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Education

PhD in Biochemistry (1999) All India Institute of Medical Sciences, New Delhi, India

MS in Physiology (1992) University of Calcutta, Calcutta, India

BS (Honours) Major in Physiology (1990) University of Calcutta, Calcutta, India

Research Experience

September 2005 - Present: Research Scientist, Stanford University School of Medicine, **Stanford University,** USA.

September 2000 - August 2005: Postdoctoral Fellow, Department of Pathology, Stanford University School of Medicine, **Stanford University,** USA. Mentor: **Prof. Michael L. Cleary**

April 1999 - August 2000: Postdoctoral Fellow, **Psoriasis Research Institute (Affiliated to Department of Dermatology, Stanford University)** Palo Alto, California. Mentor: **Prof. Eugene M. Farber**

August 1993 - February 1999: Research Fellow, Department of Biochemistry, All India Institute of Medical Sciences, New Delhi, India. Mentor: **Prof. Chandana Das**

Patents / Technology licensing

Immunogenic Coronavirus Fusion Proteins and Related Methods (**Stanford Office of Technology Licensing Reference**: **S22-278**) Nature Communication, 2023 Licensed to Vaccine Company Inc. and Dx&Vx Company Ltd.

A multivalent protein-based vaccine candidate displaying SARS-CoV-2 Spike variants for elicitation of neutralizing and protective antibodies against infection. (**Stanford Office of Technology Licensing Reference**: **S20-289**) Nature Communication, 2023. Licensed to Vaccine Company Inc. and Dx&Vx Company Ltd.

Recombinant human monoclonal antibodies specific to rotavirus VP4 and VP7 with heterotypic and homotypic neutralization capacity. (**Stanford Office of Technology Licensing Reference: 15-166).** (US provisional patent; USPTO Serial No. 62/189,901); **Science Translational Medicine,** 2017.

Developed a monoclonal antibody to study the role of Pbx2 in transcriptional regulation, embryonic development, and tissue homeostasis. (**Stanford Office of Technology Licensing Reference: S01-245C; Molecular and Cellular Biology, 2004; Circulation Research, 2008**. (Licensed to 2 US biotech companies).

Editorial Board Membership

Frontiers in Immunology, Editorial Board Member and **Associate Editor** for Vaccine and Molecular Therapeutics.

Frontiers in Immunology, **Topic Editor**: Methods in Vaccines and Molecular Therapeutics

Public Library of Science, Editorial Board Member and **Academic Editor**, PLOS One

Pulmonary Therapy, Springer Nature, Editorial Advisory Board Member

Journal Reviewer

The Journal of Immunology	PLoS One
Cellular Immunology	Circulation
Scandinavian Journal of Immunology	British Journal of Dermatology
Human Immunology	Clinical and Experimental Dermatology
Journal of Leukocyte Biology	Journal of Investigative Dermatology
Microbiology and Immunology	Journal of Paediatric Genetics
Pulmonary Therapy	Journal of Paediatric infectious Diseases
Molecules	Journal of Cancer
Vaccines	Journal of Clinical Medicine
Journal of Radiation Research and Applied Sciences	Genes
Parasite Immunology	Cell Cycles
Immunology Letters	Frontiers in Immunology

Publications

Jiang Y*, **Sanyal M***, Hussein NA*, Baghdasaryan A, Zhang M, Wang F, Ren F, Li J, Zhu G, Meng Y, Adamska JZ, Mellins E, Dai H (**2025**) A SARS-CoV-2 vaccine on an NIR-II/ SWIR emitting nanoparticle platform. **Science Advances**. 11, eadp5539 (2025) 7 February 2025.
***Equally contributed**

Xu D, Powell AE, Utz A, **Sanyal M**, Do J, Patten JJ, Moliva JI, Sullivan NJ, Davey RA, Kim PS (**2024**). Design of universal Ebola virus vaccine candidates via immunofocusing. **Proceedings of the National Academy of Sciences**; February 13, 2024;121(7): e2316960121
DOI: 10.1073/pnas.2316960121

Xu D, Carter JJ, Li C, Utz A, Weidenbacher PAB, Tang S, **Sanyal M**, Pulendran B, Barnes CO, Kim PS (2024) Vaccine design via antigen reorientation; **Nature Chemical Biology**, 15th January 2024: DOI: 10.1038/s41589-023-01529-6.

Kumru OS, **Sanyal M**, Friedland N, Hickey J, Joshi R, Weidenbacher P, Do J, Cheng YC, Kim PS, Joshi SB, and Volkin DB. (**2023**). Formulation development and comparability studies with an aluminum-salt adjuvanted SARS-CoV-2 Spike ferritin nanoparticle vaccine antigen produced from two different cell lines. **Vaccine,** 41(44):6502-6513.

Weidenbacher PA*, Friedland N*, **Sanyal M***, Morris MK, Do J, Hanson C, Kim PS. (2023) Decreased efficacy of a COVID-19 vaccine due to mutations present in early SARS-CoV-2 variants of concern. bioRxiv Preprint. 2023 Jun 29:2023.06.27.546764.
doi: 10.1101/2023.06.27.546764.
***Equally contributed**

Weidenbacher PAB*, **Sanyal M***, Friedland N*, Tang S, Arunachalam PS, Hu H, Kumru OS, Mary Morris MK, Fontenot J, Shirreff L, Do J, Cheng YC, Vasudevan G, Feinberg MB, Villinger FJ, Hanson C, Joshi SB, Volkin DB, Pulendran B, Kim PS. (2023**)** A ferritin-based COVID-19 nanoparticle vaccine that elicits robust, durable, broad-spectrum neutralizing antisera in non-human primates. **Nature Communications, 14**: 2149**.**
***Equally contributed**

Tang S, Lu Y, Skinner WM, **Sanyal M**, Lishko PV, Ikawa M, and Kim PS (2022) Human sperm TMEM95 binds eggs and facilitates membrane fusion. **Proceedings of the National Academy of Sciences**,119 (40) e2207805119.

Weidenbacher PA, Musunuri S, Powell AE, Tang S, Do J, **Sanyal M**, Kim PS. (2022) Simplified Purification of Glycoprotein-Modified Ferritin Nanoparticles for Vaccine Development. **Biochemistry**, 62 (2) 292–299.

Weidenbacher PA, Rodriguez-Rivera FP, **Sanyal M**, Visser JA, Do J, Bertozzi CR, Kim PS, (2022) Chemically Modified Bacterial Sacculi as a Vaccine Microparticle Scaffold. **ACS Chemical Biology**, 17(5): 1184-1196.

Li C, Lee A, Grigoryan L, Arunachalam PS, Scott MKD, Trisal M, Wimmers F, **Sanyal M**, Weidenbacher PA, Feng Y, Adamska JZ, Valore E, Wang Y, Verma R, Reis N, Dunham D, O'Hara R, Park H, Luo W, Gitlin AD, Kim P, Khatri P, Nadeau KC, Pulendran B. (2022) Mechanisms of innate and adaptive immunity to the Pfizer-BioNTech BNT162b2 vaccine. **Nature Immunology**, 23(4): 543-555.

Powell AE, Zhang K, **Sanyal M**, Tang S, Weidenbacher PA, Li S, Pham TD, Pak JE, Chiu W, Kim PS (2021) A single immunization with spike-functionalized ferritin vaccines elicits neutralizing antibody responses against SARS-CoV-2 in mice. **ACS Central Science,** 7 (1) 183–199.

Waltari E, Carabajal E, **Sanyal M**, Friedland N and McCutcheon KM. (**2020**) Adaption of a conventional ELISA to a 96-well ELISA-Array for measuring the antibody responses to influenza virus proteins and vaccines. **Journal of Immunological Methods**, Jun-Jul 2020;481-482:112789.

Feng N, Hu L, Ding S, **Sanyal M**, Zhao B, Sankaran B, Ramani S, McNeal M, Yasukawa LL, Song Y, Prasad BVV, Greenberg HB (2019) Human VP8* mAbs neutralize rotavirus selectively in human intestinal epithelial cells. **Journal of Clinical Investigation,** 130 (9), 3839-3851.

Sanyal M[*], Holmes TY, Maecker H, Albrecht RA, Dekker CL, He XS, Greenberg HB (2019) Diminished B-cell response after repeated influenza vaccination. **Journal of Infectious Diseases,** 219(10):1586-1595.
*** Corresponding Author**

Tamosiuniene R, Manouvakhova O, Mesange P, Saito T, Qian J, **Sanyal M**, Lin YC, Nguyen LP, Luria A, Tu A, Sante J, Rabinovitch M, Fitzgerald DJ, Graham BB, Habtezion A, Voelkel NF, Aurelian L, Nicolls MR (2018) Dominant Role for Regulatory T Cells in Protecting Females Against Pulmonary Hypertension. **Circulation Research**, 122(12):1689-1702.

Nair N, Feng N, Blum LK, **Sanyal M**, Ding S, Jiang B, Sen A, Morton JM, He XS, Robinson WH, Greenberg HB (2017) VP4- and VP7-specific antibodies mediate heterotypic immunity to rotavirus in humans. **Science Translational Medicine,** 9(395): 1-12 (pii: eaam5434)

Edward JA, **Sanyal M**, Le W, Soudry E, Ramakrishnan VR, Bravo DT, Nguyen AL, Zarabanda D, Kingdom TT, Hwang PH, Fathman CG, Nayak JV (2017) Selective expansion of human regulatory T cells in nasal polyps, and not adjacent tissue microenvironments, in individual patients exposed to steroids. **Clinical Immunology.** 179: 66-76.

Sanyal M[*], Morimoto M, Baradaran-Heravi A, Choi K, Kambham N, Jensen K, Dutt S, Dionis-Petersen KY, Liu LX, Felix K, Mayfield K, Dekel B**,** Bokenkamp A, Fryssira H, Guillen-Navarro E, Lama G, Brugnara M, Lücke T, Olney AH, Hunley TE, Polat AI, Yis U, Bogdanovic R, Mitrovic K, Berry S, Najera L, Najafian B, Gentile M, Semerci CN, Tsimaratos M, Lewis DB, Boerkoel CF[*] (2015) Lack of IL7Rα expression in T cells is a hallmark of T-cell immunodeficiency in Schimke immuno-osseous dysplasia (SIOD) **Clinical Immunology,** 161(2): 355–365.
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Li S, Huang KJ, Wu JC, Hu MS, **Sanyal M**, Hu M, Longaker MT and Lorenz HP (2015) Peripheral Blood-Derived Mesenchymal Stem Cells: Candidate Cells Responsible for Healing Critical-sized Calvarial Bone Defects. **Stem Cells Translational Medicine** 4(4): 359-368.

He XS, Holmes TH, **Sanyal M**, Albrecht RA, García-Sastre A, Dekker CL, Mark M. Davis MM and Greenberg HB (2015) Distinct patterns of B-cell activation and priming by natural influenza infection versus inactivated influenza vaccination. **Journal of Infectious Disease** 211(7): 1051-1059.

Edward JA, **Sanyal M**, Ramakrishnan V, Le W, Nguyen A, Kingdom T, Hwang PH, Nayak, JV (2013) Systemic prednisone administration selectively alters granulocyte subsets in nasal polyps from AERD and CRS patients. **International Forum of Allergy & Rhinology** 3(11): 866 - 876.

Bravo DT, Soudry E, Edward JA, Le W, Nguyen A, Hwang, PH, **Sanyal M**, Nayak JV (2013) Characterization of human upper airway epithelial progenitors. **International Forum of Allergy & Rhinology** 3(10): 841-847.

Baradaran-Heravi A, Cho KS, Tolhuis B, **Sanyal M**, Morozova O, Morimoto M, Elizondo LI, Bridgewater D, Lubieniecka J, Beirnes K, Myung C, Leung D, Fam HK, Choi K, Huang Y, Dionis KY, Zonana J, Keller K, Stenzel P, Mayfield C, Lücke T, Bokenkamp A, Marra MA, van Lohuizen M, Lewis DB, Shaw C, Boerkoel CF. (2012) Penetrance of biallelic SMARCAL1 mutations is associated with environmental and genetic disturbances of gene expression. **Human Molecular Genetics** 21(11): 2572–2587.

Monteiro MC, **Sanyal M**, Cleary ML, Sengenes C, Bouloumi. A, Dani C and Billon N. (2011) PBX1, a novel stage-specific regulator of adipocyte development. **Stem Cells** 29:1837-1848.

Dutt S, Baker J, Kohrt HE, Kambham N, **Sanyal M**, Negrin RS and Strober S. $CD8^{+}CD44^{hi}$ but not $CD4^{+}$ $CD44^{hi}$ memory T cells mediate potent graft anti-lymphoma activity without GVHD. (2011) **Blood** 117: 3230-3239.

Sanyal M, Fernandez R and Levy S. Enhanced B cell activation in the absence of CD81. (2009) **International Immunology** 21(11): 1225–1237.

Luo RF, Zhao S, Tibshirani R, Myklebust JH, **Sanyal M**, Fernandez R, Gratzinger D, Marinelli RJ, Lu ZS, Wong A, Levy R, Levy S, Natkunam Y. (2010) CD81 Protein is expressed at high levels in normal germinal center B cells and in subtypes of human lymphomas. **Human Pathology** 41:271–280.

Mani M, Venkatasubrahmanyam M, **Sanyal M**, Levy S, Butte A, Weinberg K, and Jahn T. (2009) Wiskott-aldrich syndrome protein is an effector of kit signaling**. Blood** 114 (14): 2900-2908.

Stankunas K, Shang C, Twu KY, Kao SC, Jenkins NA, Copeland NG, **Sanyal M**, Selleri L, Cleary ML, Chang CP. (2008) Pbx/Meis Deficiencies Demonstrate Multigenetic Origins of Congenital Heart Disease. **Circulation Research** 103:702-709.

Sanyal M, Tung JW, Karsunky H, Zeng H, Selleri L, Weissman IL, Herzenberg LA, Cleary ML. (2007) B-cell development fails in the absence of the Pbx1 proto-oncogene. **Blood** 109(10): 4191-4199.

Yokoyama A, Wang Z, Wysocka J, **Sanyal M**, Aufiero DJ, Kitabayashi I, Herr W, Cleary ML. (2004) Leukemia proto-oncoprotein MLL forms a SETI-like histone methyltransferase complex with menin to regulate Hox gene expression. **Molecular and Cellular Biology** 24 (13): 5639-5649.

Selleri L, DiMartino J, van Deursen J, Brendolan A, **Sanyal M**, Boon E, Capellini T, Smith KS, Rhee J, Popperl H, Grosveld G and Cleary ML. (2004) The TALE homeodomain protein Pbx2 is not essential for development and long-term survival **Molecular and Cellular Biology** 24 (12): 5324-5331.

Raychaudhuri SR, **Sanyal M**, Weltman H, Kundu-Raychaudhuri S. (2004) K252a, a high-affinity nerve growth factor receptor blocker, improves psoriasis: An in vivo study using the severe combined Immunodeficient mouse-human skin model. **Journal of Investigative Dermatology** 122(3): 812-819.

Raychaudhuri SP, Dutt S, Raychaudhuri SK, **Sanyal M** and Farber EM. (2001) Severe combined immunodeficiency mouse-human skin chimeras: a unique animal model for the study of psoriasis and cutaneous inflammation. **British Journal Dermatology** 144(5): 931-939.

Sanyal M, Nag TC and Das C. (2000) Localisation of nitric oxide synthase in cultured human trophoblast cells: role of nitric oxide in trophoblast proliferation and differentiation. **American Journal of Reproductive Immunology** 43 (2): 70-77.

Sengupta S, **Sanyal M,** Kochupillai V and Gupta SK. (1999) Expression of inducible and neuronal nitric oxide synthase in 20-methyl cholanthrene (20-MCA) induced fibrosarcoma. **Indian Journal of Pharmacology** 31:315-318.

Sanyal M. and Das C. (1997) Collagenase-IV in human trophoblast invasion and differentiation. **Indian Journal of Biochemistry Biophysics** 34: 220-225.

Book Chapter and Edited Journal Topic

Sanyal M and Das C (1999) Immunomodulators in Human Trophoblast-Uterus Cross Talk: Cytokines, Growth Factors and nitric oxide. In: Reproductive Immunology (ed. S.K. Gupta) Narosa Publishing House, New Delhi; Chapter 10, pp 99-109.

Khan, N., Fourie, P. B., **Sanyal, M**., Marques, E. T. A., eds. (2024). Methods in Vaccines and Molecular therapeutics: 2022. Lausanne: Frontiers Media SA. DOI: 10.3389/978-2-8325-4528-7.

Doctoral Thesis

Sanyal M (1998) Study of collagenase-IV and plasminogen activator activity in human trophoblast cells and control of trophoblast proliferation. **All India Institute of Medical Sciences** (Advisor: Prof. Chandana Das).

Professional Membership

American Physiological Society, Regular member (1999 - present)
American Society of Hematology, Active member (2005 - present)
International Society for Stem Cell Research, Active member (2005 - present)
Society for Science and the Public, Member (2010 - Present)
Federation of Clinical Immunology Societies, Member (2013 - Present)

Scholarships / Fellowships / Awards /Grants

The Herzenberg Prize, Immunology Program, Stanford University School of Medicine, for the Academic year 2004-2005.

Dean's Fellowship at Stanford University School of Medicine (October 2001- April 2003)

Dr. K. S. Krishnan Research Fellowship of the Department of Atomic Energy, Government of India (March 1994 - February 1999). This fellowship is awarded to one person in the country per year in each discipline.

National Scholarship of the Ministry of Human Resource Development, Government of India (August 1990 - September 1992)

Best poster award in 4th International Symposium on Biochemical roles of Eukaryotic Cell Surface Macromolecules, National Institute of Immunology, New Delhi, India. (January 1996).

Development of an immune tolerant hESC source for allogeneic cell therapy applications.
(**Co-Investigator**) California Institute of Regenerative Medicine (Transplantation Immunology: RM1-01711).

Teaching and Other Public Services

Grand Award Judge for Society for Science & the Public (SSP) at the **Intel International Science and Engineering Fair** (2011- 2020).

Regeneron Science Talent Search Reviewer for Society for Science & the Public (SSP) at Regeneron Science Talent Search (2021, 2023)

Expert Panelist: Rare Genomics Institute (2013 and 2015).

Judge at Synopsys Championship Science Fair (2014-2020), San Jose.

Co-Director, High School Summer Research Program at Molecular Medicine Research Institute, Sunnyvale, California (2014-2015)

Judge for SPARK Competition - "The Science, Play and Research Kit (SPARK), Reimagining the 21st Century Chemistry Set" organized by Society for Science & the Public (SSP) and the Gordon and Betty Moore Foundation (2014).

Special Award Judge for American Physiological Society at the **Intel International Science and Engineering Fair** (2010), San Jose.

Frontiers in Immunology: 2006 Stanford Immunology 317. It is an advanced level course discussing cutting edge topics and research in immunology. Topic: "What can immunologists do with embryonic stem cells?"

Stanford Immunology Program Seminar Series: Led seminar discussions with the first-year immunology graduate students.

Mentoring Biological Sciences Rotation Graduate students. Topic: *In vitro* differentiation of embryonic stem cells. (Mentee: **Alper Yetil**, Stanford Cancer Biology Graduate Student).

Mentoring Clinical Fellow in Pediatrics Immunology (Mentee: **Roshni Mathew**, Clinical Fellow, Pediatric Infectious Disease).

Mentoring Master's Student in Immunology (Mentee: **Justin Edwards**, Undergraduate Student, Otolaryngology).

Invited talks and lectures

National Institute of Biomedical Genomics (Kalyani, India) Reverse Vaccinology. December 30, 2019.

American Society for Virology 34th Annual Meeting (London, Ontario, Canada), Identification of Targets of Heterotypic B Cell Immunity to Rotavirus in Humans. July 12, 2015.

West Bengal State University, Department of Zoology (Kolkata, India): Applications of high-dimensional flow cytometry in molecular immunology. 2nd January 2015.

Society for Systems Biology & Translational Research, (Kolkata, India): Human immune response analysis and personalized medicine. December 28, 2014.

Combined Otolaryngology Spring Meetings (Orlando, Florida): Identification of human nasal mucosal epithelial stem cells. April 2013.

West Bengal State University, Department of Zoology (India): Transcriptional control of lymphocyte development: Role of proto-oncogene Pbx1. December 2011.

Stanford University, Len Herzenberg's 80th Birthday Symposium: Lack of IL-7 receptor alpha chain (CD127) expression in T cells is a hallmark of T-cell immunodeficiency in Schimke immuno-osseous dysplasia (SIOD). November 2011

Vanderbilt University, Department of Microbiology and Immunology: Role of Pbx1 in B cell development. July, 2005.

2nd Joint Meeting International Psoriasis Symposium and European Congress on Psoriasis (San Francisco, California): Study of NGF-R positive fibers in transplanted psoriatic plaques in SCID mouse: Role of neurogenic inflammation in pathogenesis of psoriasis. June 2001.

Guwahati Medical College, Guwahati, India: **Sanyal M,** Kumar VS, Gupta S and Das C. Modulation of trophoblast functions by growth factors and cytokines: proliferation and invasion. Young Scientist Symposium on Reproductive Health Issues, May 1997.

Goa Medical College, Goa, India: Contribution of trophoblast invasiveness in embryo implantation: A key reproductive process. Young Scientist Symposium on Frontiers in Reproductive Biology, February 1996.

Indira Gandhi Medical College, Shimla, India**:** Plasminogen activator and its Inhibitor in trophoblast invasion and differentiation. Young Scientist Symposium on Frontiers in Reproductive Biology Research, October 1996.

Selected Presentation in Scientific Conferences

Sanyal M, Dionis KY, Baradaran-Heravi A, Dekel B, Bökenkamp A, Boerkoel CF and Lewis DB. Lack of IL-7 Receptor Alpha Chain (CD127) Expression in T cells is a hallmark of T-cell immunodeficiency in Schimke Immuno-Osseous Dysplasia (SIOD). Blood (ASH Annual Meeting Abstracts), Nov 2010; **116**: 2767. Conference: 51st American Society of Hematology Annual Meeting and Exposition, December 3-7, 2010, Orlando, FL, USA.

Sanyal M, Fernandez R, Sagi Y, Levy S. CD81, a T cell co-stimulatory molecule, is not required for T cell development. 14th International Congress of Immunology. August 22-2, Kobe, Japan.

Sanyal M, Fernandez R, and Levy S. Enhanced B cell activation in the absence of CD81. BLOOD 112 (11): 2578, NOV 16 2008. Conference: 50th American Society of Hematology Annual Meeting and Exposition, December 6-9, 2008 San Francisco, CA, USA.

Sanyal M, Shoham T, Fernandez R, and Levy S. Absence of CD81 paradoxically results in a hyper-IgM and IgG response to T-independent antigens. BLOOD 108 (11): 488a, 1719 Part 1 NOV 16, 2006. Conference: 48th Annual Meeting of the American Society of Haematology; December 9-11, 2006; Orlando, Fl, USA.

Sanyal M, Tung JW, Dejbakhsh-Jones S, Strober S, Herzenberg LA and ClearyML. The transcription factor Pbx1 is required for the development of double positive thymic T cells. Blood; November 16, 2004; v.104, no.11, p.759a Conference: 46th Annual Meeting of the American Society of Haematology; December 03-07, 2004; San Diego, CA, USA

Sanyal M, Tung JW, Herzenberg LA, Cleary ML**.** Pbx1 contributes to the development of early B-cell progenitors. Blood; November 16, 2003; v.102, no.11, p.567a. Conference: 45th Annual Meeting of the American Society of Haematology; December 06-09, 2003; San Diego, CA, USA.

Sanyal M and Cleary ML. Identification of transcriptional targets for proto-oncogene Pbx1**.** FASEB summer Research Conference on Hematological Malignancies, Vermont Academy, Vermont, 2003

Sanyal M, Prohaska SS, DiMartino J, Weissman IL and Cleary ML. (2001) Role of the Pbx1 proto-oncogene in lymphopoiesis. FASEB Summer Research Conference on Haematological Malignancies. Snowmass, Colorado, July 2001.

Sanyal M, Roychudhuri SP, Roychudhuri SK, Weltman H and Farber EM (2001) Study of NGF-R positive Fibers in Transplanted Psoriatic Plaques in SCID Mouse: Role of Neurogenic Inflammation in Pathogenesis of Psoriasis. Skin Pharmacology and Applied Skin Physiology 14 (3): 136-175. (May-June 2001).

Sanyal M and Das C. Inhibition of Collagenase-IV Inhibits Trophoblast Differentiation, 4th International Symposium on Biochemical roles of Eukaryotic Cell Surface Macromolecules, National Institute of Immunology, January 1996, New Delhi, India. **(Received best poster award).**

References

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