stratified by service. A reflection of the respect his work has received is that I was invited to write a chapter on latent factor and latent

class models for the Encyclopedia of Health Economics. Latent class and latend variable methods have also proved useful in the analysis of expenditure and cost data, particularly when multiple cost variables are measured including when each outcome includes both discrete and continuous parts. This would prove applicable to the current proposal if it makes sense to model component costs as a multivariate vector as opposed to first forming an overall or net cost variable.

a. **O'Malley AJ**, Zaslavsky AM. Variance-Covariance Functions for Domain Means of Ordinal Survey Items. Survey Methodology. 2005; 31:169-182.
b. **O'Malley AJ**, Zaslavsky AM, Hays RD, Hepner KA, Keller S, Cleary PD. Exploratory factor analyses of the CAHPS Hospital Pilot Survey responses across and within medical, surgical, and obstetric services. Health Serv Res. 2005 Dec;40(6 Pt 2):2078-95. PMID: 16316439; PMCID: PMC1361242.
c. **O'Malley AJ**, Zaslavsky AM. Domain-Level Covariance Analysis for Multi-Level Survey Data with Structured Nonresponse. Journal of the American Statistical Association. 2008; 103:1405-1418.
d. **O'Malley AJ**, Zaslavsky AM. Optimal small-area estimation and design when nonrespondents are subsampled for followup. Journal of Survey Statistics and Methodology, 2016, 4 (1): 2-21. http://jssam.oxfordjournals.org/

3) Comparative Effectiveness Research including Cost Data Applications. I have made important contributions to causal inference through several problems motivated by issues in mental health, including the evaluation of costs (e.g., instrumental variable methods for analyzing mental health costs) and net costs (e.g.., offsets analyses in mental health costs). My initial work in this area was motivated by psychiatric clinical trials where patients often fail to fully comply with treatment protocol (e.g., they switch treatment) and patient dropout is nontrivial. Recognizing that intention-to-treat (ITT) analyses are prone to bias when the non-compliance and dropout mechanisms are correlated, I developed new (semi-parametric) likelihood-based estimators that conditional on latent classes representing compliance status. This approach was more efficient than the moment-based estimators available at the time but was surprisingly robust to the distribution of the data. One paper in Biometrics has been frequently cited and I have presented his work at several local and international meetings. I also helped extend the method to binary outcomes and covariate adjustment models. In the domain of observational data, I developed simultaneous equations models for instrumental variables (IV) analysis in complex situations, including nonlinear models for clustered-binary data, and evaluated alternative IV estimators. I have been principal investigator of an R01 grant from the NIH on comparative effectiveness research and a P01 project lead on the use of genetic alleles as IVs in social influence analyses. I wrote an invited commentary on a feature paper solicited by Health Services Research on causality and an invited paper on longitudinal IV methods that I presented at the Workshop on Causal Inference at Columbia University in June 2011. A number of applications of these causal inference methods have involved cost outcomes (e.g., papers b and d in the list below).

a. **O'Malley AJ**, Normand SL. Likelihood methods for treatment noncompliance and subsequent nonresponse in randomized trials. Biometrics. 2005 Jun;61(2):325-34. PMID: 16011678.
b. **O'Malley AJ**, Frank RG, Normand SL. Estimating cost-offsets of new medications: use of new antipsychotics and mental health costs for schizophrenia. Stat Med. 2011 Jul 20;30(16):1971-88. PMID: 21520217; PMCID: PMC3601436.
c. **O'Malley AJ**, Elwert F, Rosenquist JN, Zaslavsky AM, Christakis NA. Estimating peer effects in longitudinal dyadic data using instrumental variables. Biometrics. 2014 Sep;70(3):506-15. PMID: 24779654; PMCID: PMC4213357.
d. **O'Malley AJ**. Instrumental Variable Specifications and Assumptions for Longitudinal Analysis of Mental Health Cost Offsets. Health Services and Outcomes Research Methodology, 2012, 12, 254-272. PMID: 23226968

4) Social Network Analysis. My newest major research area is statistical methods for longitudinal analysis of social networks (data structures in which each observation may be correlated with each other observation). I have focused on modeling tie-dissolution and tie-formation of mutable ties such as friendships (social selection), and causal methods for estimating the influence of individuals' behaviors on one another (social influence). In my work on social selection I have developed novel dyadic models involving latent variables and lagged covariates that account for higher-level (inter-dyadic) dependencies in the network. My continuing work on social influence includes the development of IV methods in the challenging setting where the stable unit

treatment value assumption is violated. Interest in my work in social network analysis with application to medicine and health care is evident through several invitations I have received to write feature papers. My paper on social network analysis for health services researchers is unique in that it describes both social influence and social selection, and also draws important connections between network analysis and spatial analysis. A feature paper Statistics in Medicine and a book chapter was commissioned by the Encyclopedia on Health Services Research. I have also given several invited talks at conferences and at other universities on social network analysis. My work on social network analysis has included the analysis of cost outcomes (e.g., paper with Barnett). Most recently, I've had an integral role in research involving bipartite networks with the objective of determining the relationship between physician networks and the cost and quality of health care (papers c and d in the list below).

a. **O'Malley AJ**. The analysis of social network data: an exciting frontier for statisticians. Stat Med. 2013 Feb 20;32(4):539-55. PubMed PMID: 23023735; PMCID: PMC3553267.
b. Barnett ML, Christakis NA, **O'Malley AJ**, Onnela J-P, Keating NL, Landon BE. Physician Patient-Sharing Networks and the Cost and Intensity of Care in US Hospitals. Medical Care 2012, 50, 152-60. PMID: 22249922
c. Moen EL, Bynum JPW, Skinner JS, **O'Malley AJ**. Physician network position and patient outcomes following implantable cardioverter defibrillator therapy. Health Services Research, 2019, 54 (4), 880-889. PMID: 30937894
d. **O'Malley AJ**, Moen EL, Bynum JPW, Austin AM, Skinner JS. Modeling Peer Effect Modification by Network Position: The Diffusion of Implantable Cardioverter Defibrillators in the US Hospital Network. Statistics in Medicine, 2020, 39(8), 1125-1144. PMID: 31925971

**Mostly Complete List of Published Work in My Bibliography:**
http://www.ncbi.nlm.nih.gov/sites/myncbi/alistair.o'malley.1/bibliography/48398943/public/?sort=date&direction=ascending

**D. Research Support**

**Ongoing Research Support (Selected)**

P01 AG019783 Skinner (PI) 05/01/2018-02/28/2023
NIH/NIA
Causes and Consequences of Healthcare Efficiency
The major goal of this project is to improve understanding of the causes and consequences of regional variations in health care intensity, which could have important implications for the health and well-being of the elderly, for addressing health disparities and for the financial health of the Medicare trust funds.
Role: PI, Statistical and Network Analysis Core

1 P20 GM130454-01 Whitfield 08/01/2019 - 06/30/2024
NIH/NIGM
Title*: Center for Quantitative Biology: A focus on "omics", from organisms to single cells*
Goal: The Center for Quantitative Biology will synergize computational biology and biostatistics with ongoing experimental genomic initiatives across Dartmouth. Promote synergistic collaborations between quantitative biologists and experimental biologists through five related research projects, a Single-Cell Genomics Core, and a Data Analytics Core.
Role: PI, Data Analytics Core

R01HS025408 O'Malley, Subaward PI; 09/30/2017 - 07/31/2021
Harvard Medical School/AHRQ Landon, PI 0
Title*: Identifying Predictors of Hospital Admission from the ED Among the Elderly*
Goal: The major goal of this project is to collaborate with Drs. Landon and Smulowitz on all aims of the proposal including providing guidance on the formulation of research questions and strategy, overseeing data analyses, interpreting the results of analyses, and helping to prepare papers for publication.
Role: Subaward PI

**Completed Research Support (selected)**

ME-1503-28261 O'Malley (PI) 01/01/2016-1/1/2020
PCORI
Advancing Patient Centered Outcomes Research in Survival Data with Unmeasured Confounding to Improve Patient Risk Communication
This project will develop IV methods for the Cox model, the most common approach to assessing the comparative effectiveness of treatments using time-to-event data. A second problem we address is the lack of knowledge about the best format of risk information and the best visualization method to use when communicating with patients. To do so, we will conduct a qualitative study of VQI patients.

U01 AG046830 Skinner (PI) 09/30/2013-05/31/2019
NIH/NIA
Technology Diffusion, Health Outcomes, and Healthcare Expenditures
This proposal seeks to measure the impact of technology diffusion in healthcare, whether for highly effective treatments (with a large impact on health outcomes) or for expensive treatments with unknown value (with a large impact on expenditures).
Role: Co-Investigator

R01 HL109263 O'Malley, Subramanian (PIs) 04/01/2012-03/31/2016
NIH/ NHLBI
Proximity to Food Establishments and BMI in the Framingham Heart Study
Among subjects in the Framingham Heart Study Offspring and Omni Cohorts, we propose to study the association of residential and workplace proximity to food establishments with body mass index, from 1971 to 2008. We will develop new data on food establishments and employers and will create new statistical software to facilitate analyses of complex longitudinal and geographic data.