

# Stanford

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## Michelle Whirl Carrillo

Senior Research Scientist, Biomedical Data Science

### Bio

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#### CURRENT ROLE AT STANFORD

Associate Director, PharmGKB

[www.pharmgkb.org](http://www.pharmgkb.org)

#### EDUCATION AND CERTIFICATIONS

- PhD, Stanford University , Biophysics (2002)
- SB, Massachusetts Institute of Technology , Biology (1993)

### Professional

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#### PROFESSIONAL INTERESTS

My work focuses on pharmacogenomics, the study of the impact of genetics on drug response, and its application to personalized medicine and personal genomics. My interests range from basic research studying gene-variant-drug associations to translation of pharmacogenomics information into the clinical setting, including reducing barriers to implementing PGx prescribing guidelines in the clinical electronic environment (CDS/EHR). I am particularly interested in translation of human genome sequencing data to pharmacogenomic-based therapeutic recommendations that are actionable in the clinic.

### Publications

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#### PUBLICATIONS

- **Standardized Biogeographic Grouping System for Annotating Populations in Pharmacogenetic Research** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Huddart, R., Fohner, A. E., Whirl-Carrillo, M., Wojcik, G. L., Gignoux, C. R., Popejoy, A. B., Bustamante, C. D., Altman, R. B., Klein, T. E.  
2019; 105 (5): 1256–62
- **Standardizing terms for clinical pharmacogenetic test results: consensus terms from the Clinical Pharmacogenetics Implementation Consortium (CPIC).** *Genetics in medicine*  
Caudle, K. E., Dunnenberger, H. M., Freimuth, R. R., Peterson, J. F., Burlison, J. D., Whirl-Carrillo, M., Scott, S. A., Rehm, H. L., Williams, M. S., Klein, T. E., Relling, M. V., Hoffman, J. M.  
2016
- **Enabling the curation of your pharmacogenetic study.** *Clinical pharmacology & therapeutics*  
MCDONAGH, E. M., Whirl-Carrillo, M., Altman, R. B., Klein, T. E.  
2015; 97 (2): 116-119
- **Pharmacogenomics Knowledge for Personalized Medicine** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Whirl-Carrillo, M., MCDONAGH, E. M., Hebert, J. M., Gong, L., Sangkuhl, K., Thorn, C. F., Altman, R. B., Klein, T. E.  
2012; 92 (4): 414-417

- **Phased Whole-Genome Genetic Risk in a Family Quartet Using a Major Allele Reference Sequence** *PLOS GENETICS*  
Dewey, F. E., Chen, R., Cordero, S. P., Ormond, K. E., Caleshu, C., Karczewski, K. J., Whirl-Carrillo, M., Wheeler, M. T., Dudley, J. T., Byrnes, J. K., Cornejo, O. E., Knowles, J. W., Woon, et al  
2011; 7 (9)
- **An XML-based interchange format for genotype-phenotype data** *HUMAN MUTATION*  
Whirl-Carrillo, M., Woon, M., Thorn, C. E., Klein, T. E., Altman, R. B.  
2008; 29 (2): 212-219
- **Mining biochemical information: Lessons taught by the ribosome** *RNA-A PUBLICATION OF THE RNA SOCIETY*  
Whirl-Carrillo, M., Gabashvili, I. S., Bada, M., Banatao, D. R., Altman, R. B.  
2002; 8 (3): 279-289
- **Clinical Pharmacogenetics Implementation Consortium Guideline for Thiopurine Dosing Based on TPMT and NUDT15 Genotypes: 2018 Update** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Relling, M., Schwab, M., Whirl-Carrillo, M., Suarez-Kurtz, G., Pui, C., Stein, C. M., Moyer, A. M., Evans, W. E., Klein, T. E., Guillermo Antillon-Klussmann, F., Caudle, K. E., Kato, M., Yeoh, et al  
2019; 105 (5): 1095–1105
- **Pharmacogene Variation Consortium Gene Introduction: NUDT15** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Yang, J. J., Whirl-Carrillo, M., Scott, S. A., Turner, A. J., Schwab, M., Tanaka, Y., Suarez-Kurtz, G., Schaeffeler, E., Klein, T. E., Miller, N. A., Gaedigk, A.  
2019; 105 (5): 1091–94
- **Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline for CYP2B6 and Efavirenz-containing Antiretroviral Therapy.** *Clinical pharmacology and therapeutics*  
Desta, Z., Gammal, R. S., Gong, L., Whirl-Carrillo, M., Gaur, A. H., Sukasem, C., Hockings, J., Myers, A., Swart, M., Tyndale, R., Masimirembwa, C., Iwuchukwu, O. F., Chirwa, et al  
2019
- **Are Randomized Controlled Trials Necessary to Establish the Value of Implementing Pharmacogenomics in the Clinic?** *Clinical pharmacology and therapeutics*  
Huddart, R., Sangkuhl, K., Whirl-Carrillo, M., Klein, T. E.  
2019
- **BIOINFORMATICS: ACCUMULATING AND IMPLEMENTING PHARMACOGENOMICS INFORMATION**  
Whirl-Carrillo, M.  
JAPANESE SOC STUDY XENOBIOTICS.2019: S6
- **Recommendations for Clinical CYP2C9 Genotyping Allele Selection: A Joint Recommendation of the Association for Molecular Pathology and College of American Pathologists.** *The Journal of molecular diagnostics : JMD*  
Pratt, V. M., Cavallari, L. H., Del Tredici, A. L., Hachad, H., Ji, Y., Moyer, A. M., Scott, S. A., Whirl-Carrillo, M., Weck, K. E.  
2019
- **The Evolution of PharmVar.** *Clinical pharmacology and therapeutics*  
Gaedigk, A., Sangkuhl, K., Whirl-Carrillo, M., Twist, G. P., Klein, T. E., Miller, N. A., PharmVar Steering Committee  
2018
- **Pharmacogene Variation Consortium Gene Introduction: NUDT15.** *Clinical pharmacology and therapeutics*  
Yang, J. J., Whirl-Carrillo, M., Scott, S. A., Turner, A. J., Schwab, M., Tanaka, Y., Suarez-Kurtz, G., Schaeffeler, E., Klein, T. E., Miller, N. A., Gaedigk, A.  
2018
- **Standardized biogeographic grouping system for annotating populations in pharmacogenetic research.** *Clinical pharmacology and therapeutics*  
Huddart, R., Fohner, A. E., Whirl-Carrillo, M., Wojcik, G. L., Gignoux, C. R., Popejoy, A. B., Bustamante, C. D., Altman, R. B., Klein, T. E.  
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- **Clinical Pharmacogenetics Implementation Consortium (CPIC) guideline for thiopurine dosing based on TPMT and NUDT15 genotypes: 2018 update.** *Clinical pharmacology and therapeutics*  
Relling, M. V., Schwab, M., Whirl-Carrillo, M., Suarez-Kurtz, G., Pui, C., Stein, C. M., Moyer, A. M., Evans, W. E., Klein, T. E., Antillon-Klussmann, F. G., Caudle, K. E., Kato, M., Yeoh, et al  
2018

- **Essential characteristics of pharmacogenomics study publications.** *Clinical pharmacology and therapeutics*  
Thorn, C. F., Whirl-Carrillo, M., Hachad, H., Johnson, J. A., McDonagh, E. M., Ratain, M. J., Relling, M. V., Scott, S. A., Altman, R. B., Klein, T. E.  
2018
- **Standardization can accelerate the adoption of pharmacogenomics: current status and the path forward** *PHARMACOGENOMICS*  
Caudle, K. E., Keeling, N. J., Klein, T. E., Whirl-Carrillo, M., Pratt, V. M., Hoffman, J. M.  
2018; 19 (10): 847–60
- **Pharmacogenomics and big genomic data: from lab to clinic and back again.** *Human molecular genetics*  
Lavertu, A., McInnes, G., Daneshjou, R., Whirl-Carrillo, M., Klein, T. E., Altman, R. B.  
2018; 27 (R1): R72–R78
- **Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline for CYP2D6 and Tamoxifen Therapy** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Goetz, M. P., Sangkuhl, K., Guchelaar, H., Schwab, M., Province, M., Whirl-Carrillo, M., Symmans, W., McLeod, H. L., Ratain, M. J., Zembutsu, H., Gaedigk, A., van Schaik, R. H., Ingle, et al  
2018; 103 (5): 770–77
- **Comparison of the Guidelines of the Clinical Pharmacogenetics Implementation Consortium and the Dutch Pharmacogenetics Working Group** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Bank, P. D., Caudle, K. E., Swen, J. J., Gammal, R. S., Whirl-Carrillo, M., Klein, T. E., Relling, M. V., Guchelaar, H.  
2018; 103 (4): 599–618
- **Clinical Pharmacogenetics Implementation Consortium Guideline for HLA Genotype and Use of Carbamazepine and Oxcarbazepine: 2017 Update** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Phillips, E. J., Sukasem, C., Whirl-Carrillo, M., Mueller, D. J., Dunnenberger, H. M., Chantratita, W., Goldspiel, B., Chen, Y., Carleton, B. C., George, A. L., Mushiroda, T., Klein, T., Gammal, et al  
2018; 103 (4): 574–81
- **THE PHARMACOGENE VARIATION CONSORTIUM: INCORPORATION OF THE HUMAN CYTOCHROME P450 ALLELE NOMENCLATURE DATABASE.**  
Gaedigk, A., Klein, T. E., Twist, G. P., Whirl-Carrillo, M., Miller, N. A.  
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- **The Pharmacogene Variation (PharmVar) Consortium: Incorporation of the Human Cytochrome P450 (CYP) Allele Nomenclature Database** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Gaedigk, A., Ingelman-Sundberg, M., Miller, N. A., Leeder, J., Whirl-Carrillo, M., Klein, T. E., PharmVar Steering Comm  
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- **PharmGKB: A worldwide resource for pharmacogenomic information.** *Wiley interdisciplinary reviews. Systems biology and medicine*  
Barbarino, J. M., Whirl-Carrillo, M., Altman, R. B., Klein, T. E.  
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- **Clinical pharmacogenetics implementation consortium (cpic) guideline for pharmacogenetics-guided warfarin dosing: 2017 update.** *Clinical pharmacology & therapeutics*  
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2017; 19 (2): 215-223
- **"The Pharmacogenomics Research Network Translational Pharmacogenetics Program: Outcomes and Metrics of Pharmacogenetic Implementations Across Diverse Healthcare Systems".** *Clinical pharmacology & therapeutics*  
Luzum, J. A., Pakyz, R. E., Elsey, A. R., Haidar, C. E., Peterson, J. F., Whirl-Carrillo, M., Handelman, S. K., Palmer, K., Pulley, J. M., Beller, M., Schildcrout, J. S., Field, J. R., Weitzel, et al  
2017

- **PharmGKB summary: ivacaftor pathway, pharmacokinetics/pharmacodynamics** *PHARMACOGENETICS AND GENOMICS*  
Fohner, A. E., McDonagh, E. M., Clancy, J. P., Carrillo, M. W., Altman, R. B., Klein, T. E.  
2017; 27 (1): 39-42
- **Prediction of CYP2D6 phenotype from genotype across world populations** *GENETICS IN MEDICINE*  
Gaedigk, A., Sangkuhl, K., Whirl-Carrillo, M., Klein, T., Leeder, J. S.  
2017; 19 (1): 69-76
- **Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline for CYP2D6 Genotype and Use of Ondansetron and Tropisetron.** *Clinical pharmacology & therapeutics*  
Bell, G. C., Caudle, K. E., Whirl-Carrillo, M., Gordon, R. J., Hikino, K., Prows, C. A., Gaedigk, A., Agundez, J. A., Sadhasivam, S., Klein, T. E., Schwab, M.  
2016
- **Evidence and resources to implement pharmacogenetic knowledge for precision medicine** *AMERICAN JOURNAL OF HEALTH-SYSTEM PHARMACY*  
Caudle, K. E., Gammal, R. S., Whirl-Carrillo, M., Hoffman, J. M., Belling, M. V., Klein, T. E.  
2016; 73 (23): 1977-1985
- **Evidence and resources to implement pharmacogenetic knowledge for precision medicine.** *American journal of health-system pharmacy*  
Caudle, K. E., Gammal, R. S., Whirl-Carrillo, M., Hoffman, J. M., Relling, M. V., Klein, T. E.  
2016; 73 (23): 1977-1985
- **PharmGKB summary: ivacaftor pathway, pharmacokinetics/pharmacodynamics.** *Pharmacogenetics and genomics*  
Fohner, A. E., McDonagh, E. M., Clancy, J. P., Whirl Carrillo, M., Altman, R. B., Klein, T. E.  
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- **Prediction of CYP2D6 phenotype from genotype across world populations.** *Genetics in medicine*  
Gaedigk, A., Sangkuhl, K., Whirl-Carrillo, M., Klein, T., Leeder, J. S.  
2016
- **Developing knowledge resources to support precision medicine: principles from the Clinical Pharmacogenetics Implementation Consortium (CPIC)** *JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION*  
Hoffman, J. M., Dunnenberger, H. M., Hicks, J. K., Caudle, K. E., Carrillo, M. W., Freimuth, R. R., Williams, M. S., Klein, T. E., Peterson, J. F.  
2016; 23 (4): 796-801
- **Developing knowledge resources to support precision medicine: principles from the Clinical Pharmacogenetics Implementation Consortium (CPIC).** *Journal of the American Medical Informatics Association*  
Hoffman, J. M., Dunnenberger, H. M., Kevin Hicks, J., Caudle, K. E., Whirl Carrillo, M., Freimuth, R. R., Williams, M. S., Klein, T. E., Peterson, J. F.  
2016; 23 (4): 796-801
- **Novel Disease-Drug Database Demonstrating Applicability for Pharmacogenomic-Based Prescribing.** *Clinical pharmacology & therapeutics*  
Whirl-Carrillo, M., Sangkuhl, K., Gong, L., Klein, T. E.  
2016
- **Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline for UGT1A1 and Atazanavir Prescribing.** *Clinical pharmacology & therapeutics*  
Gammal, R. S., Court, M. H., Haidar, C. E., Iwuchukwu, O. F., Gaur, A. H., Alvarellos, M., Guillemette, C., Lennox, J. L., Whirl-Carrillo, M., Brummel, S. S., Ratain, M. J., Klein, T. E., Schackman, et al  
2016; 99 (4): 363-369
- **Pharmacogenetic allele nomenclature: International workgroup recommendations for test result reporting.** *Clinical pharmacology & therapeutics*  
Kalman, L. V., Agúndez, J., Appell, M. L., Black, J. L., Bell, G. C., Boukouvala, S., Bruckner, C., Bruford, E., Caudle, K., Coulthard, S. A., Daly, A. K., Tredici, A. D., den Dunnen, et al  
2016; 99 (2): 172-185
- **Sequence to Medical Phenotypes: A Framework for Interpretation of Human Whole Genome DNA Sequence Data** *PLOS GENETICS*  
Dewey, F. E., Grove, M. E., Priest, J. R., Waggott, D., Batra, P., Miller, C. L., Wheeler, M., Zia, A., Pan, C., Karzcewski, K. J., Miyake, C., Whirl-Carrillo, M., Klein, et al  
2015; 11 (10)
- **A twentieth anniversary tribute to psb.** *Pacific Symposium on Biocomputing. Pacific Symposium on Biocomputing*  
Hewett, D., Whirl-Carrillo, M., Hunter, L. E., Altman, R. B., Klein, T. E.

2015; 20: 1-7

- **PharmGKB summary: very important pharmacogene information for CYP4F2** *PHARMACOGENETICS AND GENOMICS*  
Alvarellos, M. L., Sangkuhl, K., Daneshjou, R., Whirl-Carrillo, M., Altman, R. B., Klein, T. E.  
2015; 25 (1): 41-47
- **Clinical Pharmacogenetics Implementation Consortium Guidelines for CYP2C9 and HLA-B Genotypes and Phenytoin Dosing** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Caudle, K. E., Rettie, A. E., Whirl-Carrillo, M., Smith, L. H., Mintzer, S., Lee, M. T., Klein, T. E., Callaghan, J. T.  
2014; 96 (5): 542-548
- **Clinical pharmacogenetics implementation consortium guidelines for CYP2C9 and HLA-B genotypes and phenytoin dosing.** *Clinical pharmacology & therapeutics*  
Caudle, K. E., Rettie, A. E., Whirl-Carrillo, M., Smith, L. H., Mintzer, S., Lee, M. T., Klein, T. E., Callaghan, J. T.  
2014; 96 (5): 542-548
- **In silico comparative characterization of pharmacogenomic missense variants** *BMC GENOMICS*  
Li, B., Seligman, C., Thusberg, J., Miller, J. L., Auer, J., Whirl-Carrillo, M., Capriotti, E., Klein, T. E., Mooney, S. D.  
2014; 15
- **Clinical interpretation and implications of whole-genome sequencing.** *JAMA : the journal of the American Medical Association*  
Dewey, F. E., Grove, M. E., Pan, C., Goldstein, B. A., Bernstein, J. A., Chaib, H., Merker, J. D., Goldfeder, R. L., Enns, G. M., David, S. P., Pakdaman, N., Ormond, K. E., Caleshu, et al  
2014; 311 (10): 1035-1045
- **Incorporation of Pharmacogenomics into Routine Clinical Practice: the Clinical Pharmacogenetics Implementation Consortium (CPIC) Guideline Development Process.** *Current drug metabolism*  
Caudle, K. E., Klein, T. E., Hoffman, J. M., Muller, D. J., Whirl-Carrillo, M., Gong, L., McDonagh, E. M., Sangkuhl, K., Thorn, C. F., Schwab, M., Agundez, J. A., Freimuth, R. R., Huser, et al  
2014; 15 (2): 209-217
- **PharmGKB summary: very important pharmacogene information for the epidermal growth factor receptor.** *Pharmacogenetics and genomics*  
Hodoglugil, U., Carrillo, M. W., Hebert, J. M., Karachaliou, N., Rosell, R. C., Altman, R. B., Klein, T. E.  
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- **Clinical pharmacogenetics implementation consortium guidelines for hla-B genotype and carbamazepine dosing.** *Clinical pharmacology & therapeutics*  
Leckband, S. G., Kelson, J. R., Dunnenberger, H. M., George, A. L., Tran, E., Berger, R., Müller, D. J., Whirl-Carrillo, M., Caudle, K. E., Pirmohamed, M.  
2013; 94 (3): 324-328
- **The Pharmacogenomics Research Network Translational Pharmacogenetics Program: Overcoming Challenges of Real-World Implementation** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Shuldiner, A. R., RELLING, M. V., Peterson, J. F., Hicks, J. K., Freimuth, R. R., Sadee, W., Pereira, N. L., Roden, D. M., Johnson, J. A., Klein, T. E.  
2013; 94 (2): 207-210
- **Challenges in the Pharmacogenomic Annotation of Whole Genomes** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Altman, R. B., Whirl-Carrillo, M., Klein, T. E.  
2013; 94 (2): 211-213
- **Clinical Pharmacogenetics Implementation Consortium Guidelines for Thiopurine Methyltransferase Genotype and Thiopurine Dosing: 2013 Update** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Relling, M. V., Gardner, E. E., Sandborn, W. J., Schmiegelow, K., Pui, C., Yee, S. W., Stein, C. M., Carrillo, M., Evans, W. E., Hicks, J. K., Schwab, M., Klein, T. E.  
2013; 93 (4): 324-325
- **PharmGKB summary: very important pharmacogene information for cytochrome P-450, family 2, subfamily A, polypeptide 6** *PHARMACOGENETICS AND GENOMICS*  
McDonagh, E. M., Wassenaar, C., David, S. P., Tyndale, R. F., Altman, R. B., Whirl-Carrillo, M., Klein, T. E.  
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- **PharmGKB summary: phenytoin pathway** *PHARMACOGENETICS AND GENOMICS*  
Thorn, C. F., Whirl-Carrillo, M., Leeder, J. S., Klein, T. E., Altman, R. B.

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- **Using ODIN for a PharmGKB revalidation experiment** *DATABASE-THE JOURNAL OF BIOLOGICAL DATABASES AND CURATION*  
Rinaldi, F., Clematide, S., Garten, Y., Whirl-Carrillo, M., Gong, L., Hebert, J. M., Sangkuhl, K., Thorn, C. F., Klein, T. E., Altman, R. B.  
2012
- **Personal Omics Profiling Reveals Dynamic Molecular and Medical Phenotypes** *CELL*  
Chen, R., Mias, G. I., Li-Pook-Than, J., Jiang, L., Lam, H. Y., Chen, R., Miriami, E., Karczewski, K. J., Hariharan, M., Dewey, F. E., Cheng, Y., Clark, M. J., Im, et al  
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- **From pharmacogenomic knowledge acquisition to clinical applications: the PharmGKB as a clinical pharmacogenomic biomarker resource** *BIOMARKERS IN MEDICINE*  
McDonagh, E. M., Whirl-Carrillo, M., Garten, Y., Altman, R. B., Klein, T. E.  
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- **Clinical Pharmacogenetics Implementation Consortium Guidelines for CYP2C9 and VKORC1 Genotypes and Warfarin Dosing** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Johnson, J. A., Gong, L., Whirl-Carrillo, M., Gage, B. F., Scott, S. A., Stein, C. M., Anderson, J. L., Kimmel, S. E., Lee, M. T., Pirmohamed, M., Wadelius, M., Klein, T. E., Altman, et al  
2011; 90 (4): 625-629
- **PharmGKB summary: fluoropyrimidine pathways** *PHARMACOGENETICS AND GENOMICS*  
Thorn, C. F., Marsh, S., Carrillo, M. W., McLeod, H. L., Klein, T. E., Altman, R. B.  
2011; 21 (4): 237-242
- **Clinical Pharmacogenetics Implementation Consortium Guidelines for Thiopurine Methyltransferase Genotype and Thiopurine Dosing** *CLINICAL PHARMACOLOGY & THERAPEUTICS*  
Relling, M. V., Gardner, E. E., Sandborn, W. J., Schmiegelow, K., Pui, C., Yee, S. W., Stein, C. M., Carrillo, M., Evans, W. E., Klein, T. E.  
2011; 89 (3): 387-391
- **The BioPAX community standard for pathway data sharing** *NATURE BIOTECHNOLOGY*  
Demir, E., Cary, M. P., Paley, S., Fukuda, K., Lemer, C., Vastrik, I., Wu, G., D'Eustachio, P., Schaefer, C., Luciano, J., Schacherer, F., Martinez-Flores, I., Hu, et al  
2010; 28 (9): 935-942
- **Cytochrome P450 2C9-CYP2C9** *PHARMACOGENETICS AND GENOMICS*  
Van Booven, D., Marsh, S., McLeod, H., Carrillo, M. W., Sangkuhl, K., Klein, T. E., Altman, R. B.  
2010; 20 (4): 277-281
- **Taxane pathway** *PHARMACOGENETICS AND GENOMICS*  
Oshiro, C., Marsh, S., McLeod, H., Carrillo, M. W., Klein, T., Altman, R.  
2009; 19 (12): 979-983
- **The pharmacogenetics and pharmacogenomics knowledge base: accentuating the knowledge** *NUCLEIC ACIDS RESEARCH*  
Hernandez-Boussard, T., Whirl-Carrillo, M., Hebert, J. M., Gong, L., Owen, R., Gong, M., Gor, W., Liu, F., Truong, C., Whaley, R., Woon, M., Zhou, T., Altman, et al  
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- **Pacific Symposium on Biocomputing--computational approaches for pharmacogenomics.** *Pharmacogenomics*  
Wilke, R. A., Carrillo, M. W., Ritchie, M. D.  
2005; 6 (2): 111-113
- **A resource to acquire and summarize pharmacogenetics knowledge in the literature** *11th World Congress on Medical Informatics*  
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- **Ribosomal dynamics inferred from variations in experimental measurements** *RNA-A PUBLICATION OF THE RNA SOCIETY*  
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2003; 9 (11): 1301-1307
- **Scoring functions sensitive to alignment error have a more difficult search: A paradox for threading** *Symposium held in Honor of William N Lipscomb on Structures and Mechanisms*

Chang, J., Carrillo, M. W., Waugh, A., Wei, L. P., Altman, R. B.  
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- **Calculation of the relative geometry of tRNAs in the ribosome from directed hydroxyl-radical probing data** *RNA-A PUBLICATION OF THE RNA SOCIETY*  
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2000; 6 (2): 220-232
- **Evidence of oxidative stress in mdx mouse muscle: Studies of the pre-necrotic state** *JOURNAL OF THE NEUROLOGICAL SCIENCES*  
Disatnik, M. H., Dhawan, J., Yu, Y., Beal, M. F., Whirl, M. M., Franco, A. A., Rando, T. A.  
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- **MUTAGENESIS OF VITAMIN-K-DEPENDENT CARBOXYLASE DEMONSTRATES A CARBOXYL TERMINUS-MEDIATED INTERACTION WITH VITAMIN-K HYDROQUINONE** *JOURNAL OF BIOLOGICAL CHEMISTRY*  
Roth, D. A., Whirl, M. L., VELAZQUEZESTADES, L. J., Walsh, C. T., Furie, B., Furie, B. C.  
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