Dylan S. Small

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Education

1998-2002	**Ph.D.**, Statistics, Stanford University Dissertation title: "Inference and Model Selection for Instrumental Variables Regression" Advisor: Professor Tze Leung Lai
1993-1997	**A.B.**, *magna cum laude*, Mathematics, Harvard University

Professional Experience

2016-present	**Class of 1965 Wharton Professor of Statistics**, The Wharton School, University of Pennsylvania.
2014-2016	**Professor**, Department of Statistics, The Wharton School, University of Pennsylvania.
2012-present	**Faculty**, Applied Mathematics & Computational Science Graduate Group, University of Pennsylvania.
2008-present	**Senior Fellow**, Leonard Davis Institute of Health Economics.
2004-present	**Associate Scholar**, Biostatistics Unit, Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine.
2016-present	**Co-director**, Center for Causal Inference, University of Pennsylvania.
2008-2014	**Associate Professor**, Department of Statistics, The Wharton School, University of Pennsylvania.
2002-2008	**Assistant Professor**, Department of Statistics, The Wharton School, University of Pennsylvania.
1998-2002	**Teaching Assistant and Research Assistant**, Stanford University, Department of Statistics.
1997-1998	**Research Analyst**, Cambridge Economics, Inc.
1996-1997	**Research Assistant**, Professor John Kain.

Teaching Experience

2002-present	Instructor, Department of Statistics, The Wharton School, University of Pennsylvania. Courses: Introductory Business Statistics I (Fall 2015); Introductory Statistics II (Fall, 2002; Fall, 2003; Spring, 2004; Fall 2004; Fall, 2005; Fall, 2006; Fall, 2007; Fall, 2008); Introductory Business Statistics II (Spring, 2003; Spring, 2004; Spring 2005); Probability (Fall 2005; Fall, 2006); Seminar in Advanced Applications of Statistics: Causal Inference for Economic Relationships and Other Topics in Microeconometrics (Spring, 2003); Mathematical Statistics (STAT 512) (Spring, 2005); Mathematical Statistics (STAT 550) (Fall, 2005; Fall, 2006; Fall, 2007; Fall, 2008; Fall, 2009; Fall, 2010; Fall, 2011; Fall, 2012; Fall, 2013; Fall, 2014; Fall, 2015); Experimental Design and Observational Studies (Fall, 2007; Fall, 2009; Fall, 2011; Fall, 2013; Fall, 2015); Survey Sampling (Fall, 2008; Fall, 2010; Fall, 2012; Fall, 2014); Applied Econometrics I (Fall, 2010; Fall, 2011; Fall, 2012); Applied Econometrics II (Spring, 2010); Linear Models (Spring 2017); Advanced Methods for Applied Statistics (Spring 2017)
2003	Instructor, Department of Statistics, Stanford University. Course: Introduction to Statistical Inference (Summer, 2003).
2000	Instructor, Department of Statistics, Stanford University. Course: Introduction to Statistical Methods in the Social Sciences (Summer, 2000).

Advising

Ph.D. students

- Jing Cheng, Department of Biostatistics and Epidemiology, University of Pennsylvania, 2006, Dissertation title: "Causal inference for randomized trials with noncompliance." (joint advisor with Tom Ten Have)

- Peng Zhang, Department of Statistics, The Wharton School, University of Pennsylvania, 2006, Dissertation title: "Bayesian inference for autoregressive panel data models."

- Kenny Shirley, Department of Statistics, The Wharton School, University of Pennsylvania, 2007, Dissertation title: "Hidden Markov models for alcoholism treatment trial data."

- David Lewin, Department of Statistics, The Wharton School, University of Pennsylvania, 2008. Dissertation title: "Causal inference methods for randomized controlled trials with noncompliance."

- Xu Han, Department of Statistics, The Wharton School, University of Pennsylvania, 2009. Dissertation title: "Topics in shrinkage estimation and in casual inference" (joint advisor with Larry Brown).

- Mingyuan Zhang, Department of Statistics, The Wharton School, University of Pennsylvania, 2009. Dissertation title: "Causal inference in discretely observed continuous time processes." (joint advisor with Marshall Joffe).

- Michael Freiman, Department of Statistics, The Wharton School, University of Pennsylvania, 2010. Dissertation title: "Mixture models and censoring by death."

- Bing Cai, Department of Biostatistics and Epidemiology, University of Pennsylania, 2010. Dissertation title: "Causal Inference with Two-Stage Logistic Regression - Accuracy, Precision, and Application." (joint advisor with Tom Ten Have).

- Michael Baiocchi, Department of Statistics, The Wharton School, University of Pennsylvania, 2011. Dissertation title: "Methodologies for Observational Studies of Health Care Policy."

- Yao Zhang, Department of Statistics, The Wharton School, University of Pennsylvania, 2012. Dissertation title: "New Clumpiness Measures and Their Application in Customer Evaluation." (joint advisor with Eric Bradlow).

- Oliver Entine, Department of Statistics, The Wharton School, University of Pennsylvania, 2012. Dissertation title: "Disease Diagnosis from Immunoassays with Plate to Plate Variability."

- Andrew Hong, Department of Statistics, The Wharton School, 2013. Dissertation title: "Gaussian Markov Random Field Models for Surveillance Error and Geographic Boundaries." (joint advisor with Mike Levy).

- Lola Luo, Department of Biostatistics and Epidemiology, University of Pennsylvania, 2013. Dissertation title: "Some Extensions of Hidden Markov Models for Estimating Disease State Transition Rates Using Observational Healthcare Databases." (joint advisor with Jason Roy).

- Fan Yang, Applied Mathematics and Computational Science, University of Pennsylvania, 2014. Dissertation title: "Causal Inference Methods for Addressing Censoring by Death and Unmeasured Confounding Using Instrumental Variables." (joint advisor with Ed George).

- Hyunseung Kang, Department of Statistics, The Wharton School, 2015. Dissertation title: "Instrumental Variables and Mendelian Randomization with Invalid Instruments." (joint advisor with Tony Cai).

- Fei Wan, Department of Biostatistics and Epidemiology, University of Pennsylvania, 2015. Dissertation title: "Instrumental Variable and Propensity Score Methods for Bias Adjustment in Non-linear Models." (joint advisor with Nandita Mitra).

- Colin Fogarty, Department of Statistics, The Wharton School, University of Pennsylvania, 2016. Dissertation title: "Modern Optimization in Observational Studies." item Edward Kennedy, Department of Biostatistics and Epidemiology, University of Pennsylvania, 2016. Dissertation title: "Doubly Robust Causal Inference with Complex Parameters." (joint advisor with Marshall Joffe).

- Yang Jiang, Department of Statistics, The Wharton School, University of Pennsylvania, 2017. Dissertation title: "Topics in Statistical Inference for Treatment Effects." (joint advisor with Nancy Zhang).

- Kwon Sang Lee, Applied Mathematics and Computational Science, University of Pennsylvania, 2017. Dissertation title: "Causal Inference Beyond Estimating Average Treatment Effects."

- Xinyao Ji, Department of Statistics, The Wharton School, University of Pennsylvania, 2017. Dissertation title: "Causal Inference Using Variation in Treatment Over Time."

- Colman Humphrey, Department of Statistics, The Wharton School, expected to graduate in 2018 (joint advisor with Shane Jensen).

- Halima Twabi, Biostatistics, Chancellor College, University of Malawi, expected to graduate in 2021 (joint advisor with Samuel Manda).

- Bikram Karmakar, Department of Statistics, The Wharton School, University of Pennsylvania, expected to graduate in 2019

- Raiden Hasegawa, Department of Statistics, The Wharton School, University of Pennsylvania, expected to graduate in 2019

- Siyu Heng, Applied Mathematics and Computational Science, University of Pennsylvania, expected to graduate in 2021.

Postdoctoral Fellows

- Wei Wang, 2008-2010.

- Yen-chih (Jesse) Hsu, 2011-2014.

- Ashkan Ertefaie, 2014-2016

- Qingyuan Zhao, 2016-

Fulbright Fellows

- Ibrahim Erkan, Department of Statistics, Middle East Technical University, research mentor for his visit to Penn as a Fulbright Fellow in 2006-2007.

Undergraduate thesis and research

- Jake Weissman, University of Pennsylvania School of Arts and Sciences, 2008. Thesis title: "Generalized Estimating Equations as a robust statistical method for clinical trial analysis: An application to dentistry."

- Mark Huang and Xiao Qiao, The Wharton School, Summer Program for Undergraduate Research, 2009. Project title: "A multifactor estimation of beta in CAPM analysis."

- Ola Aboukhsaiwan, The Wharton School, Wharton Research Scholars thesis, 2014. Thesis title: "Marriage equality, labor (in)equality: the impact of same-sex marriage legalization on the labor outcomes of lesbian women."

- John Han, The Wharton School, Summer Program for Undergraduate Research, 2015. Project title: "Nurse work environment and patient outcomes."

- Liqhwa Ncube, University of Pennsylvania, Summer Undergraduate Minority Research Program, 2017.

Papers
Refereed Publications

1. Chen, Y. and Small, D. (2005). "Exact tests for the Rasch model via sequential importance sampling." *Psychometrika*, **70**, 11-30.

2. Small, D., Ten Have, T., Joffe, M. and Cheng, J. (2006). "Random effects logistic models for analysing efficacy of a longitudinal randomized treatment with non-adherence." *Statistics in Medicine*, **25**, 1981-2007.

3. Cheng, J. and Small, D. (2006). "Bounds on causal effects in three-arm trials with non-compliance." *Journal of the Royal Statistical Society, Series B*, **68**, 815-836.

4. Small, D., Gastwirth, J., Krieger, A. and Rosenbaum, P. (2006). "R-estimates vs. GMM: a theoretical case study of validity and efficiency." *Statistical Science*, **21**, 363-375.

5. Apter, A., Cheng, J., Small, D., Albert, C., Fein, D., Bennett, I., George, M., Van Horne, M. and Chang, D. (2006). "Asthma numeracy skill and health literacy." *Journal of Asthma*, **43**, 705-710.

6. Lai, T. and Small, D. (2007). "Marginal regression analysis of longitudinal data with time-dependent covariates: a generalized method of moments approach." *Journal of the Royal Statistical Society, Series B*, **69**, 79-99.

7. Joffe, M., Small, D. and Hsu, C. (2007). "Defining and estimating intervention effects for groups that will develop an auxiliary outcome." *Statistical Science*, **22**, 74-97.

8. Small, D. (2007). "Sensitivity analysis for instrumental variables regression with overidentifying restrictions." *Journal of the American Statistical Association*, **102**, 1049-1058.

9. Small, D., Ten Have, T. and Rosenbaum, P. (2008). "Randomization inference in a group-randomized trial of treatments for depression: covariate adjustment, noncompliance, and quantile effects." *Journal of the American Statistical Association*, **103**, 271-279.

10. Small, D. and Rosenbaum, P. (2008). "War and wages: the strength of instrumental variables and their sensitivity to unobserved biases." *Journal of the American Statistical Association*, **103**, 924-933.

11. Joffe, M., Small, D., Brunelli, S., Ten Have, T. and Feldman, H. (2008). "Extended instrumental variables estimation for overall effects." *International Journal of Biostatistics*, **4**, Issue 1, Article 4.

12. Entine, O. and Small, D. (2008). "The role of rest in the NBA home-court advantage." *Journal of Quantitative Analysis in Sports*, **4**, Issue 2, Article 6.

13. Lai, T., Small, D. and Liu, J. (2008). "Statistical inference in dynamic panel data models." *Journal of Statistical Planning and Inference*, **138**, 2763-2776.

14. Cheng, J., Small, D., Tan, Z. and Ten Have, T. (2009). "Efficient nonparametric estimation of causal effects in randomized trials with noncompliance." *Biometrika*, **96**, 1-9.

15. Kurichi, J., Small, D., Bates, B., Prvu-Bettger, J., Kwong, P., Vogel, W.B., Bidelspach, D. and Stineman, M. (2009). "Possible incremental benefits of specialized rehabilitation bed units among veterans after lower extremity amputation." *Medical Care*, **47**, 457-465.

16. Small, D., Gastwirth, J., Krieger, A. and Rosenbaum, P. (2009). "Simultaneous sensitivity analysis for observational studies using full matching or matching with multiple controls." *Statistics and Its Interface*, **2**, 203-211.

17. Gallop, R., Small, D., Lin, J., Elliott, M., Joffe, M. and Ten Have, T. (2009). "Mediation analysis with principal stratification." *Statistics in Medicine*, **28**, 1108-1130.

18. Heller, R., Manduchi, E. and Small, D. (2009). "Matching methods for observational microarray studies." *Bioinformatics*, **25**, 904-909.

19. Heller, R., Rosenbaum, P. and Small, D. (2009). "Split Samples and Design Sensitivity in Observational Studies." *Journal of the American Statistical Association*, **104**, 1090-1101.

20. Small, D. and Rosenbaum, P. (2009). "Error-free milestones in error prone measurements." *Annals of Applied Statistics*, **3**, 881-901.

21. Jensen, S., Erkan, I., Arnardottir, E. and Small, D. (2009). "Bayesian testing of many hypotheses × many genes: a study of sleep apnea." *Annals of Applied Statistics*, **3**, 1080-1101.

22. Kunreuther, H., Silvasi, G., Bradlow, E. and Small, D. (2009), "Bayesian analysis of deterministic and stochastic prisoners dilemma games." *Judgment and Decision Making*, **4**, 363-384.

23. Lorch, S., Baiocchi, M., Evan-Shosan, O., Escobar, G., Silber, J. and Small, D. (2010). "The role of outpatient facilities in explaining variations in risk-adjusted readmission rates between hospitals." *Health Services Research*, 45, 24-41.

24. Shirley, K., Small, D., Lynch, K., Maisto, S. and Oslin, D. (2010). "Hidden Markov models for alcoholism treatment trial data." *Annals of Applied Statistics*, **4**, 366-395.

25. Heller, R., Jensen, S., Rosenbaum, P. and Small, D. (2010). "Sensitivity analysis for the cross-match test, with applications to genomics." *Journal of the American Statistical Association*, **105**, 1005-1013.

26. Small, D., Cheng, J. and Ten Have, T. (2010), "Challenges in evaluating the efficacy of a malaria vaccine." *International Journal of Biostatistics*, Vol. 6, Iss. 2, Article 4.

27. Baiocchi, M., Small, D., Lorch, S. and Rosenbaum, P. (2010). "Building a stronger instrument in an observational study of perinatal care for premature infants." *Journal of the American Statistical Association*, 105, 1285-1296.

28. Heller, R., Rosenbaum, P. and Small, D. (2010). "Using the cross-match test to appraise covariate balance in matched pairs." *The American Statistican*, 64, 299-309.

29. Zhang, M., Joffe, M. and Small, D. (2011). "Causal inference for continuous time processes when covariates are observed only at discrete times." *Annals of Statistics*, 39, 131-173.

30. Han, X., Small, D., Foster, D. and Patel, V. (2011). "The effect of winning an Oscar award on survival: correcting for healthy performer survivor bias with a rank preserving structural accelerated failure time model." *Annals of Applied Statistics*, 5, 746-772.

31. Nie., H., Cheng, J. and Small, D. (2011). "Inference for the effect of treatment on survival probability in randomized trials with noncompliance and administrative censoring." *Biometrics*, 67, 1397-1405.

32. Cai, B., Small, D. and Ten Have, T. (2011). "Two-stage instrumental variable methods for estimating the causal odds ratio: analysis of bias." *Statistics in Medicine*, 30, 1809-1824.

33. Small, D., Volpp, K. and Rosenbaum, P. (2011). "Structured testing of 2x2 factorial effects: an analytic plan requiring fewer observations." *The American Statistician*, 65, 11-15.

34. Zhang, K., Small, D., Lorch, S., Srinivas, S. and Rosenbaum, P. (2011). "Using split samples and evidence factors in an observational study of neonatal outcomes." *Journal of the American Statistical Association*, 106, 511-524.

35. Traskin, M. and Small, D. (2011). "Defining the study population for an observational study to ensure sufficient overlap: a tree approach." *Statistics in Biosciences*, 3, 94-118.

36. Levy, M., Small, D., Vilhena, D., Bowman, N., Kawai, V., Cornejo del Carpio, J., Cordova-Benzaquen, E., Gilman, R., Bern, C., and Plotkin, J. (2011). "Retracing Micro-Epidemics of Chagas Disease Using Epicenter Regression." *PLoS Computational Biology*, 7, 1002146.

37. Okui, R., Small, D., Tan, Z. and Robins, J. (2012). "Doubly robust instrumental variable regression." *Statistica Sinica*, 22, 173-205.

38. Zhang, K., Traskin, M. and Small, D. (2012). "A powerful and robust test statistic for randomization inference in group randomized trials with matched pairs of groups." *Biometrics*, 68, 75-84.

39. Yang, D., Small, D., Silber, J. and Rosenbaum, P. (2012). "Optimal matching with minimal deviation from fine balance in a study of obesity and surgical outcomes." *Biometrics*, 68, 628-636.

40. Tustin, A., Small, D., Delgado, S., Castillo Neyra, R., Verastegui, M., Ancca Ju/'arez, J., Quispe Machaca, MR., Gilman, R., Bern, C. and Levy, M. (2012). "Use of individual-level covariates to improve latent class analysis of Trypanosoma Cruzi diagnostic tests." *Epidemiologic Methods*, 1, 33-54.

41. Luo, X., Small, D., Li, C. and Rosenbaum, P. (2012). "Inference with interference between units in an fMRI experiment of motor inhibition." *Journal of the American Statistical Association*, 107, 530-541.

42. Cai, B., Hennessy, S., Flory, J., Sha, D., Ten Have, T. and Small, D. (2012). "Simulation study of instrumental variable approaches with an application to a study of the antidiabetic effect of bezafibrate." *Pharmacoepidemiology and Drug Safety*, 21, 114-120.

43. Baiocchi, M., Small, D., Yang, L., Polsky, D. and Groeneveld, P. (2012). "Near/far matching: a study design approach to instrumental variables." *Health Services and Outcomes Research Methodology*, 12, 237-253.

44. Lorch, S.A., Baiocchi, M., Ahlberg, C. and Small, D.S. (2012). "The differential impact of delivery hospital on the outcomes of premature infants." *Pediatrics*, 130, 270-278.

45. Hsu, J.Y., Lorch, S.A. and Small. D.S. (2012). "Perils and prospects of using aggregate area level socioeconomic information as a proxy for individual level socioeconomic confounders in instrumental variables regression." *Health Services and Outcomes Research Methodology*, 12, 119-140.

46. Zhang, M. and Small, D. (2012). "Effect of vitamin A deficiency on respiratory infection: Causal inference for a discretely observed continuous time non-stationary Markov process." *Canadian Journal of Statistics*, 40, 646-662.

47. Volpp, K., Shea, J., Small, D., Basner, M., Zhu, J., Norton, L., Ecker, A., Novak, C., Bellini, L., Dine, J., Mollicone, D. and Dinges, D. (2012). "Effect of a protected sleep period on hours slept during extended overnight in-hospital duty hours among medical interns: A randomized trial." *Journal of the American Medical Association*, 308, 2208-2217.

48. Farmer, S.A., Tuohy, E.J., Small, D.S., Wang, Y. and Groeneveld, P.W. (2012). "Impact of Community Wealth on Use of Cardiac-Resynchronization Therapy With Defibrillators for Heart Failure Patients." *Circulation: Cardiovascular Quality and Outcomes*, 5, 798-807.

49. Wang, W. and Small, D. (2012). "A comparative study of parametric and nonparametric estimates of the attributable fraction for a semi-continuous exposure." *International Journal of Biostatistics*, Vol. 8, Iss. 1, Article 32.

50. Small, D. (2012). "Mediation analysis without sequential ignorability: using baseline covariates interacted with random assignment as instrumental variables." *Journal of Statistical Research*, 46, 91-103.

51. Traskin, M., Wang, W., Ten Have, T. and Small, D. (2013). "Efficient estimation of the attributable fraction when there are monotonicity constraints and interactions." *Biostatistics*, 14, 173-188.

52. Barbu, C., Hong, A., Manne, J., Small, D., Quintanilla Calderón, J., Sethuraman, K., Quispe-Machaca, V., Ancca-Juárez, J., Cornejo del Carpio, J.,. Malaga Chavez, F., Náquira, C. and Levy, M. (2013). "The effects of city streets on an urban disease vector." *PLoS Computational Biology*, 9, e1002801.

53. Navathe, A., Silber, J., Small, D., Rosen, A., Romano, P., Even-Shoshan, O., Wang, Y., Zhu, J., Halenar, M. and Volpp, K. (2013). "Teaching hospital financial status and patient outcomes following ACGME duty hour reform." *Health Services Research*, 48, 476-498.

54. Goyal, N., Zubizarreta, J., Small, D. and Lorch, S. (2013). "Length of stay and readmission among late preterm infants: an instrumental variable approach." *Hospital Pediatrics*, 3, 7-15.

55. Yang, D. and Small, D. (2013). "An R package and a study of methods for computing empirical likelihood." *Journal of Statistical Computation and Simulation*, 83, 1363-1372.

56. Lorch, S., Srinivas, S., Ahlberg, C. and Small, D. (2013). "The impact of obstetric unit closures on maternal and infant pregnancy outcomes." *Health Services Research*, 48, 455-475.

57. Zubizarreta, J., Small, D., Goyal, N., Lorch, S. and Rosenbaum, P. (2013). "Stronger instruments via integer programming in an observational study of late preterm birth outcomes." *Annals of Applied Statistics*, 7, 25-50.

58. Kohn, R., Harhay, M.O., Cooney, E., Small, D.S. and Halpern, S.D. (2013). "Do windows or natural views affect outcomes or costs among patients in ICUs?" *Critical Care Medicine*, 41, 1645-1655.

59. Hsu, J.Y., Small, D.S. and Rosenbaum, P.R. (2013). "Effect modification and design sensitivity in observational studies." *Journal of the American Statistical Association*, 108, 135-148.

60. Leung, D.H.Y., Small, D.S., Qin, J. and Zhu, M. (2013). "Shrinkage empirical likelihood estimator in longitudinal analysis with time-dependent covariates– application to modeling the health of Filipino children." *Biometrics*, 69, 624-632.

61. Volpp, K.G., Small, D.S., Romano, P.S., Itani, K.M. F., Rosen, A.K., Even-Shoshan, O., Wang, Y., Bellini, L., Halenar, M.J., Zhu, J. and Silber, J.H. (2013). "Teaching Hospital Five Year Mortality Trends in the Wake of Duty Hour Reforms." *Journal of General Internal Medicine*, 28, 1048-1055.

62. Cui, N., Chen, Y. and Small, D.S. (2013). "Modeling parasite infection dynamics when there is heterogeneity and imperfect detectability." *Biometrics*, 69, 683-692.

63. Wang, P., Traskin, M. and Small, D.S. (2013). "Robust Inferences from a Before-and-After Study with Multiple Unaffected Control Groups." *Journal of Causal Inference*, 1, 209-234.

64. Kerlin, M.P., Small, D.S., Cooney, E., Fuchs, B.D., Bellini, L.M., Mikkelsen, M.E., Schweickert, W.D., Bakhru, R.N., Gabler, N.B., Harhay, M.O., Hansen-Flaschen, J. and Halpern, S.D. (2013). "A Randomized Trial of Nighttime Physician Staffing in an Intensive Care Unit." *New England Journal of Medicine*, 368, 2201-2209.

65. Kang, H., Kreuels, B., Adjei, O., Krumkamp, R., May, J. and Small, D.S. (2013). "The causal effect of malaria on stunting: a Mendelian randomization and matching approach." *International Journal of Epidemiology*, 42, 1390-1398.

66. Zhang, Y., Bradlow, E.T. and Small, D.S. (2013). "New Measures of Clumpiness for Incidence Data." *Journal of Applied Statistics*, 40, 2533-2548.

67. Small, D.S., Cheng, J., Halloran, M.E. and Rosenbaum, P.R. (2013). "Case Definition and Design Sensitivity." *Journal of the American Statistical Association*, 108, 1457-1468.

68. Luo, L., Small, D.S., Stewart, W.F. and Roy, J.A. (2013). "Methods for Estimating Kidney Disease Stage Transition Probabilities Using Electronic Medical Records." *eGEMs (Generating Evidence & Methods to improve patient outcomes)*, 1, Article 6.

69. Hsu, J.Y. and Small, D.S. (2013). "Calibrating sensitivity analyses to observed covariates in observational studies." *Biometrics*, 69, 803-811.

70. McHugh, M.D., Berez, J. and Small, D.S. (2013). "Hospitals with higher nurse staffing had lower odds of readmissions penalties than hospitals with lower staffing." *Health Affairs*, 32, 740-747.

71. Buttenheim, A.M., Paz-Soldan, V., Barbu, C., Skovirak, C., Calderón, J.Q., Margot Riveros, L.M.M., Cornejo, J.O., Small, D.S., Bicchieri, C., Naquira, C. and Levy, M.Z. (2014). "Is participation contagious? Evidence from a household vector control campaign in Peru." *Journal of Epidemiology and Community Health*, 68, 103-109.

72. Shea J.A., Dinges, D.F., Small D.S., Basner, M., Zhu, J., Norton, L., Ecker, A.J., Novak, C., Bellini, L.M., Dine, C.J., Mollicone, D.J. and Volpp, K.G. (2014). "A randomized trial of a 3-hour protected nap period in a medicine training program: Sleep, alertness and patient outcomes." *Academic Medicine*, 89, 452-459.

73. Flory, J.H., Small, D.S., Cassano, P.A., Brillon, D.J., Mushlin, A.I. and Hennessy, S. (2014). "Comparative effectiveness of oral diabetes drug combinations in reducing glycosylated hemoglobin." *Journal of Comparative Effectiveness Research*, 3, 29-39.

74. Shea, J.A., Bellini, L.M., Dinges, D.F., Curtis, M.L., Tao, Y., Zhu, J., Small, D.S., Basner, M., Norton, L., Novak, C., Dine, C.J., Rosen, I.M. and Volpp, K.G. (2014). "The Impact of Protected Sleep Period for Internal Medicine Interns on Overnight Call on Depression, Burnout, and Empathy." *Journal of Graduate Medical Education*, 6, 256-263.

75. Feng, X., Feng, Y., Chen, Y. and Small, D.S. (2014). "Randomization inference for the trimmed mean of effects attributable to treatment." *Statistica Sinica*, 24, 773-797.

76. Hansen, B.B., Rosenbaum, P.R. and Small, D.S. (2014). "Clustered Treatment Assignments and Sensitivity to Unmeasured Biases in Observational Studies." *Journal of the American Statistical Association*, 109, 133-144.

77. Yang, F., Lorch, S.A. and Small, D.S. (2014). "Estimation of causal effects using instrumental variables with nonignorable missing covariates: application to effect of type of delivery NICU on premature infants." *Annals of Applied Statistics*, 8, 48-73.

78. Silber, J.H., Romano, P.S., Itani, K.M.F., Rosen, A.K., Small, D.S., Lipner, R.S., Bosk, C.L., Wanli, Y., Halenar, M.J., Even-Shoshan, O. and Volpp, K.G. (2014). "Internal Medicine Board Scores and the Resident Duty Hour Reform of 2003." *Academic Medicine*, 89, 644-651.

79. Baiocchi, M., Cheng, J. and Small, D.S. (2014). "Tutorial in biostatistics: Instrumental variable methods for causal inference." *Statistics in Medicine*, 33, 2297-2340.

80. Harhay, M.O., Wagner, J., Ratcliffe, S.J., Bronheim, R.S., Gopal, A., Green, S., Cooney, E., Mikkelsen, M.E., Kerlin, M.P., Small, D.S. and Halpern, S.D. (2014). "Outcomes and Statistical Power in Adult Critical Care Randomized Trials." *American Journal of Respiratory and Critical Care Medicine*, 189, 1469-1478.

81. Small, D.S., Joffe, M.M., Lynch, K.G., Roy, J.A. and Localio, A.R. (2014). "Tom Ten Have's contributions to causal inference and biostatistics: review and future research directions." *Statistics in Medicine*, 33, 3421-3433.

82. Helstrom, A., Ingram, E., Wang, W., Small, D., Klaus, J. and Oslin, D. (2014). "Treating Heavy Drinking in Primary Care Practices: Evaluation of a Telephone-Based Intervention Program." *Addictive Disorders & Their Treatment*, 13, 101-109.

83. Guo, Z., Cheng, J., Lorch, S.A. and Small, D.S. (2014). "Using an instrumental variable to test for unmeasured confounding." *Statistics in Medicine*, 33, 3528-3546.

84. Patel, M.S., Day, S., Small, D.S., Howell III, J.T., Lautenbach, G.L., Nierman, E.H. and Volpp, K.G. (2014). "Using default options within the electronic health record to increase the prescribing of generic equivalent medications: A quasi experimental study." *Annals of Internal Medicine*, 161, S44-52.

85. Austin, P.C. and Small, D.S. (2014). "The use of bootstrapping with propensity-score matching without replacement: A simulation study." *Statistics in Medicine*, 33, 4306-4319.

86. Freiman, M. and Small, D.S. (2014). "Large sample bounds on the survivor average causal effect in the presence of a binary covariate with conditionally ignorable treatment assignment." *International Journal of Biostatistics*, 10, 143-163.

87. Yang, F., Zubizarreta, J.R., Small, D.S., Lorch, S.A. and Rosenbaum, P.R. (2014). "Dissonant conclusions when testing the validity of an instrumental variable." *The American Statistician*, 68, 253-263.

88. Fogarty, C.B. and Small, D.S. (2014). "Equivalence testing for functional data with an application to comparing pulmonary function devices." *Annals of Applied Statistics*, 8, 2002-2026.

89. Zubizarreta, J.R., Small, D.S. and Rosenbaum, P.R. (2014). "Isolation in the construction of natural experiments." *Annals of Applied Statistics*, 8, 2096-2121.

90. Patel, M.S., Volpp, K.G., Small, D.S., Hill, A.S., Even-Shoshan, O., Rosenbaum, L., Ross, R.N., Bellini, L., Zhu, J. and Silber, J.H. (2014). "Association of the 2011 ACGME Resident Duty Hour Reforms with Mortality and Readmissions among Hospitalized Medicare Patients." *Journal of the American Medical Association*, 312, 2364-2373.

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174. Stern, H.S., Blower, D., Cohen, M.L., Czeisler, C.A., Dinges, D.F., Greenhouse, J.B., Guo, F., Hanowski, R.J., Hartenbaum, N.P., Krueger, G.P., Mallis, M.M., Pain, R.P., Rizzo, M., Sinha, E., Small, D.S., Stuart, E.A. and Wegman, D.H. "Data and Methods for Studying Commercial Motor Vehicle Driver Fatigue, Highway Safety and Long-Term Driver Health." *Accident Analysis & Prevention*, in press.

175. Desai, S.V., Asch, D.A., Bellini, L.M., Chaiyachati, K.H., Liu, M., Sternberg, A.L., Tonascia, J., Yeager, A.M., Asch, J.A., Katz, J.T., Basner, M., Bates, D.W., Bilimoria, K.Y., Dinges, D.F., Even-Shoshan, O., Shade, D.M., Silber, J.H., Small, D.S., Volpp, K.G., Shea, J.A. for the iCOMPARE Research Group. "Education Outcomes from a Duty-Hour Flexibility Trial in Internal Medicine." *New England Journal of Medicine*, in press.

Discussions

- Small, D. and Cheng, J. (2009). "Discussion of identifiability and estimation of causal effects in randomized trials with noncompliance and completely non-ignorable missing data by Chen, Geng and Zhou." *Biometrics*, **65**, 682-6ww86.

- Zhang, K. and Small, D. (2009). "Comment: The Essential Role of Pair Matching in Cluster Randomized Experiments with Application to the Mexican Universal Health Insurance Evaluation." *Statistical Science*. **24**, 59-64.

- Hsu, J.Y. and Small, D.S. (2014). "Discussion on Dynamic treatment regimes: technical challenges and applications." *Electronic Journal of Statistics*, 8, 1301-1308.

- Small, D. (2014). "Interpretation and Sensitivity Analysis for the Localized Average Causal Effect Curve." *Epidemiology*, 25, 886-888.

Chapters

- Cheng, J. and Small, D.S. "Compliance." In: James D. Wright (editor-in-chief), *International Encyclopedia of Social & Behavioral Sciences, 2nd Edition*, Vol 4. Oxford: Elsevier. pp. 445-455.

- Baiocchi, M., Cheng, J. and Small, D.S. "Instrumental Variable Methods." In: Constantine Gatsonis and Sally Morton (editors), *Quantitative Methods for Comparative Effectiveness Research*.

Op-ed

- Deshpande, S., Hasegawa, R., Master, C., Rabinowitz, A. and Small, D. (2017). "Head Trauma in High School Football May Be More Complicated Than We Thought." *Scientific American*, August 24, 2017.

Professional Activities
Statistical Community

- Editorial Board:

  - Biometrics, Associate Editor (2008-2010).
  - Evaluation Review, Associate Editor (2008-2010).
  - Journal of the American Statistical Association, Application and Case Studies Section, Associate Editor (2008-2012).
  - Journal of Quantitative Analysis in Sports, Associate Editor (2011-2014).
  - Journal of Educational and Behavioral Statistics, Associate Editor (2003-present).
  - The American Statistician, Associate Editor (2008-present).
  - Journal of Causal Inference, Associate Editor (2011-present).
  - Journal of the Royal Statistical Society, Series B, Associate Editor (2011-2016).
  - Annals of Statistics, Associate Editor (2015-present).
  - Journal of the American Statistical Association, Theory and Methods Section, Associate Editor (2017-).
  - Statistical Science, Associate Editor (2018-)

- Founding Editor: Observational Studies.

- Secretary/Treasurer, Statistics in Sports Section, American Statistical Association, 2007-2009.

- Chair, Statistics in Sports Section, American Statistical Association, 2011.

- Publications Officer, Statistics in Epidemiology Section, American Statistical Association, 2007-2009.

- Program Chair, Statistics in Epidemiology Section, American Statistical Association, 2012.

- Short course instructor: Causal Inference and Its Application in the Health Sciences (co-taught with Miguel Hernan), Joint Statistical Meetings, 2013.

- Invited session organizer: Joint Statistical Meetings, 2005; ENAR Spring Meeting, 2006; ENAR Spring Meeting, 2007; ENAR Spring Meeting, 2012; Joint Statistical Meetings (topic contributed), 2007; Joint Statistical Meetings, 2008,2013.

- Conference organizer: Mid-Atlantic Causal Modeling Conference, June 2006; Atlantic Causal Modeling Conference, May 2009; Atlantic Causal Inference Conference, May 2015.

- NSF Statistics grant review panel, February 2010.

- NSF Measurement, Methodology and Statistics Grant Review Panel, 2013-2014.

- Volunteer Editor, Prose Editing Project, International Biometric Society, 2013-.

- Member, National Research Council Committee, "Panel on Research Methodologies and Statistical Approaches to Understanding Driver Fatigue Factors in Motor Carrier Safety and Driver Health," 2014-2015.

- Member, ESRD Dialysis Facility Compare (DFC) Star Ratings Technical Expert Panel, 2015.

- Member, National Research Council Committee, "Committee on Gulf War and Health, Volume 11: Generational Health Effects of Serving in the Gulf War," 2016-2018.

- Member: American Statistical Association, Institute of Mathematical Statistics, International Biometric Society (ENAR).

- Advisory Board: Flexible Sleeper Berth Pilot Program.

- Data Safety and Monitoring Board: Multicenter Randomized Controlled Trial of Refeeding in Anorexia Nervosa.

- R Packages Contributed to CRAN: ivpack (with Yang Jiang), SensitivityCaseControl, ivmodel (with Yang Jiang and Hyunseung Kang), sensitivity2x2xk (with Paul Rosenbaum).

Internal Service:

- Seminar Organizer: Department of Statistics, The Wharton School, 2004-2005.

- Ph.D. program co-director: Department of Statistics, The Wharton School, 2008-2011.

- Member, Quinquennial Review Committee for Business and Public Policy Department, 2009.

- Graduate Council of the Faculties, Wharton representative, 2010-2012.

- Diversity Search Advisor, 2012-2015.

- Member, Committee to Review the Masters of Science Program in Health Policy Research, 2014.

- Member, Quinquennial Review Committee for Boettner Center for Pensions and Retirement Research, 2014

- Member, Internal Quinquennial Review Committee for Statistics Department, 2015-2016.

- Faculty Senate Executive Committee, Wharton representative, 2016-2017.

- Member, Search Committee for Director of Biostatistics, 2017.

- Ph.D. Dissertation Committee (not a principal advisor): Arun Kumar Kuchibhotla (Statisics, in progress), Xuran Wang (Applied Math and Computational Sciences, in progress), Sameer Deshpande (Statistics, in progress), Zijian Guo (Statistics, 2017), Samuel Pimentel (Statistics, 2017), Michael Harhay (Epidemiology, 2016), Jiaqi Li (Biostatistics, 2016), Philip Ernst (Statistics, 2014), Heather de Vries McClintock (Epidemiology, 2014), Jordan Rodu (Statistics, 2014), Kay See Tan (Biostatistics, 2014), Justin Rising (Statistics, 2013), Jose Zubizarreta (Statistics, 2013), Sathyanarayan Anand (Statistics, 2012), Pengyuan Wang (Statistics, 2012), Dan Yang (Statistics, 2012), Kai Zhang (Statistics, 2012), James Piette (Statistics, 2011), Rongmei Zhang (Biostatistics, 2011), Chia-Hao Wang (Biostatistics, 2010), Alex Braunstein (Statistics, 2009), Frank Yoon (Statistics, 2009), Robin Mogg (Biostatistics, 2008), Chaitra Nagaraja (Statistics, 2008), Lie Wang (Statistics, 2008), Long-Long Gao (Biostatistics, 2007), Kartikeya Ghia (Statistics, 2007), Lisha Chen (Statistics, 2006), Zhihua Qiao (Statistics, 2006), Yi Shen (Statistics, 2005), Jonathan Weinberg (Statistics, 2005), Robert Greevy (Statistics, 2004).

Honors

- Fellow, American Statistical Association.

- Centennial Teaching Assistant Award. Awarded to about thirty of the most outstanding teaching assistants from different schools and departments at Stanford.

- John Harvard Scholarship, Harvard College Scholarship for academic achievement (Harvard University).

- National Merit Scholarship recipient.

Grants
Principal Investigator

- "Improved Statistical Methods for Instrumental Variables Regression," University Research Foundation, University of Pennsylvania, February 2003-January 2004.

- "Instrumental Variable Methods for Observational Studies," Measurement, Methodology and Statistics Program, National Science Foundation, June 2010-May 2013.

- "Causal Inference in Observational Studies," Measurement Methodology and Statistics Program, National Science Foundation, March 2013-February 2016 (co-PI with Paul Rosenbaum).

Investigator

- "Perinatal Regionalization and Quality of Care," Principal Investigator: S. Lorch. Agency for Healthcare Research and Quality, 09/01/07-08/31/10.

- "Parental Trust and Racial Disparities in the Care of Discharged Premature Infants ", Principal Investigator: S. Lorch. National Institute of Child Health and Human Development, 07/01/09-06/31/13..

- "Interventions to Improve Fatigue Management among Physician Trainees," Principal Investigator: K. Volpp. Veterans Administration, 05/01/09-04/31/11.

- "Evaluating Maternal and Neonatal Outcomes: A comparison of 2 models of obstetric care delivery," Principal Investigator: S. Srinivas. Maternal and Child Health Bureau of Health Services and Resource Administration, 2/10-1/12.

- "A Randomized Trial of Incentives and Peer Mentors to Improve Diabetic Outcomes," Principal Investigator: J. Long. National Institute of Diabetes and Digestive and Kidney Diseases, 5/10-4/14.

- "Work Hour Regulation for Physician Trainees: Education and Clinical Outcomes," Principal Investigator: K. Volpp. National Heart, Lung and Blood Institute, 7/09-4/12.

- "Advancing Instrumental Variable Methods in Comparative Effectiveness Research," Principal Investigator: A. Basu. National Institute of Health. 8/10-7/13.

- "Comparative Efficacy, Acceptance and Effectiveness of Health Incentive Structures," Principal Investigator: S. Halpern, National Institute of Health. 8/11-7/15.

- "Impact of Obstetric Unit Closures on Pregnancy Outcomes," Principal Investigator: S. Lorch, 7/09-6/14.

- "A Pediatric Quality Measurement Center and Testing Laboratory," Principal Investigator: J. Silber, 10/10-9/14.

- "Selective and Future Ignorability in Causal Inference," Principal Investigator: M. Joffe (I served as the co-PI while Dr. Joffe was on medical leave), National Institute of Health. 9/10-7/16.

- "Disrupting Vector-Borne Disease Transmission in Complex Urban Environments," Principal Investigator: M. Levy. National Institute of Health. 6/13-5/18.

- "Improving Participation in Vector Control Campaigns through Behavioral Economics," Principal Investigators: A. Buttenheim and M. Levy. National Institute of Health. 9/14-5/19.

- "Default Palliative Care Consultation for Seriously Ill Hospitalized Patients." Principal Investigator: S. Halpern. National Institute of Health. 9/14-6/19.

- "Smarter Big Data for a Healthy Pennsylvania: Changing the Paradigm of Healthcare," Principal Investigators: D. Polsky and K. Volpp. Pennsylvania Department of Health. 6/15-5/19.

- "iCOMPARE – Data Coordinating Center." Principal Investigator: J. Tonascia. National Institute of Health. 8/15-6/19.

- "Predicting and Preventing Pediatric Hospital Readmissions." Principal Investigator: S. Lorch. Agency for Healthcare Research and Quality. 8/15-5/19.