

SUDHIR KUMAR, PH.D.

RESEARCH STATEMENT

Molecular Evolution and Phylomedicine

We use integrative and comparative approaches to make fundamental discoveries in the fields of phylomedicine, molecular evolution and functional genomics. The common theme of our research is the use of comparative analysis to reveal genome differences that are outcomes of natural selection on novel mutations. The taxonomic breadth of our studies spans the tree of life and the timescale of mutation transmission ranges from generation to generation and cell division to cell division. The resulting patterns of evolutionary conservation and divergence form the basis of a Pattern-Process-Prediction-Product (P⁴) approach that enables us to conduct research investigations ranging from scaling the tree of life to time (Timetree of Life) to forecasting disruptive mutations found in personal germline and somatic genomes (Phylomedicine). In pursuit of these biological discoveries, we are developing new statistical methods and computer algorithms to quickly analyze large-scale datasets. We have also developed and disseminated many high-impact software tools (MEGA) and databases (www.TimeTree.org, www.FlyExpress.net, www.myPEG.info).

CITATION PROFILE

H-INDEX = 67, WITH >150,000 CITATIONS

“Sudhir Kumar” on Google Scholar ([Click Here to Access](#))

>120,000 citations to software and databases

> 30,000 citations to discoveries, methods, reviews, and books

EDUCATION

(1990) B. ENGG. – ELECTRICAL & ELECTRONICS ENGINEERING (HONORS)

Birla institute of Technology & Science, Pilani, Rajasthan, India, 1985–1990

(1990) M. SC. – BIOLOGICAL SCIENCES (HONORS)

Birla institute of Technology & Science, Rajasthan, India (*concurrent with B. Engg.)

(1996) PH. D. – GENETICS (ADVISOR: M. NEI)

Pennsylvania State University, University Park, Pennsylvania, USA, 1991–1996

APPOINTMENTS (ACADEMIC)

(2014) LAURA H. CARNELL PROFESSOR

Department of Biology, Temple University, 2014–present

(2014) FULL PROFESSOR

Department of Computer and Information Sciences, Temple University, 2014–present

(2012) REGENTS’ PROFESSOR

School of Life Sciences, Arizona State University (ASU), 2012–2014

(2011) FOUNDATION PROFESSOR

School of Life Science, ASU, 2011–2016

(2006) FULL PROFESSOR

School of Life Science, ASU, 2006–2011

(2002) ASSOCIATE PROFESSOR, SOLS, ASU

School of Life Science, ASU, 2002–2006

(1998) ASSISTANT PROFESSOR

Department of Biology, ASU, 1998–2002

(1996) POSTDOCTORAL FELLOW (WITH M. NEI)

Department of Biology, Pennsylvania State University (PSU), 1996–1998

(1991) RESEARCH AND TEACHING ASSISTANT (WITH M. NEI)

Department of Biology, PSU, 1991–1996

**APPOINTMENTS
(LEADERSHIP)**

(2014) DIRECTOR (IGEM.TEMPLE.EDU)

Institute for Genomics and Evolutionary Medicine (iGEM), Temple University

(2010) DIRECTOR, CENTER FOR EVOLUTIONARY MEDICINE & INFORMATICS

Biodesign Institute, ASU, 2010–2014

(2008) CHIEF SCIENTIFIC OFFICER

Espis Vaccines, LLC, 2008–2010

(2003) DIRECTOR, CENTER FOR EVOLUTIONARY FUNCTIONAL GENOMICS

Biodesign Institute, ASU, 2003–2010

(2003) FACULTY LEADER, GENOMICS, EVOLUTION, AND BIOINFORMATICS

School of Life Science, ASU, 2003–2004

**APPOINTMENTS
(SCIENTIFIC
SOCIETIES)**

(2013) PRESIDENT (ELECTED)

Society for Molecular Biology and Evolution, 2012–2014

(2012) EDITOR-IN-CHIEF

Molecular Biology and Evolution (2012–2022)

(2004) SECRETARY (ELECTED)

Society for Molecular Biology and Evolution, 2004–2006

(2004) WEBMASTER

Society for Molecular Biology and Evolution (www.smbe.org), 2004–2008

(1999) WEBMASTER

American Genetic Association (www.theaga.org), 1999–2007

**APPOINTMENTS
(ADJUNCT)**

(2014) MEMBER, MOLECULAR THERAPEUTICS PROGRAM

Fox Chase Cancer Center, Philadelphia, PA.

(2013) ADJUNCT PROFESSOR

Research Center for Genomics and Bioinformatics, Tokyo Metropolitan University, Tokyo, Japan

(2013) ADJUNCT PROFESSOR

Center of Excellence in Genomic Medicine Research (CEGMR), King Abdulaziz University, Jeddah, Saudi Arabia

(2007) GUEST PROFESSOR

Center for Computational and Evolutionary Biology (CCEB), Institute of Zoology @ Beijing, China

(2005) AFFILIATE PROFESSOR

Department of Biomedical Informatics, ASU, 2005–2007

(2004) ADJUNCT SENIOR INVESTIGATOR

Translational Genomics Research Institute (TGen), Phoenix, AZ, 2004–2007

(2002) AFFILIATE PROFESSOR

School of Computing, Informatics, and Decision Support Engineering, ASU

**APPOINTMENTS
(OTHER)**

(2012) COORDINATOR, ACADEMIC EXCHANGE AND COLLABORATION

Tokyo Metropolitan University, Japan and Arizona State University

(2012) CO-DIRECTOR

Biological Design Graduate (Ph.D.) Program, ASU, 2012–2013

(2000) MEMBER, ASTROBIOLOGY/EVOLUTIONARY GENOMICS FOCUS GROUP

National Aeronautics and Space Administration (NASA)

(1998) ASSOCIATE MEMBER, ASTROBIOLOGY RESEARCH CENTER

Pennsylvania State University, USA

AWARDS/HONORS

(2017) COMMUNITY SERVICE AWARD

Society for Molecular Biology and Evolution (SMBE)

(2017) FELLOW OF F1000

Faculty of 1000, Ltd.

(2015) OUTSTANDING SCIENCE ALUMNI AWARD

Pennsylvania State University, USA

(2015) FACULTY OF THE GAME, TEMPLE VS. PENN STATE FOOTBALL

Temple University Athletics, USA

(2014) HIGHLY CITED RESEARCHER (COMPUTER SCIENCE)

Thomson Reuters ScienceWatch, 2013, 2014

(2014) MOST INFLUENTIAL MINDS

Thomson Reuters ScienceWatch, 2014

(2011) GOVERNOR'S CELEBRATION OF INNOVATION – ACADEMIA (FINALIST)

State of Arizona, USA (also in 2009)

(2009) AAAS FELLOW

American Association for the Advancement of Science (AAAS)

(2009) HONORARY PROFESSORSHIP

School of Computing and Informatics, ASU

(2007) LONG-TERM VISITING FELLOWSHIP AWARD

Japanese Society for Promotion of Science (JSPS), 2007–2008

(2006) EXEMPLAR FACULTY

Arizona State University

(2000) INNOVATION AWARD IN FUNCTIONAL GENOMICS

Burroughs-Wellcome Fund

CITATION HONORS

HIGHLY CITED PAPER DESIGNATION (TOP 1% OF THE ACADEMIC FIELD)

Nature (2007) 450: 203–218; Molecular Biology and Evolution (2007) 24:1596–1599;
Briefings in Bioinformatics: (2008) 9:299–306; Molecular Biology and Evolution (2011)
28:2731–2739; Bioinformatics (2012) 28:2685–2686; Molecular Biology and Evolution

(2013) 30:2735–2729; Molecular Biology and Evolution (2015) 32:835–845; Molecular Biology and Evolution (2016) 1870–1874.

(2014) TOP-100 CITED ARTICLES OF ALL TIME

Nature (October 29, 2014) [Molecular Biology and Evolution 24:1596–1599]

(2014) TOP CITED ARTICLE OF THE DECADE (2001-2011)

SCOPUS (09/2014), Agriculture and Biological Sciences section

Molecular Biology and Evolution 24:1596–1599

(2013) ARTICLE OF SPECIAL SIGNIFICANCE BY FACULTY OF 1000 PRIME

Proceedings of the National Academy of Sciences, USA 109:19333-19338

(2010) CURRENT CLASSIC IN MULTIDISCIPLINARY SCIENCES, WEB OF SCIENCE (WOS)

Proceedings of the National Academy of Sciences, USA 101:11030–11035

(2010) CURRENT CLASSIC IN BIOLOGY & BIOCHEMISTRY, WOS

Molecular Biology & Evolution 24:1596–1599 (2010-2011)

(2007) CURRENT CLASSIC COMPUTER SCIENCE, WOS

Briefings in Bioinformatics 5: 150–163 (2007-2010)

(2009) HOT PAPER IN COMPUTER SCIENCE, WOS

Briefings in Bioinformatics 9:299–306

(2006) HOT PAPER IN COMPUTER SCIENCE, WOS

Briefings in Bioinformatics 5:150–163

(2006) SCIENCE, EDITOR'S CHOICE, AUGUST 25

Molecular Biology and Evolution 23:1946–1951

(2004) TOP-10 MOST-CITED AUTHOR, COMPUTER SCIENCE

Web of Science, 2004 –2009 (series discontinued)

(2004) HOT PAPER IN BIOLOGY & IN COMPUTER SCIENCE, WOS

Bioinformatics 17:1244–1245

(2000) HOT PAPER IN BIOLOGY, WOS

Nature 392: 917–920

EDITORIAL BOARDS

EDITOR-IN-CHIEF

Molecular Biology and Evolution, 2012–present

EDITORIAL BOARD

Biomolecules, 2010-2014

Bioinformatics and Biology Insights, 2009–2014

Molecular and Developmental Evolution (J. Exp. Zool.), 2004–2010

ASSOCIATE EDITOR

Quarterly Review of Biology, 2010–2013

Evolutionary Bioinformatics Online, 2005–2014

Molecular Biology and Evolution, 2005–2012

Genome Research, 2005–2009

Gene: Functional Genomics, 2005–2006

Journal of Heredity, 1999–2005

GRANT SUPPORT
CURRENT

PRINCIPAL INVESTIGATOR

(2017) INFERRING MOLECULAR EVOLUTIONARY RATES AND DIVERGENCE DATES

National Institutes of Health (GM) (PI) 2017–2020

(2017) OPEN-SOURCE, EXTENSIBLE, AND CROSS-PLATFORM MEGA

National Science Foundation (NSF, ABI) (PI), 2017–2020

(2016) EVOLUTIONARY BIOINFORMATICS OF TUMOR PROFILES

National Institutes of Health (NLM) (PI), 2016–2019

CO-PRINCIPAL OR CO-INVESTIGATOR

(2017) BAYESIAN EVOLUTION-AWARE METHODS FOR TUMOR SINGLE CELL SEQUENCES

National Institutes of Health (NLM) (co-I), 2017–2019

(2016) eQTL MEGA-ANALYSIS FOR FUNCTIONAL ASSESSMENT OF MULTI-ENHANCER REGULATION

National Institutes of Health (NHGRI; co-I), 2016–2019

(2016) INNOVATIVE MOLECULAR TIMING APPLICATIONS TO OBTAIN ACCURATE HISTORIES OF EARLY LIFE

NASA Exobiology (co-PI), 2016–2019

(2015) NRT-IGE: INNOVATING GRADUATE STEM EDUCATION THROUGH BIO-SOCIAL PARTNERSHIPS

National Science Foundation (co-PI), 2015–2018

GRANT SUPPORT
COMPLETED

PRINCIPAL INVESTIGATOR

(2013) ENABLING DISCOVERY ACROSS DISCIPLINES THROUGH A SYNTHESIS OF TIME-CALIBRATED EVOLUTIONARY HISTORIES

National Science Foundation (ABI; PI), 2013–2016

(2013) METHODS FOR EVOLUTIONARY INFORMED NETWORK ANALYSIS TO DISCOVER DISEASE VARIATION (R01)

National Institutes of Health (NIDDKS; co-PI), 2013–2018

(2012) IDENTIFYING DISEASE-ASSOCIATED GENOME VARIANTS THROUGH COMPUTATIONAL PREDICTION OF FUNCTIONAL SITES IN PROTEIN STRUCTURES

ASU/Mayo Seed Grant, 2012–2013

(2011) COMPARATIVE MOLECULAR SEQUENCE ANALYSIS (R01)

National Institute of Health (NHGRI), 2011–2015

(2011) COMPUTATIONAL ANALYSIS OF GENE EXPRESSION PATTERN IMAGES (R01)

National Institutes of Health (NHGRI; PI), 2011–2016

(2011) COMPUTATIONAL METHODS FOR EXPRESSION IMAGE ANALYSIS (R01)

Multi-PI, National Institutes of Health (NLM), 2011–2015

(2010) EVOLUTIONARY BIOINFORMATICS OF HUMAN MUTATIONS (R01)

National Institutes of Health (NLM), 2010–2014

(2007) COMPARATIVE MOLECULAR SEQUENCE ANALYSIS (R01)

National Institutes of Health (NHGRI), 2007–2011

(2007) COMPUTATIONAL ANALYSIS OF GENE EXPRESSION PATTERN IMAGES (R01)

National Institutes of Health (NHGRI), 2007–2011

(2007) BIOINFORMATICS OF ASSEMBLING THE TIMESCALE OF LIFE

Science Foundation of Arizona, 2007–2008

(2007) RE-ENGINEERING THE MEGA SOFTWARE PACKAGE (R01)

National Institutes of Health (NIGMS/ARRA), 2007–2011

(2004) COMPARATIVE MOLECULAR SEQUENCE ANALYSIS (R01)

National Institutes of Health (NHGRI), 2004–2007

(2003) COMPUTATIONAL GENOMIC ANALYSIS TO IDENTIFY AND DISSECT FUNCTIONALLY IMPORTANT MUTATIONS IN PROTEIN SEQUENCES

Burroughs-Wellcome Fund, USA, 2003–2006

(2003) COMPUTATIONAL ANALYSIS OF GENE EXPRESSION PATTERN IMAGES (R01)

National Institutes of Health (NHGRI), 2003–2007

(2000) COMPARATIVE MOLECULAR SEQUENCE ANALYSIS (R01),

National Institutes of Health (NHGRI), 2000–2004

(2000) DESIGN OF A BIOINFORMATIC DATABASE FOR FUNCTIONAL EVOLUTIONARY FOOTPRINTS IN MULTIGENE FAMILIES

National Science Foundation (DBI), 2000–2004

CO-PRINCIPAL OR CO-INVESTIGATOR

(2015) TEMPLE GENOMICS AND ANALYTICS COLLABORATIVE (TGAC) RESEARCH INFRASTRUCTURE

PA Commonwealth University Enhancement Program (PI), 2015–2018

(2014) ABI INNOVATION: IDENTIFYING PHYLOGENETICALLY INFORMATIVE DATA FROM NEXT-GENERATION SEQUENCING

National Science Foundation (ABI; co-I), 2014–2018

(2014) COMPUTATIONAL DIAGNOSIS OF NON-SYNONYMOUS VARIATIONS USING STRUCTURAL DYNAMICS (R21)

National Institutes of Health (NLM; co-I), 2014–2017

(2014) III: SMALL: LARGE-SCALE STRUCTURED SPARSE LEARNING

National Science Foundation (co-PI), 2014–2016

(2013) RATIONAL DESIGN AND TARGETED SELECTION OF EFFECTIVE DNA-SCAFFOLDED NICOTINE VACCINES (R01)

National Institutes of Health (NIDA; co-I), 2013–2016

(2011) A PHYLOGENETIC APPROACH TO METAGENOMIC ANALYSIS (R21)

National Institutes of Health (NHGRI), 2011–2014

(2010) CENTER FOR MEMBRANE PROTEINS IN INFECTIOUS DISEASES (MIPD, U54)

National Institutes of Health (NIGMS), 2010–2015

(2009) TEAM APPROACH TO TRANSLATE NOVEL BIOMARKERS FOR DIABETES

National Institutes of Health (NIDDK), 2009–2010

(2009) BIOINFORMATICS OF MOLECULAR TIMETREES

National Science Foundation (DBI), 2009–2013

(2008) DISCOVERING THE HIDDEN PROTEOME IN THE HUMAN GENOME (R01)

National Institutes of Health (EUREKA), 2008–2012

(2006) DEVELOPING A BIOINFORMATIC DATABASE FOR STOICHIOPROTEOMICS

National Science Foundation (DBI), 2006–2010

(2006) MACHINE LEARNING APPROACHES FOR BIOLOGICAL IMAGE INFORMATICS

National Science Foundation, 2006–2010

(2004) BIODESIGN BRIDGES TO THE DOCTORATE

National Science Foundation (LSAMP), 2004–2006 (instructional)

(2001) DEVELOPMENT OF AN EVOLUTIONARY TIMESCALE DATABASE

National Science Foundation (DBI), 2001–2004

(2001) A COMPUTATIONAL BIOSCIENCES PROFESSIONAL MASTER'S PROGRAM

Sloan Foundation, 2001–2003 (instructional)

(2000) EMERGING WILDLIFE DISEASES: THREATS TO AMPHIBIAN BIODIVERSITY

National Science Foundation (IRCEB), 2000–2008

**MEMBERSHIPS IN
SCIENTIFIC &
PROFESSIONAL
ORGANIZATIONS**

American Association for the Advancement of Science

American Association for Cancer Research

American Genetic Association

The Genetics Society of America

Human Genome Variation Society

International Society of Computational Biologists (lifetime)

Society for Molecular Biology and Evolution (lifetime)

Society for the Study of Evolution (lifetime)

**CONFERENCES AND
ORGANIZED
SYMPOSIA**

(2018) ORGANIZER, MEGA 25TH ANNIVERSARY WORKSHOP (7/8-7/12)

Annual meeting of Society for Molecular Biology and Evolution, Yokohama, Japan

(2018) COORDINATOR, WORKSHOP IN BIOGENOMICS & NANOBIOLOGY (4/23-4/24)

International Collaboration Conference, Riyadh, Saudi Arabia

(2017) ORGANIZER, MOLECULAR EVOLUTON AND MEDICINE (9/16-9/17)

Temple University, Philadelphia, USA (100 attendees)

(2016) ORGANIZER, SYMPOSIUM ON NEXT GENERATION TOOLS

Annual meeting of Society for Molecular Biology and Evolution, Gold Coast, Australia

(2014) MEMBER, EXTERNAL ADVISORY BOARD

Annual meeting of the Society for Molecular Biology and Evolution (SMBE), Puerto Rico

(2012) SYMPOSIUM ON PHYLOMEDICINE @ ASU (3/23–3/24; 100 ATTENDEES)

Awarded by Society for Molecular Biology and Evolution

(2011) MEMBER, GLOBAL ORGANIZING COMMITTEE (GOC)

Annual meeting of SMBE, Kyoto Japan (7/26–7/30)

(2010) ORGANIZER, SYMPOSIUM ON EVOLUTIONARY BIOLOGY IN HEALTH AND MEDICINE

Annual meeting of SMBE, Lyon France (7/4–7/8); co-organizers: J Dudley and A Butte

(2010) CO-ORGANIZER, MOLECULAR PHYLO`GENETICS SYMPOSIUM,

Moscow State University, Russia (5/17–5/21)

(2007) MEMBER, PROGRAM COMMITTEE

International Conference on Computational Phylogenetics and Molecular Systematics, Moscow State University, Russia (12/16–12/19)

(2006) LEAD ORGANIZER OF ANNUAL MEETING OF SMBE (750 ATTENDEES)

Arizona State University, Tempe, Arizona (5/24–5/28)

(2005) ORGANIZER, GENOME DATABASE WORKSHOP

National Evolutionary Synthesis Center, Wilmington Beach, North Carolina, (5/31– 6/3)

(2004) SYMPOSIUM ON EVOLUTIONARY AND POPULATION GENOMICS

Future of Statistics Conference at Indian School of Business, Hyderabad (12/29–1/1)

MAJOR ADVISORY & REVIEW BOARDS

(2017) SCIENTIFIC ADVISORY BOARD, ELOXX PHARMACEUTICALS

Waltham, MA, 2017–

(2016) ADVISORY BOARD, SICCS

Northern Arizona University, 2016–2017

(2016) CHAIR, GENOME VARIATION AND EVOLUTION (GVE)

Study Section, National Institutes of Health, 2016–2018

(2015) INVITED MEMBER, THOUGHT LEADER SUMMIT

American Heart Association

(2013) STANDING MEMBER, GENOME VARIATION AND EVOLUTION (GVE)

Study Section, National Institutes of Health, 2013–2018

(2012) MEMBER, REVIEW COMMITTEE, GENOMIC SCIENCES PROGRAM

NC State University, Raleigh, North Carolina

(2011) ADVISORY BOARD MEMBER

Münster Graduate School of Evolution (MGSE), Münster, Germany

(2010) MEMBER, 10-YEAR REVIEW COMMITTEE

Institute for Genomics and Bioinformatics @ University of California, Irvine

(2007) FLYBASE ADVISORY GROUP

2007-2008

(2006) CONSULTANT, AMERIGENICS, INC., USA

(2006) MEMBER, ADVISORY COMMITTEE ON EVOLUTIONARY BIOINFORMATICS

University of South Dakota, USA

(2006) STANDING MEMBER, BIODATA MGMT. AND ANALYSIS (BDMA)

Study Section, National Institutes of Health, 2006 – 2010

(2006) MEMBER, INFORMATICS ADVISORY COMMITTEE

National Center for Evolutionary Synthesis (NESCent), 2006–2009

(2006) MEMBER, WORKING GROUP ON EVOLUTIONARY INFORMATICS

Supporting Interoperability in Evolutionary Analysis, NESCent, 2006–2008

(2005) MEMBER, FIVE-YEAR REVIEW COMMITTEE

Institute for Genomics and Bioinformatics @ University of California, Irvine

(2002) CONSULTANT, PHARMACIA CORPORATION, USA

2002-2003

PUBLICATIONS

BOOKS AND GUIDES

1. **Kumar S**, Tamura K & Nei M (1993) *A Guide to Molecular Evolutionary Genetics Analysis Program for Microcomputers*, Institute of Molecular Evolutionary Genetics, Pennsylvania State University, University Park, PA (140 pp; >2500 printed manuals distributed).
2. Nei M & **Kumar S** (2000) *Molecular Evolution and Phylogenetics*. Oxford University Press, New York (333 pp). (Translated in Chinese, Japanese, and Russian)
3. Hedges SB & **Kumar S** (2009) *The Timetree of Life*. Oxford University Press, New York (550 pp; edited volume with 81 contributions).

ARTICLES: 1992 – 1999

4. Hedges SB, **Kumar S**, Tamura K & Stoneking M (1992) Human origins and analysis of mitochondrial DNA sequences. *Science* 255:737–739.
5. **Kumar S**, Tamura K & Nei M (1994) MEGA: Molecular Evolutionary Genetics Analysis software for microcomputers. *Computer Applications in Biosciences* 10:189–191.

6. Rzhetsky A, **Kumar S** & Nei M (1995) Four-cluster analysis: A simple method to test phylogenetic hypotheses. *Molecular Biology & Evolution* 12:163–167.
7. Yang Z, **Kumar S** & Nei M (1995) A new method of inference of ancestral nucleotide and amino acid sequences. *Genetics* 141:1641–1650.
8. Winnepenninckx W, Backeljau T, Mackey LY, Brooks JM, De-Wachter R, **Kumar S** & Garey JR (1995) 18S rRNA data indicate that Aschelminthes are polyphyletic in origin and consist of at least three distinct clades. *Molecular Biology and Evolution* 12:1132–1137.
9. Hedges SB, Parker PH, Sibley CG & **Kumar S** (1996) Continental breakup and the ordinal diversification of birds and mammals. *Nature* 381:226–229.
10. **Kumar S** (1996) A stepwise algorithm for finding minimum evolution trees. *Molecular Biology and Evolution* 13:584–593.
11. **Kumar S** (1996) Patterns of nucleotide substitution in mitochondrial protein coding genes of vertebrates. *Genetics* 143:537–548.
12. **Kumar S**, Balczarek KA & Lai Z-C (1996) Evolution of the hedgehog gene family. *Genetics* 142:965–972.
13. **Kumar S** & Rzhetsky A (1996) Evolutionary relationships of eukaryotic kingdoms. *Journal of Molecular Evolution* 42:183–193.
14. Yang Z & **Kumar S** (1996) Approximate methods for estimating the pattern of nucleotide substitution and the variation of substitution rates among sites. *Molecular Biology and Evolution* 13:650–659.
15. Balczarek KA, Lai Z-C & **Kumar S** (1997) Evolution and functional diversification of the Paired box (Pax) DNA-binding domains. *Molecular Biology and Evolution* 14:829–842.
16. Zhang J & **Kumar S** (1997) Detection of convergent and parallel evolution at the amino acid sequence level. *Molecular Biology and Evolution* 14:527–536.
17. Zhang J, **Kumar S** & Nei M (1997) Small-sample tests of episodic adaptive evolution: A case study of primate lysozymes. *Molecular Biology and Evolution* 14:1335–1338.
18. Yeager M, **Kumar S** & Hughes AL (1997) Sequence convergence in the peptide-binding region of primate and rodent MHC class Ib molecules. *Molecular Biology and Evolution* 14:1035–1041.
19. Leitner TL, **Kumar S** & Albert J (1997) Tempo and mode of nucleotide substitutions in gag and env gene fragments in Human Immunodeficiency Virus Type 1 populations with a known transmission history. *Journal of Virology* 71:4761–4770.
20. **Kumar S** & Hedges SB (1998) A molecular timescale for vertebrate evolution. *Nature* 392:917–920.
21. Nei M, **Kumar S** & Takahashi K (1998) The optimization principle in phylogenetic analysis tends to give incorrect topologies when the number of nucleotides or amino acids used is small. *Proceedings of the National Academy of Sciences (USA)* 95:12390–12397.
22. Hedges SB & **Kumar S** (1999) Divergence times of eutherian mammals. *Science* 285:2031a.
23. Newfeld SJ, Wisotzkey RG & **Kumar S** (1999) Molecular evolution of a development pathway: Phylogenetic analyses of transforming growth factor- β family ligands, receptors, and Smad signal transducers. *Genetics* 152:783–795.
24. Wang Y-C, **Kumar S** & Hedges SB (1999) Divergence time estimates for the early history of animal phyla and the origin of plants, animals, and fungi. *Proceedings of the Royal Society, London. B* 266:163–171.

ARTICLES: 2000 – 2005

25. **Kumar S**, Mitnik C, Valente G & Floyd-Smith G (2000) Expansion and molecular evolution of the interferon-induced 2'-5' oligoadenylate synthetase gene family. *Molecular Biology and Evolution* 17:738–750.
26. **Kumar S**, Hedrick P, Dowling T & Stoneking M (2000) Questioning evidence for recombination in human mitochondrial DNA. *Science* 288:1931a.

27. **Kumar S** & Gadagkar SR (2000) Efficiency of the neighbor-joining method in reconstructing deep and shallow evolutionary relationships in large phylogenies. *Journal of Molecular Evolution* 51:544–553.
28. Purdom PW, Bradford PG, Tamura K & **Kumar S** (2000) Single column discrepancy and dynamic max-mini optimizations for quickly finding the most parsimonious evolutionary trees. *Bioinformatics* 16:140–151.
29. **Kumar S**, Tamura K, Jakobsen IB & Nei M (2001) MEGA2: Molecular Evolutionary Genetics Analysis software. *Bioinformatics* 17:1244–1245.
30. Gerber AS, Loggins R, **Kumar S** & Dowling TE (2001) Does non-neutral evolution shape observed patterns of DNA variation in animal mitochondrial genomes? *Annual Review of Genetics* 35:539–566.
31. **Kumar S**, Gadagkar SR, Filipinski A & Gu X (2001) Determination of the number of conserved chromosomal segments between species. *Genetics* 157:1387–1395.
32. **Kumar S** & Gadagkar SR (2001) Disparity Index: A simple statistic to measure and test the homogeneity of substitution patterns between molecular sequences. *Genetics* 158:1321–1327.
33. **Kumar S** & Panchanathan S (2001) Elucidating gene interaction networks based on gene expression pattern image analysis. *Proceedings of the International Conference on Biomedical Engineering* 5A:232–234.
34. Rosenberg MS & **Kumar S** (2001) Traditional phylogenetic reconstruction methods reconstruct shallow and deep evolutionary relationships equally well. *Molecular Biology and Evolution* 18:1823–1827.
35. Rosenberg MS & **Kumar S** (2001) Incomplete taxon sampling is not a problem for phylogenetic inference. *Proceedings of the National Academy of Sciences (USA)* 98:10751–10756.
36. Miller MP & **Kumar S** (2001) Understanding human disease mutations through the use of interspecific genetic variation. *Human Molecular Genetics* 10: 2319–2328.
37. Hedrick P & **Kumar S** (2001) Mutation and linkage disequilibrium in human mtDNA. *European Journal of Human Genetics* 9:969–972.
38. Hedges SB, Chen H, **Kumar S**, Wang DY-C, Thompson AS & Watanabe H (2001) A genomic timescale for the origin of eukaryotes. *BMC Evolutionary Biology* 1:4 (10 pp).
39. Jayaraman K, Panchanathan S & **Kumar S** (2001) Classification and indexing of gene expression images. *Proceedings of Society of Photo-optical Instrumentation Engineers* 4472:471–481.
40. Hedges SB & **Kumar S** (2002) Vertebrate genomes compared. *Science* 297:1283–1285.
41. **Kumar S** & Subramanian S (2002) Mutation rates in mammalian genomes. *Proceedings of the National Academy of Sciences (USA)* 99:803–808.
42. **Kumar S**, Jayaraman K, Panchanathan S, Gurunathan R, Marti-Subirana A & Newfield SJ (2002) BEST: A novel computational approach for comparing gene expression patterns from early stages of *Drosophila melanogaster* development. *Genetics* 162:2037–2047.
43. Tamura K & **Kumar S** (2002) Evolutionary distance estimation under heterogeneous substitution pattern among lineages. *Molecular Biology & Evolution* 19:1727–1736.
44. Jiang Z, Melville JS, Cao H, **Kumar S**, Filipinski A & Verrinder Gibbins AM (2002) Measuring conservation of contiguous sets of autosomal markers on bovine and porcine genomes in relation to the map of the human genome. *Genome* 45:769–776.
45. Hedges SB & **Kumar S** (2003) Genomic clocks and evolutionary timescales. *Trends in Genetics* 19:200–206.
46. Subramanian S & **Kumar S** (2003) Neutral substitutions occur as a faster rate in exons than in noncoding DNA in primate genomes. *Genome Research* 13:838–844.

47. Rosenberg MS & **Kumar S** (2003) Taxon sampling, bioinformatics, and phylogenomics. *Systematic Biology* 52:119–124.
48. Rosenberg MS, Subramanian S & **Kumar S** (2003) Patterns of transitional mutation biases within and among mammalian genomes. *Molecular Biology and Evolution* 20:988–993.
49. Rosenberg MS & **Kumar S** (2003) Heterogeneity of nucleotide frequencies among evolutionary lineages and phylogenetic inference. *Molecular Biology and Evolution* 20:610–621.
50. Miller MP, Parker JD, Rissing SW, & **Kumar S** (2003) Quantifying the intragenic distribution of human disease mutations. *Annals of Human Genetics* 67:567–579.
51. Jancovich J, Mao J, Chinchar VG, Wyatt C, Case S, **Kumar S**, Valente G, Subramanian S, Davidson EW, Collins JP & Jacobs BL (2003) Genomic sequence of a ranavirus (family Iridoviridae) associated with salamander mortalities in North America. *Virology* 316:90–103.
52. **Kumar S**, Tamura K & Nei M (2004) MEGA3: Integrated software for Molecular Evolutionary Genetics Analysis and sequence alignment. *Briefings in Bioinformatics* 5:150–163.
53. Hedges SB & **Kumar S** (2004) Precision of molecular time estimates. *Trends in Genetics* 20:242–247.
54. Tamura K, Subramanian S & **Kumar S** (2004) Temporal patterns of fruit fly evolution revealed by mutation clocks. *Molecular Biology and Evolution* 21:36–44.
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164. **Kumar S** (1995) *PhylTest: A Program for Testing Phylogenetic Hypotheses*. Pennsylvania State University, University Park.
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EDITORIALS

Molecular Biology and Evolution (MBE) Editor's messages (2013-2018)
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 MBE Editor-in-Chief's annual reports (2013-2018)

F1000 RECOMMENDATIONS

Kumar S: F1000Prime Recommendation of [Shen XX et al., Nat Ecol Evol 2017, 1(5):126]. In F1000Prime, 01 Sep 2017; DOI: 10.3410/f.727814781.793536165.
 Kumar S: F1000Prime Recommendation of [Warnock RCM et al., Proc Biol Sci 2017, 284(1857)]. (DOI: 10.3410/f.727752709.793536398)

INVITED PRESENTATIONS

2018 • Keynote Presentation, Tokyo Metropolitan University, Japan • King Abdullah University of Science and Technology (KAUST)

2017 • Selected Talk, Annual meetings of Society for Molecular Biology and Evolution • University of California (Los Angeles) • Keynote Presentation, King Abdullah University of Science and Technology (KAUST)

2016 • University of Pittsburgh • Symposium in the Annual meetings of Society for Molecular Biology and Evolution • Arizona State U • Northern Arizona U • Keynote, International Symposium ISEGB, Kaohsiung, Taiwan.

2015 • Biodiversity Workshop, Temple Univ., Philadelphia • Fox Chase Cancer Center, Philadelphia, PA • University of Maryland, College Park, MD • Plenary Speaker, Center of Excellence in Genomic Medicine Research at King Abdulaziz University, KSA.

2014 • Chancellor's Distinguished Visitor/Speaker, University of Missouri, Columbia, MO • Keynote Address, Temple University, Philadelphia, PA • Speaker at two symposia, Society for Molecular Biology and Evolution Annual Conference, Puerto Rico • Presenter, Research Center for Genomics and Bioinformatics International symposium, Tokyo Metropolitan University, Japan • Speaker, Population Genetics Group, University of Bath, England

2013 • Plenary Speaker, Center of Excellence in Genomic Medicine Research at King Abdulaziz University, KSA • VWR Distinguished Speaker, Georgia Tech School of Biology • Keynote Address, Molecular Medicine: Next-Gen Sequencing for the Clinic, Frankfurt • Nei Lecture, SMBE Annual Meeting @ Chicago, Illinois • Chinese Academy of Sciences (CAS), Beijing, China • Nanjing Normal University, China • Center of Excellence in Genomic Medicine Research at King Abdulaziz University, KSA • Quantitative Biology Colloquium, University of Arizona, Tucson, AZ • Mount Sinai School of Medicine CME Seminar Series, New York, NY • National Cancer Institute Conference of Physical Sciences-Oncology, Scottsdale, Arizona • Temple University, Department of Biology, Philadelphia, Pennsylvania • Keynote Speaker, Sigma Xi, Oakland University, Rochester, Michigan

2012 • Plenary Speaker, Society for Evolutionary Studies Annual Meetings @ Tokyo Metropolitan University • SMBE Annual Meeting (The animal tree of life and its application) @ Dublin, Ireland • Biomedicine: Big Data and New Paths to Personalized Medicine, ASU • International Conference on Bioinformatics & Computational Biology @ BKK, Thailand • SMBE Satellite Meeting on Phylomedicine @ Arizona State University

2011 • ORSP Research Seminar Series @ Midwestern University, Phoenix, Arizona • Molecular Biosciences Seminar Presentation on Phylomedicine at Montana State • Keynote Speaker, Young Scientists' Workshop on Evolutionary Genomics @ Tokyo, Japan • SMBE Annual Meeting (Methods for multiple alignment and phylogenetic tree) @ Kyoto, Japan • International Society for Molecular Biology/ECCB (SNPSigs Selection) @ Vienna, Austria • Workshop on Bioinformatic Software for Comparative Genomics and Metagenomics. The Smithsonian Institution (SI), American Museum of Natural History (AMNH) and the Food and Drug Administration (FDA) • Department of Biomedical Informatics, ASU • Barrett Honors College, ASU • SMBE Symposium on Molecular and Genomic Evolution @ Penn State University • Keynote, Mini-symposium on Data Mining for Biomedical Informatics @ SIAM International Conference on Data Mining, Mesa, Arizona • Keynote, Interdisciplinary Graduate Student's Symposium on Evolution Across Fields @ Institute for Evolution and Biodiversity, Muenster, Germany

2010-2008 • Plenary Speaker, Molecular Phylogenetics Symposium, Russia • Stanford University, California, USA • Symphogen Corporation (Copenhagen) • Chalk Talk, Physics Department, ASU • Spirit of Senses Group, Phoenix, Arizona • University of Cologne, Germany • Quantitative Expression Analysis workshop @ Drosophila Research Conference, Chicago, Illinois • University of North Carolina, Charlotte, NC • Washington University, St. Louis, MO • Keynote, Symposium on Evolutionary Bioinformatics, Lava Springs, Idaho State University • Japan Biological Information Research Center (JBIRC), Tokyo, Japan • Symposium on New Insight of Genome Evolution into Fundamental Activities of Life, National Institute of Genetics (NIG) and the Tokyo Institute of Technology (TIT), Japan • Global Center for Excellence, Hokkaido University, Sapporo, Japan • Discussion leader, Computational and Statistical Advances, Gordon Conference in Molecular Evolution @ Ventura, California

2007-2005 • SOLUR Program, Arizona State University • Department of Biomedical Informatics, Arizona State University • FlyBase Advisory Group @ Harvard University, Boston, MA • Keynote Speaker, Ohio Collaborative Conference on Bioinformatics (OCCBIO) @ Miami University, Oxford, Ohio, • EMBO workshop on "Human Evolution and Disease" @ Center for Cellular and Molecular Biology, Hyderabad, India • Department of Biological Sciences, University of Idaho, Moscow, ID • Microbiology Department, Montana State University, Bozeman, MT • ASU Emeritus Faculty Association, Tempe, Arizona • Symposium on Molecular Evolution @ Moscow Conference on Computational Molecular Biology, Moscow State University, Russia • Symposium on Systems Biology @ Moscow Conference on Computational Molecular Biology, Moscow State University, Russia • Special presentation to the Panel on Chemical Imaging, National Academies (USA), Washington DC

2004-2002 • Symposium on Evolutionary and Population Genomics @ Future of Statistics Conference, Hyderabad, India • Symposium on Advances in Methods for Estimating Species Divergence Dates using Molecular Data @ International Congress of Zoology, Beijing, China • Symposium on Molecular Phylogeny and Molecular Clocks @ Annual Meeting of SMBE, Penn State University, University Park, PA • Hexapodium, Center for Insect Research, University of Arizona • Techniques Workshop @ 44th Annual Drosophila Research Conference, Chicago, IL • Comparative and Functional Genomics Workshop, Wellcome Trust and Dept. of Energy, Hinxton, Cambridgeshire, UK • Annual Meeting of SMBE, Newport Beach, CA • Department of Biology, Duke University, Durham, NC • Bioinformatics Research Center, North Carolina State University, Raleigh, NC • Symposium on Evolutionary Genetics @ Annual meeting of the American Genetic Association, Arizona State University, Tempe, Arizona • The 12th International Workshop on Beyond the Identification of Transcribed Sequences: Functional, Evolutionary, and Expression Analysis sponsored by Department of Energy, Washington, DC • The 18th International Symposium in Conjunction with Award of the International Prize for Biology, Tokyo, Japan • Department of Biology, Indiana University, Bloomington, Indiana • Department of Computer Science, Arizona State University, Tempe, AZ • Department of Biology, University of Michigan, Ann Arbor, Michigan

2001-1995 • International Workshop on Population Genetics @ University of Montreal, Montreal, Canada • ASU President's Community Enrichment Program, Phoenix, Arizona • Department of

Biology, Ohio State University, Columbus, Ohio • Department of Biology, Hong Kong University, Hong Kong, China (2 lectures) • Department of Biology, Syracuse University, Syracuse, New York • Program in Ecology and Evolutionary Biology, University of Illinois, Urbana Champaign, Illinois • Department of Biology, Grand Canyon University, Phoenix, Arizona • Ecology & Evolutionary Biology Program/IGERT, Indiana University, Bloomington, Indiana • Department of Biology, Tokyo Metropolitan University, Tokyo, Japan • Biomedical Engineering, Indian Institute of Science, Bangalore, India • Department of Biology, Tokyo Metropolitan University, Tokyo, Japan • Graduate University for Advanced Studies, Hayama, Japan • Genetics Program, University of Arizona, Tucson, Arizona • Birla Institute of Technology & Sciences, Pilani, India • University of South Carolina, Columbia, South Carolina • Symposium on Genomic Diversity @ Annual meeting of the American Genetic Association, Pennsylvania State University, University Park, PA • Department of Biology, Arizona State University-West, Phoenix, Arizona • Department of Zoology and Genetics, Iowa State University, Ames, Iowa • Symposium on Large Phylogenies @ Annual meeting of the Society for the Study of Systematic Biology, University of Colorado, Boulder, Colorado • National Cancer Institute, Frederick, Maryland • Department of Biology, Arizona State University, Tempe, Arizona

TEACHING

Average Rating in Parentheses (Scale: 1 = Best; 4 = Worst)

BIO 494	(1.2)	Advanced Evolution	(14 Students)	ASU	1999
BIO 594	(1.5)	Molecular Evolutionary Genetics	(10 Students)	ASU	1999
BIO 594	(1.3)	Molecular Evolutionary Genetics	(7 Students)	ASU	2000
BIO 445	(1.7)	Organic Evolution	(106 Students)	ASU	2000
BIO 494	(1.3)	Computational Genomics	(7 Students)	ASU	2001
BIO 445	(1.4)	Organic Evolution	(180 Students)	ASU	2001
BIO 494	(1.2)	Introduction to Comparative Genomics	(12 Students)	ASU	2003
BIO 345	(1.4)	Organic Evolution	(185 Students)	ASU	2003
BIO 494	(1.3)	Introduction to Comparative Genomics	(11 Students)	ASU	2004
BIO 345	(1.6)	Organic Evolution	(150 Students)	ASU	2005
BIO 345	(1.4)	Organic Evolution	(180 Students)	ASU	2006
BIO 494	(1.2)	Introduction to Comparative Genomics	(12 Students)	ASU	2007
BIO 455	(1.2)	Introduction to Comparative Genomics	(10 Students)	ASU	2008
BIO 455	(1.2)	Introduction to Comparative Genomics	(25 Students)	ASU	2009
BIO 494	(1.1)	Evolutionary Medicine	(30 Students)	ASU	2010
BIO 455	(1.2)	Introduction to Comparative Genomics	(41 Students)	ASU	2011
BIO 494	(1.5)	Evolutionary Medicine	(41 Students)	ASU	2012
BIO 189	(1.4)	Phylomedicine	(19 Students)	ASU	2013
BIO 591	(1.5)	Seminar: Evolution in Medicine	(12 Students)	ASU	2013
BIO 3112/5112		Genomic Evolutionary Medicine	(49 Students)	TU	2016
BIO 3112/5112		Genomic Evolutionary Medicine	(45 Students)	TU	2017
BIO 3112		Genomic Evolutionary Medicine	(75 Students)	TU	2018

STUDENTS MENTORED

CURRENT DOCTORAL AND POSTDOCTORAL TRAINEES

(2012) SAYAKA MIURA

Project: Cancer Phylogenetics (Postdoctoral; Research Faculty)

(2014) RAVI PATEL

Project: Phylomedicine of complex diseases (Doctoral)

(2014) QIQING TAO

Project: Molecular Phylogenetics and Timetrees (Doctoral)

(2016) CARYN BABAIAAN

Project: Bridging Science with Art to communicate the Timetree of Life (Doctoral)

CURRENT UNDERGRADUATE TRAINEES

LOUISE A HUUKI, Timetree of Life/Cancer Evolution

JESSICA PRIEST, Timetree and Phylomedicine

TAMERA R. LANHAM, Population polymorphism and disease

HARRY HO, MEGA software development

OLUMIDE OLADEINDE, Phylogenomics

VIRIYA KEO, Structural Bioinformatics

KARI STRAUSS, Evolutionary genomics

SUJAY RAJKUMAR, Bioinformatics data processing

PAST POSTDOCTORAL TRAINEES

BEATRIZ MELLO (2015-2016) Research Scientist, Brazil

CHARLOTTE KONIKOFF (2013-2015) Teacher, Arizona

LI LIU (2012-2015) Assistant Professor, Biomed Informatics, Arizona State U (M.D. China).

ALAN FILIPSKI, (1998-2014) Retired (Ph.D. Michigan state).

LIFANG LIU, (2012-2013) Associate Professor (China)

NEVIN GEREK, (2010-2013) Sr. Research Engineer, Schneider Electric, CA (Ph.D., University of Akron, OH).

FABIA BATTISTUZZI, (2008-2012) Assistant Professor, Oakland University, CA (Ph.D., Biology/Astrobiology, Penn State).

CLAUDIA ACQUISTI, (2006-2010) Junior Professor, Westfälische Wilhelms-Universität Münster (Ph.D., Molecular Evolution, Italy).

ANTONIO MARCO-CASTILLO, (2008-2009) Lecturer, University of Essex, UK (Ph.D., Genetics, Spain)

BAO HONG SHEN, (2005-2007) Software Engineer, Microsoft Inc., Seattle, WA (Ph.D., Computer Science, ASU).

ANUP SOM, (2005-2007) Assistant Professor, University of Allahabad, India (Ph.D., Bioinformatics, India).

CHRISTINE KUSLICH, (2003-2005) Chief Scientific Officer, Hologic, Inc. San Diego, CA (Ph.D., Biomedical Sciences, Hawaii).

SANKAR SUBRAMANIAN, (2000-2006) Research Fellow in Genomics, Griffith School of Environment, QLD, Australia (Ph.D., Microbiology, IARI, India).

ARAXI URRUTIA, (2003-2004) Lecturer in Genetics, University of Bath, UK (Ph.D., Evolutionary Genomics).

MICHAEL S. ROSENBERG (2000-2003) Associate Professor, Arizona State University (Ph.D., Stony Brook, NY).

MARK P. MILLER, (2000-2002) Statistician, USGS-FRESC, OR (Ph.D., Evol & Conservation Genetics).

SUDHINDRA R. GADAGKAR (1998–2003). Associate Professor, Midwestern University, Arizona (PHD, Dalhousie, Canada).

PAST CHAIR/CO-CHAIR OF GRADUATE STUDENT COMMITTEES

Charlotte Konikoff • Siddarth Selvaraj • Bindu Koshy • Vinod Swarna • Hector Ramos • Xiaofen Liu • Stephanie Rogers • Madhusudhana Gargasha • Rajalakshmi Gurunathan • Vinod Swarna •

HoJoon Lee • Shubhra Gupta • Jian Yang • Sandhya Durvasala • Patrick Kolb • Rekha Iyer • Karthik Jayaraman

PAST UNDERGRADUATE/HIGH SCHOOL RESEARCH ASSISTANTS MENTORED

Karen Gomez • Heather R. DeWall • Brianna Spell • Tamera Lanham • Oscar Murillo • Stephanie Tate • Anant Bhargava • Stephen McAleer • Anna Freydenzen • Adam Orr • Ivan Montiel • Pegah Biparvah • Diana Alarcon • Brandy Buck • Eric Thomas • Kristyn Gerold • Brandon Butler • Ronika Nirankari • Chikku Baiju • Natalia Santiago • Liz Garcia • Amber Ahmed • Alyza Villa • Greg McInnes • Paul Billing-Ross • Vanessa Gray • Alicia Varma • Aditya Paliwal • Glenn Markov • Kimberly Kukurba • Jenna Makis • Hariharan Mohanraj • Nate Sutton • Michael Suleski • Nicholas Peterson • Simon Lawrence • Adithya Rajan • Stephen Watson • Robert Adrian • Alexander Woodard • Elizabeth Villalba • Nicolas Feddern • Kailah Davis • Christopher Busick • Bryan Sexton • Veronica Shi • Asaria Jimenez • Melizabeth Santana • Yea Jin Ko • Ariana Rodriguez • Stephanie Negron • Thania Martinez • Wilda Rivera • Victor Correa • Liris Gonzalez • Jose Maldonado • German Velez • Cristina Rivera • Krizia Cabrera • Karen Canales • Carol Diaz • Raul Navedo • Rachel Sipes • Antoine Al-Foune • Jacob Reidhead • Veena Ganeshan • Emily Davenport • Diana Tlougan • Heather Wiemann • Candice White • Roman Johnson • Timothy Sweeney

MEMBER OF GRADUATE STUDENT COMMITTEES

Matthew Dunn • HoJoon Lee • Joel Dudley • Takahiro Maruki • Jianhui Chen • Hugo F. Gante • Shuiwang Ji • Michael Schwemm • Peter Unmack • Evan Carson • Carla Hurt • Daniel Garrigan

TECHNICAL STAFF MANAGED

SCHOLAR • Ade Banjoko • Mia Champion • Joel Dudley • Dana Desonie • **IT** • Keith Davis • Zach Hanson-Hart • Roman Fuentes • Jason Wulf • Sean Dudley • Quan Nguyen • **WEB** • Michael Li • Bremen Braun • Lin-Wei Wu • Wayne Parkhurst • Melinda Caballero • Renee Grothe • Ben Timmerick • **PROGRAMMER** • Michael Suleski • Glen Stecher • Daniel Peterson • Kelly Boccia • Raj Bayapu • Suganthi Cidambaram • Lakshmie Viswanathan • Nicholas Peterson • Jana McAlpin • Ashly Ruttman • Vesna Djinovic • Joseph Svitak • David Schwartz • **DATABASE** • Maxwell Sanderford • Michael McCutchan • Bernard Van Emden • **ANALYSTS** • Eric Thomas • Maxwell Sanderford • Natalia Briones • David Fisher • Revak Raj Tyagi • Siddarth Selvaraj • Aditya Rajan • Mahesh Sundara Raman • Annirudha Kadne • Ashini Bolia • Graziela Valente