Matthew A. Psioda

Collaborative Studies Coordinating Center
123 W Franklin St, Office # 4107   919-962-3264
Chapel Hill, North Carolina 27516   matt_psioda@unc.edu

EDUCATION

2011 - 2016	PhD, Biostatistics University of North Carolina at Chapel Hill, Chapel Hill, NC
2004 - 2006	MS, Mathematics University of North Carolina at Wilmington, Wilmington, NC
2000 - 2004	BS, Mathematics University of North Carolina at Wilmington, Wilmington, NC

PROFESSIONAL AND RESEARCH EXPERIENCE

08/2016 - Current	**Research Assistant Professor**, Department of Biostatistics, University of North Carolina at Chapel Hill, Chapel Hill, NC
03/2018 - Current	**Advisor on Bayesian Clinical Trial Design**, Center for Drug Evaluation and Research, US Food and Drug Administration, Silver Spring, MD
08/2015 - 10/2017	**ORISE Research Fellow**, Center for Drug Evaluation and Research, US Food and Drug Administration, Silver Spring, MD
08/2012 - 12/2014	**Trainee in Genomics and Cancer**, Department of Biostatistics, UNC-Chapel Hill, Chapel Hill, NC
08/2007 - 08/2012	**Biostatistician II**, INC Research, Raleigh, NC (now Syneos Health)
06/2006 - 08/2007	**Programmer/Biostatistician**, INC Research, Raleigh, NC (now Syneos Health)

HONORS AND AWARDS

2016	Barry H. Margolin Dissertation Award
2015-2017	FDA ORISE Research Fellow
2012-2014	Genomics and Cancer Training Grant recipient

PROFESSIONAL MEMBERSHIPS

American Statistical Association

Eastern North American Region of the International Biometric Society

PEER REVIEWED PUBLICATIONS

Note: † indicates doctoral advisee and ‡ indicates GRA

Statistical Methodology

1. N. Bean†, J. G. Ibrahim, and **M. A. Psioda**. Bayesian Design of Multi-Regional Clinical Trials Using Model Averaging. *Biostatistics*, accepted

2. **M. A. Psioda**, S. B. Jones, R. B. D'Agostino Jr., C. D. Bushnell, P. W. Duncan, and W. D. Rosamond. Methodological Challenges and Strategies in the Comprehensive Post-Acute Stroke Services (COMPASS) Study. *Medical Care*, accepted

3. **M. A. Psioda**, X. Jiang, H. A. Xia, J. Xu†, and J. G. Ibrahim. Bayesian Adaptive Design for Concurrent Trials Involving Biologically-Related Diseases. *Biostatistics*, available online ahead of print

4. J. Xu†, **M. A. Psioda**, and J. G. Ibrahim. Bayesian Design of Clinical Trials for Joint Models of Longitudinal and Time-to-event Data. *Biostatistics*, available online ahead of print

5. S. Thomas, K. Jung, H. Sun, **M. A. Psioda**, P. Quibrera, and S. Strakowski. Enhancing Clarity of Clinical Trial Safety Reports for Data Monitoring Committees. *Journal of Biopharmaceutical Statistics*, 30(1):1147–1161, 2020

6. **M. A. Psioda** and X. Xue. A Bayesian Adaptive Two-Stage Design for Pediatric Clinical Trials. *Journal of Biopharmaceutical Statistics*, 30(6):1091–1108, 2020

7. **M. A. Psioda**, J. Xu†, Q. Jiang, C. Ke, Z. Yang, and J. G. Ibrahim. Bayesian Adaptive Basket Trial Design Using Model Averaging. *Biostatistics*, 22(1):19–34, 2021

8. **M. A. Psioda**, K. Hu, Y. Zhang, J. Pan, and J. G. Ibrahim. Bayesian design of biosimilars clinical programs involving multiple therapeutic indications. *Biometrics*, 76(2):630–642, 2020

9. **M. A. Psioda** and J. G. Ibrahim. Bayesian clinical trial design using historical data that inform the treatment effect. *Biostatistics*, 20(3):400–415, 2019

10. **M. A. Psioda** and J. G. Ibrahim. Bayesian design of a survival trial with a cured fraction using historical data. *Statistics in Medicine*, 37(26):3814–3831, 2018

11. **M. A. Psioda**, M. Soukup, and J. G. Ibrahim. A Practical Bayesian Adaptive Design Incorporating Data from Historical Controls. *Statistics in Medicine*, 37(27):4054–4070, 2018

Manuscripts Under Review

R1. B. Nifong†, **M. A. Psioda**, and J. G. Ibrahim. The Scale Transformed Power Prior with Applications to Studies with Different Endpoints. *Biometrics*, under review

R2. E. Alt†, **M. A. Psioda**, and J. G. Ibrahim. Multivariate Bayesian probability of success for continuous endpoints using historical data. *Biostatistics*, under review

R3. E. Kwiatkowski†, E. Andraca-Carrera, M. Soukup, and **M. A. Psioda**. A Structured Framework for Bayesian Sequential Monitoring in Clinical Trials. *Biostatistics*, under review

R4. J. Xu, **M. A. Psioda**, and J. G. Ibrahim. Bayesian Design of Clinical Trials Using Joint Models for Recurrent and Terminating Events. *Biostatistics*, under review

R5. K. Donovan, **M. A. Psioda**, M. Hudgens, and M. Loop. An R Package for Regression with Biomarkers Subject to Limit of Detection. *The R Journal*, under review

Manuscripts In Preparation

P1. **M. A. Psioda**, E. Andraca-Carrera, and M. Soukup. Bayesian Monitoring in Clinical Trials: A Case Study Based on the PRECISION Trial. *In Preparation*

P2. **M. A. Psioda** and X. Xue. Bayesian Sequential Monitoring using Skeptical Power Priors for Prospectively Incorporating Adult Data in Pediatric Trials. *In Preparation*

P3. D. Pritchard[†] and **M. A. Psioda**. A Bayesian Approach for Improved Estimation of Day-Specific Probability Conception Models. *In Preparation*

P4. E. Alt[†], **M. A. Psioda**, and J. G. Ibrahim. Multivariate Bayesian probability of success with mixed response types using historical data. *In Preparation*

P5. N. Bean[†], J. G. Ibrahim, and **M. A. Psioda**. Bayesian Design of Multi-Regional Clinical Trials with Time-to-Event Endpoints Using Model Averaging. *In Preparation*

P6. E. Alt[†], **M. A. Psioda**, and J. G. Ibrahim. Hierarchical Bayesian generalized linear models with mean shrinkage. *In Preparation*

P7. B. Nifong[†], **M. A. Psioda**, and J. G. Ibrahim. The Scale Transformed Power Prior for Time-To-Event Data. *In Preparation*

Collaborative Research

12. P. W. Duncan, C. D. Bushnell, S. B. Jones, **M. A. Psioda**, S. B. Gesell, R. B. D'Agostino, M. E. Sissine, S. W. Coleman, A. M. Johnson, B. F. Barton-Percival, J. Prvu-Bettger, A. G. Calhoun, D. M. Cummings, J. K. Freburger, J. R. Halladay, A. M. Kucharska-Newton, G. Lundy-Lamm, B. J. Lutz, L. H. Mettam, A. M. Pastva, J. G. Xenakis, W. T. Ambrosius, M. D. Radman, B. Vetter, and W. D. Rosamond. Randomized Pragmatic Trial of Stroke Transitional Care: The COMPASS Study. *Circulation: Cardiovascular Quality and Outcomes*, 13(6):322–332, 2020

13. J. M. Sales, C. Escoffery, S. A. Hussen, L. B. Haddad, M. McCumber, E. Kwiatkowski[†], T. Filipowicz, M. Sanchez, **M. A. Psioda**, and A. N. Sheth. Pre-Exposure Prophylaxis Implementation in Family Planning Services across the Southern United States: Findings from a survey among staff, providers and administers working in Title X-funded Clinics. *AIDS and Behavior*, available online ahead of print

14. A. N. Sheth, S. A. Hussen, C. Escoffery, L. B. Haddad, L. Powell, N. Brown, T. Filipowicz, M. McCumber, M. Sanchez, L. Renshaw, **M. A. Psioda**, and J. M. Sales. Pre-Exposure Prophylaxis Integration into Family Planning Services at Title X Clinics in the Southeastern United States: A Mixed Methods Hybrid Type I Effectiveness Implementation Study - (Phase 2 ATN 155). *JMIR Research Protocols*, 9(9):e18784, 2020

15. J. Halladay, C. Bushnell, **M. A. Psioda**, S. Jones, S. Lycan, C. Condon, J. Xenakis[‡], and J. Prvu-Bettger. Patient Factors Associated with Attendance at a Comprehensive Post-Acute Stroke Visit, Insight from the Vanguard Site. *Archives of Rehabilitation Research and Clinical Translation*, 2(1):100037, 2020

16. S. B. Gesell, C. D. Bushnell, S. B. Jones, S. W. Coleman, S. M. Levy[‡], J. G. Xenakis[‡], B. J. Lutz, J. P. Bettger, J. Freburger, J. R. Halladay, A. M. Johnson, A. M. Kucharska-Newton,

L. H. Mettam, A. M. Pastva, **M. A. Psioda**, M. D. Radman, W. D. Rosamond, M. E. Sissine, J. Halls, and P. W. Duncan. Implementation of a Billable Transitional Care Model for Stroke Patients: The COMPASS Study. *BMC Health Services Research*, 19(1):978, 2019

17. J. M. Sales, C. Escoffery, S. A. Hussen, L. B. Haddad, A. Phillips, T. Filipowicz, M. Sanchez, M. McCumber, B. Rupp, E. Kwiatkowski, **M. A. Psioda**, and A. N. Sheth. Integrating PrEP into Family Planning Services at Title X Clinics in the Southeastern US – Phase 1 (ATN 155). *JMIR Research Protocols*, 8(6):e12774, 2019

18. H. P. Santos, A. Bhattacharya, E. M. Martin, K. Addo, **M. A. Psioda**, L. Smeester, R. M. Joseph, S. R. Hooper, J. A. Frazier, K. C. Kuban, T. O'Shea, and R. C. Fry. Epigenome-Wide DNA Methylation in Placentas from Preterm Infants: Association with Maternal Socioeconomic Status. *Epigenetics*, 14(8):751–765, 2019

19. J. T. Bangma, E. Kwiatkowski†, **M. A. Psioda**, H. P. Santos Jr., S. R. Hooper, L. Douglass, R. M. Joseph, J. A. Frazier, K. C. K. Kuban, T. M. O'Shea, and R. C. Fry. Early life antecedents of positive child health among 10-year-old children born extremely preterm. *Pediatric Research*, 86(6):758–765, 2019

20. J. T. Bangma, E. Kwiatkowski†, **M. A. Psioda**, H. P. Santos Jr., S. R. Hooper, L. Douglass, R. M. Joseph, J. A. Frazier, K. C. K. Kuban, T. M. O'Shea, and R. C. Fry. Understanding positive child health. *Pediatric Research*, 86(6):690–691, 2019

21. J. H. Brice, **M. A. Psioda**, R. Johnson, A. Oakley, J. M. Cyr, C. S. Cowden, and R. Uribe. Effect of Dial-Out Prefix Change on 9-1-1 Calls at a Large State University. *Prehospital Emergency Care*, 22(6):1–5, 2018

22. A. Lockhart, **M. A. Psioda**, J. Ting, S. Campbell, N. Mugo, J. Kwatampora, M. Chitwa, J. Kimani, A. Gakure, and J. S. Smith. Prospective Evaluation of Cervicovaginal Self- and Cervical Physician Collection for the Detection of Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis, and Mycoplasma genitalium Infections. *Sexually Transmitted Diseases*, 45(7), 2018

23. J. T. Bangma, E. Kwiatkowski†, **M. A. Psioda**, H. P. Santos Jr, S. R. Hooper, L. Douglass, R. M. Joseph, J. A. Frazier, K. C. K. Kuban, T. M. O'Shea, and R. C. Fry. Assessing Positive Child Health among Individuals Born Extremely Preterm. *The Journal of Pediatrics*, 202:44–49.e4, 2018

24. P. W. Duncan, R. M. Abbott, S. Rushing, A. M. Johnson, C. N. Condon, S. L. Lycan, B. J. Lutz, D. M. Cummings, A. M. Pastva, R. B. D'Agostino, J. M. Stafford, R. M. Amoroso, S. B. Jones Berkeley, **M. A. Psioda**, S. B. Gesell, W. D. Rosamond, J. Prvu-Bettger, M. E. Sissine, D. Boynton Mark, and C. D. Bushnell. COMPASS-CP: An Electronic Application to Capture Patient-Reported Outcomes to Develop Actionable Stroke and Transient Ischemic Attack Care Plans. *Circulation: Cardiovascular Quality and Outcomes*, 11(8):e004444, 2018

25. M. McCumber, D. Cain, S. LeGrand, K. H. Mayer, D. A. Murphy, **M. A. Psioda**, A. C. Seña, T. J. Starks, and M. Hudgens. Adolescent Medicine Trials Network for HIV/AIDS Interventions Data Harmonization: Rationale and Development of Guidelines. *JMIR Res Protoc*, 7(12):e11207, 2018

26. J. H. Brice, F. S. Shofer, C. Cowden, E. B. Lerner, **M. A. Psioda**, M. Arasaratanam, N. C. Mann, A. R. Fernandez, A. Waller, C. Moss, and M. Mian. Evaluation of the Implementation

of the Trauma Triage and Destination Plan on the Field Triage of Injured Patients in North Carolina. *Prehospital Emergency Care*, 21(5):591–604, 2017

27. J. J. Bower, L. D. Vance, **M. A. Psioda**, S. L. Smith-Roe, D. A. Simpson, J. G. Ibrahim, K. A. Hoadley, C. M. Perou, and W. K. Kaufmann. Patterns of cell cycle checkpoint deregulation associated with intrinsic molecular subtypes of human breast cancer cells. *npj Breast Cancer*, 3(1):9, 2017

28. J. A. Cribb, L. D. Osborne, K. Beicker, **M. A. Psioda**, J. Chen, E. T. O'Brien, R. M. Taylor II, L. Vicci, J. P.-L. Hsiao, C. Shao, M. Falvo, J. G. Ibrahim, K. C. Wood, G. C. Blobe, and R. Superfine. An Automated High-throughput Array Microscope for Cancer Cell Mechanics. *Scientific Reports*, 6:27371, 2016

Manuscripts Under Review

R1. M. Radman, S. B. Jones, S. Levy[‡], S. Coleman, M. Sissine, **M. A. Psioda**, C. Bushnell, and P. W. Duncan. Patient-Reported Physical Outcomes Measure Global Health in Mild-to-Moderate Stroke and TIA Patients. *Stroke*, under review

R2. E. Cherenack, K. Enders[‡], B. M. Rupp, A. C. Seña, and **M. A. Psioda**. Daily predictors of art adherence among hiv-infected young men who have sex with men: A longitudinal daily diary study. *AIDS and Behavior*, under review

R3. A. M. Kucharska-Newton, J. R. Halladay, **M. A. Psioda**, S. B. Jones, A. M. Johnson, S. W. Coleman, D. M. Cummings, J. K. Freburger, L. C. Daras, W. D. Rosamond, P. W. Duncan, and C. D. Bushnell. Post-acute ambulatory care service use among patients discharged home after stroke or tia: The cluster-randomized compass study. *Neurology*, under review

R4. W. D. Rosamond, A. M. Kucharska-Newton, S. B. Jones, **M. A. Psioda**, B. J. Lutz, A. M. Johnson, S. W. Coleman, S. R. Schilsky, M. D. Patel, and P. W. Duncan. Emergency department utilization after hospitalization discharge for acute stroke or tia: The compass study. *Stroke*, under review

R5. B. J. Lutz, A. M. Kucharska-Newton, S. B. Jones, **M. A. Psioda**, S. B. Gesell, S. W. Coleman, A. M. Johnson, M. D. Radman, S. Levy, J. A. Prvu Bettger, J. K. Freburger, A. Chou, J. F. Celestino, W. Rosamond, C. D. Bushnell, and P. W. Duncan. Familial caregiving following stroke: Findings from the compass pragmatic cluster-randomized trial. *Disability and Rehabilitation*, under review

ORAL PRESENTATIONS

* indicates invited presentation

2021* **M. A. Psioda**. Bayesian Sequential Monitoring for Pediatric Clinical Trials with Adult Data Extrapolation. WNAR. 2021. Virtual Conference.

2021* **M. A. Psioda**. Bayesian Sequential Monitoring for Pediatric Clinical Trials with Adult Data Extrapolation. International Indian Statistical Association Conference. 2021. Virtual Conference.

2021* **M. A. Psioda**. Performing comprehensive simulations to evaluate adaptive Bayesian trials that incorporate information borrowing. Duke Industry Statistics Symposium. 2021. Virtual Conference.

2021* E. Alt and **M. A. Psioda**. Bayesian Multivariate Probability of Success with Strict Control of Type I Error. DIA Bayesian KOL Lecture Series. 2021. Virtual Seminar.

2020* **M. A. Psioda**. Use of Hybrid Control Arms with Adaptive Power Priors for Time-to-Event Data. International Chinese Statistical Association Applied Statistics Symposium. 2020. Virtual Conference.

2020* **M. A. Psioda**. An Introduction to use of Bayesian Methods for Clinical Trials. US Food and Drug Administration. 2020. Virtual Meeting.

2020* **M. A. Psioda**. Bayesian Sequential Monitoring of Clinical Trials. Boston University Clinical Trials Seminar Series. 2020. Virtual Meeting.

2020* **M. A. Psioda**. Bayesian Sequential Monitoring of Clinical Trials. ENAR. 2020. Virtual Conference (ENAR Top Ranked Invited Proposal)

2020* **M. A. Psioda**. Bayesian Sequential Monitoring of Clinical Trials Using SAS. SAS Global Forum. 2020. Virtual Conference

2020* **M. A. Psioda**. An Introduction to Bayesian Methods for Clinical Trials: Applications Ranging from Simple to Complex. US Food and Drug Administration. 2020. Silver Spring, MD.

2019* **M. A. Psioda**. Bayesian Sequential Monitoring for Pediatric Clinical Trials. ASA Regulatory-Industry Statistics Workshop. 2019. Washington, DC.

2019* **M. A. Psioda**, M. Soukup, J. G. Ibrahim. A Practical Bayesian Adaptive Design with Application to Cardiovascular Outcomes Trials. ASA Regulatory-Industry Statistics Workshop. 2019. Washington, DC

2019*	**M. A. Psioda**, Q. Jiang, C. Ke, Y. Zhao, J. G. Ibrahim. Bayesian Adaptive Basket Trial Design Using Model Averaging. Duke Industry Statistics Symposium. 2019. Durham, NC.
2019	**M. A. Psioda**, T. Jiang, A. Xia, J. Xu, J. G. Ibrahim. A Bayesian Adaptive Design for Concurrent Trials Involving Biologically-Related Diseases. ENAR. 2019. Philadelphia, PA.
2018*	**M. A. Psioda**. An Introduction to Bayesian Sequential Monitoring of Clinical Trials. US Food and Drug Administration. 2018. Silver Spring, MD.
2018*	**M. A. Psioda**, S. B. Jones. Methodological Challenges & Strategies in the Comprehensive Post-Acute Stroke Services (COMPASS) Study. PCORI Transitional Care Evidence to Action Network Meeting. 2018. Washington, DC.
2018	**M. A. Psioda**, Q. Jiang, C. Ke, Y. Zhao, J. G. Ibrahim. Bayesian Adaptive Basket Trial Design Using Model Averaging. The Joint Statistical Meetings. 2018. Vancouver, BC.
2017*	**M. A. Psioda**, M. Soukup, J. G. Ibrahim. A Practical Bayesian Adaptive Design with Application to Cardiovascular Outcomes Trials. US Food and Drug Administration. 2018. Silver Spring, MD.
2017	**M. A. Psioda**, M. Soukup, J. G. Ibrahim. A Practical Bayesian Adaptive Design with Application to Cardiovascular Outcomes Trials. The Joint Statistical Meetings. 2017. Baltimore, MD.
2016	**M. A. Psioda**, J. G. Ibrahim. Bayesian Clinical Trial Design for Survival Studies with Historical Data Under a Proportional Hazards Assumption. The Joint Statistical Meetings. 2016. Chicago, IL.
2012	**M. A. Psioda**. Random Effects Simulation for Sample Size Calculations Using SAS. Proceedings of the Southeast SAS Users Group. 2012. Raleigh, NC.
2010	**M. A. Psioda**, E. Bakewell. Leveraging CDISC Models to Drive Process Efficiency and Increase Product Quality. North American CDISC Interchange. 2010. Baltimore, MD.

TEACHING EXPERIENCE

Fall, 2016-2019	Bios 511: Statistical Computing and Research Data Management Department of Biostatistics University of North Carolina at Chapel Hill Course size: 55-65 students per year
Spring, 2021	Bios 767: Longitudinal Data Analysis Department of Biostatistics University of North Carolina at Chapel Hill Course size: 20-30 students per year

DOCTORAL STUDENTS ADVISED

1. Emily Damone (2021 –), co-advised with Dr. Joseph G. Ibrahim

2. Ethan Alt (2019 –), co-advised with Dr. Joseph G. Ibrahim

3. Seoyoon Cho (2019 –), co-advised with Dr. Joseph G. Ibrahim

4. Kimberly Enders (2019 –)

5. Evan Kwiatkowski (2019 –)

6. Jiawei Xu (2018 –), co-advised with Dr. Joseph G. Ibrahim

7. Brady Nifong (2018 –), co-advised with Dr. Joseph G. Ibrahim

8. Nathan Bean (2018 –), co-advised with Dr. Joseph G. Ibrahim

9. David Pritchard (2017 – 2020), co-advised with Dr. Yufeng Liu

MASTERS STUDENTS ADVISED

1. Samantha Levy (2018 – 2019)

2. Marcus Spearman (2018 – 2019)

3. Betsy Hensel (2019 – 2020)

DOCTORAL DISSERTATION COMMITTEE

1. Elizabeth Rowley, Department of Biostatistics (2018).
   Advisors: Dr. Chirayath M. Suchindran & Dr. Annie Green Howard

2. Pooja T. Saha, Department of Biostatistics (2021).
   Advisors: Dr. Anastasia Ivanova

ACTIVE GRANT FUNDING

1. Title: Back Pain Consortium (BACPAC) Research Program Data Integration, Algorithm Development and Operations Management Center [1 U24 AT076730-01] ; Source: National Institute of Arthritis and Musculoskeletal and Skin Disease (NIAMS); Role: Co-Investigator (PI: LaVange); Start & End: 09/30/19 – 09/29/24

2. Title: Complex Innovative Design for Genentech; Source: Genentech, Inc.; Role: Primary Investigator; Start & End: 09/06/19 –12/06/21

3. Title: Placental DNA Methylation, Maternal Hardship and Child Neurodevelopmental Outcomes [1-K23-NR017898-01] ; Source: National Institute of Nursing Research (NINR); Role: Co-Investigator (PI: Santos); Start & End: 07/01/18 – 06/30/21

4. Title: FDA Assignment Agreement [A18-1056-002] ; Source: US Food & Drug Administration; Role: Primary Investigator; Start & End: 04/01/18 – 03/31/22

5. Title: Supported Research Agreement [PO 7300001228]; Source: Amgen, Inc.; Role: Co-Investigator (PI: Ibrahim); Start & End: 01/01/17 – 12/31/21

6. Title: Adolescent Medicine Trials Network for HIV/AIDS Interventions (ATN) Coordinating Center Supplement [1 U24 HD089880-01S1]; Source: E. K. Shriver National Institute of Child Health and Human Development (NICHD); Role: Co-Investigator (PI: LaVange); Start & End: 09/30/16 – 05/31/21

7. Title: COMprehenstive Post-Acute Stroke Service Study (COMPASS) [WFUHS 668420 UNC]; Source: Wake Forest University (PCORI); Role: Co-Investigator (PI: Duncan); Start & End: 04/01/15 – 06/30/21

DEPARTMENT SERVICE

2016 – Current	Computing Committee (Chair), Department of Biostatistics
2018 – Current	MPH Data Science Committee (Member), Department of Biostatistics

UNIVERSITY SERVICE

2018 – 2019	Gillings One MPH Steering Committee (Representative for Public Health Data Science Concentration)

OTHER SERVICE

2019 – Current	NIH Back Pain Consortium (BACPAC) Executive Committee (NIH Appointed Chair)
2020 – 2021	NIH Back Pain Consortium (BACPAC) Steering Committee (Elected Co-Chair)

JOURNAL REFEREEING

Biometrics
Biostatistics
Controlled Clinical Trials
Journal of the American Statistical Association
Journal of Biopharmaceutical Statistics
PCORI Methodology Review
Statistics in Biopharmaceutical Research
Statistics in Medicine