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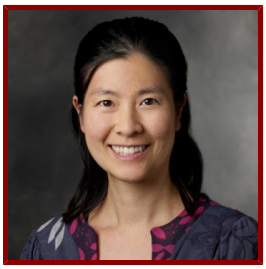

Christin S Kuo

Assistant Professor of Pediatrics (Pulmonary Medicine)

Pediatrics - Pulmonary Medicine

CLINICAL OFFICE (PRIMARY)

- **Pediatric Pulmonary and Cystic Fibrosis Clinic**
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ACADEMIC CONTACT INFORMATION

- **Administrative Contact**
  Meena Kakani - Administrative Manager
  Email mkakani@stanford.edu
  Tel 925-640-2404

Bio

BIO

Dr. Kuo is a physician-scientist with expertise in single-cell genomics and pulmonary medicine. She has made pioneering contributions to pulmonary neuroendocrine cell (PNEC) biology by developing innovative strategies that established the first comprehensive framework for understanding the molecular and cellular diversity of normal PNECs and their roles in health and disease. Her discoveries have laid the foundation for this emerging field and her contributions are recognized internationally.

PNECs are exceedingly rare lung epithelial cells with specialized airway sensory, secretory, and stem cell functions. These neurosensory cells are thought to monitor airway oxygen, chemicals, mechanical deformation, infection, and injury, and serve as sentinels that signal this sensory information locally in the lung, to the brain through synapses with pulmonary sensory neurons and potentially globally throughout the body via secretion of myriad local signals and hormones. PNECs are also known to play critical roles in the control of breathing, cough, and respiratory physiology. Among their diverse physiologic functions, their response to injury has been most intensively studied in murine models and they are a cell of origin for high grade lung neuroendocrine tumors.

Dr. Kuo performed the first comprehensive anatomical mapping and lineage tracing studies of PNECs in mice which generated a foundational understanding of PNEC development (Kuo and Krasnow, Cell 2015). She also led single cell transcriptomic profiling studies that revealed a surprising diversity in PNEC sensors and signals (Kuo et al, eLife 2022). PNECs express over 25 different sensory receptor genes ("sensors") and over 40 different neuropeptide and peptide hormone genes ("signals"). Her scRNA-seq analysis of PNECs revealed a remarkable number and diversity of PNEC neuropeptide signals and their predicted cellular targets both within the lung and to innervating sensory neurons (Kuo et al., 2022, eLife).

In contrast to the advanced understanding of PNEC development, stem cell, and signaling function in mouse, little is known about human PNECs. To compare the findings of PNEC development, diversity, and function in mouse models to human diseases, her lab recently established a platform to systematically construct a human PNEC atlas. This foundational work created a molecular and anatomic framework for the entire human pulmonary

neuroendocrine system and the diseases that are predicted to originate from distinct PNECs. Her lab has recently used this new PNEC atlas combined with single cell transcriptomic approaches to identify the molecular diversity of anatomically and functionally distinct human PNECs.

Dr. Kuo's studies with human models extends her lab's current research aims to define the diverse neuroendocrine sensory and signaling interactions and the molecules that mediate them to their roles in lung cancer, neuroendocrine proliferative disorders such as diffuse idiopathic neuroendocrine cell hyperplasia (DIPNECH), neuroendocrine cell hyperplasia of infancy (NEHI) and major inflammatory and obstructive pulmonary diseases. Dr. Kuo's lab engages a network of collaborators to develop and implement clinical protocols and strategically apply cutting-edge technologies to studying minor, but physiologically diverse airway sentinels.

Please visit the research website for additional information and current research areas (https://kuo.stanford.edu).

CLINICAL FOCUS

- Pediatric Pulmonology
- Interstitial Lung Diseases

ACADEMIC APPOINTMENTS

- Assistant Professor-Univ Med Line, Pediatrics - Pulmonary Medicine
- Member, Bio-X
- Member, Cardiovascular Institute
- Member, Maternal & Child Health Research Institute (MCHRI)

HONORS AND AWARDS

- Maternal and Child Health Research Institute (MCHRI) Faculty Scholar, Stanford University (2022-2027)
- Esther Ehrman Lazard Faculty Scholar, Stanford University (2020-2021)
- Doris Duke Clinical Scientist Award, Doris Duke Charitable Foundation (DDCF) (2018-2022)
- Harvey Cohen Lectureship, Lucile Packard Children's Hospital (Stanford University) (2017)
- Klosterfrau Award for Outstanding Pediatric Pulmonary Research, Society for Pediatric Pneumonology (Dresden, Germany) (2016)
- Outstanding Instructor Presentation Award, Stanford University (2013)
- Parker B. Francis Fellowship in Pulmonary Research, Francis Family Foundation (2011-2014)
- Pediatric Clerkship Faculty Honor Roll for Excellence in Teaching, Stanford University Medical School (2010-2011)

PROFESSIONAL EDUCATION

- Board Certification: Pediatric Pulmonology, American Board of Pediatrics (2010)
- Residency: UCSF Pediatric Residency (2007) CA
- Medical Education: St Louis University School of Medicine (2004) MO
- Board Certification: Pediatrics, American Board of Pediatrics (2007)
- Fellowship: Lucile Packard Children's Hospital (2011) CA

LINKS

- Website: https://kuo.stanford.edu/

Teaching

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Helen Yue Zhang

Publications

PUBLICATIONS

- **Beyond Breathing: Lung as a Sensory Organ A Report from the NHLBI Workshop on Lung Sensing and its Implication in Diseases.** *American journal of respiratory cell and molecular biology*

  Jendzjowsky, N., Kuo, C. S., Reznikov, L. R., Chen, Z., Li, P., Prescott, S., Liu, Y., Seeholzer, L., Tschumperlin, D. J., Taylor-Clark, T. E., Rajagopal, J., Haber, A. L., Noël, et al

  2026

- **Cellular and molecular characterization of peripheral glia in the lung and other organs.** *PloS one*

  Hall, S., Liu, S., Liang, I., Schulz, S., Ezran, C., Tan, M., Kuo, C. S.

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- **Interleukin(IL)-1/IL-6-inhibitor-associated drug reaction with eosinophilia and systemic symptoms (DReSS) in systemic inflammatory illnesses.** *The journal of allergy and clinical immunology. In practice*

  Saper, V. E., Tian, L., Verstegen, R. H., Conrad, C. K., Cidon, M., Hopper, R. K., Kuo, C. S., Osoegawa, K., Baszis, K., Bingham, C. A., Ferguson, I., Hahn, T., Horne, et al

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- **Interstitial macrophages are a focus of viral takeover and inflammation in COVID-19 initiation in human lung.** *The Journal of experimental medicine*

  Wu, T. T., Travaglini, K. J., Rustagi, A., Xu, D., Zhang, Y., Andronov, L., Jang, S., Gillich, A., Dehghannasiri, R., Martinez-Colon, G. J., Beck, A., Liu, D. D., Wilk, et al

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- **An organism-wide atlas of hormonal signaling based on the mouse lemur single-cell transcriptome.** *Nature communications*

  Liu, S., Ezran, C., Wang, M. F., Li, Z., Awayan, K., Long, J. Z., De Vlaminck, I., Wang, S., Epelbaum, J., Kuo, C. S., Terrien, J., Krasnow, M. A., Ferrell, et al

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- **Neuroendocrinology of the lung revealed by single-cell RNA sequencing.** *eLife*

  Kuo, C. S., Darmanis, S., Diaz de Arce, A., Liu, Y., Almanzar, N., Wu, T. T., Quake, S. R., Krasnow, M. A.

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- **The Tabula Sapiens: A multiple-organ, single-cell transcriptomic atlas of humans.** *Science (New York, N.Y.)*

  Jones, R. C., Karkanias, J., Krasnow, M. A., Pisco, A. O., Quake, S. R., Salzman, J., Yosef, N., Bulthaup, B., Brown, P., Harper, W., Hemenez, M., Ponnusamy, R., Salehi, et al

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- **Tissue-specific telomere shortening and degenerative changes in a patient with TINF2 mutation and dyskeratosis congenita.** *Human pathology (New York)*

  Roake, C. M., Juntilla, M., Agarwal-Hashmi, R., Artandi, S., Kuo, C. S.

  2021; 25

- **A molecular cell atlas of the human lung from single-cell RNA sequencing.** *Nature*

  Travaglini, K. J., Nabhan, A. N., Penland, L., Sinha, R., Gillich, A., Sit, R. V., Chang, S., Conley, S. D., Mori, Y., Seita, J., Berry, G. J., Shrager, J. B., Metzger, et al

  2020

- **A single-cell transcriptomic atlas characterizes ageing tissues in the mouse.** *Nature*

  2020

- **Rare Pulmonary Neuroendocrine Cells Are Stem Cells Regulated by Rb, p53, and Notch.** *Cell*
  Ouadah, Y. n., Rojas, E. R., Riordan, D. P., Capostagno, S. n., Kuo, C. S., Krasnow, M. A.
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- **A national registry for childhood interstitial and diffuse lung diseases in the United States.**
  Young, L., Nevel, R., Casey, A., Fishman, M., Welsh, S., Liptzin, D., Hagood, J., Kurland, G., Craven, D., Fiorino, E., Taylor, J., Goldfarb, S., Conrad, et al
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- **Single-cell transcriptomics of 20 mouse organs creates a Tabula Muris.** *Nature*
  2018; 562 (7727): 367–72

- **Pulmonary arteriovenous malformations: an uncharacterised phenotype of dyskeratosis congenita and related telomere biology disorders** *EUROPEAN RESPIRATORY JOURNAL*
  Khincha, P. P., Bertuch, A. A., Agarwal, S., Townsley, D. M., Young, N. S., Keel, S., Shimamura, A., Boulad, F., Simoneau, T., Justino, H., Kuo, C., Artandi, S., McCaslin, et al
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- **Respiratory System Involvement in Costello Syndrome** *AMERICAN JOURNAL OF MEDICAL GENETICS PART A*
  Gomez-Ospina, N., Kuo, C., Ananth, A. L., Myers, A., Brennan, M., Stevenson, D. A., Bernstein, J. A., Hudgins, L.
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- **Formation of a Neurosensory Organ by Epithelial Cell Slithering** *CELL*
  Kuo, C. S., Krasnow, M. A.
  2015; 163 (2): 394-405

- **Cellular mechanisms of alveolar pathology in childhood interstitial lung diseases: current insights from mouse genetics** *CURRENT OPINION IN PEDIATRICS*
  Kuo, C. S., Desai, T. J.
  2015; 27 (3): 341-347

- **Interstitial lung disease in children.** *Current opinion in pediatrics*
  Kuo, C. S., Young, L. R.
  2014; 26 (3): 320-327

- **PML-dependent apoptosis after DNA damage is regulated by the checkpoint kinase hCds1/Chk2** *NATURE CELL BIOLOGY*
  Yang, S. T., Kuo, C., Bisi, J. E., Kim, M. K.
  2002; 4 (11): 865-870

- **Localization, dynamics, and protein interactions reveal distinct roles for ER and Golgi SNAREs** *JOURNAL OF CELL BIOLOGY*
  Hay, J. C., Klumperman, J., Oorschot, V., Steegmaier, M., Kuo, C. S., Scheller, R. H.
  1998; 141 (7): 1489-1502

- **Protein interactions regulating vesicle transport between the endoplasmic reticulum and Golgi apparatus in mammalian cells** *CELL*
  Hay, J. C., Chao, D. S., Kuo, C. S., Scheller, R. H.
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- **Molecular hallmarks of heterochronic parabiosis at single-cell resolution.** *Nature*
  Palovics, R., Keller, A., Schaum, N., Tan, W., Fehlmann, T., Borja, M., Kern, F., Bonanno, L., Calcuttawala, K., Webber, J., McGeever, A., Tabula Muris Consortium, Luo, J., et al
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- **Cell types of origin of the cell-free transcriptome.** *Nature biotechnology*
  Vorperian, S. K., Moufarrej, M. N., Tabula Sapiens Consortium, Quake, S. R., Jones, R. C., Karkanias, J., Krasnow, M., Pisco, A. O., Quake, S. R., Salzman, J., Yosef, N., Bulthaup, B., Brown, P., et al
  2022

- **RNA splicing programs define tissue compartments and cell types at single-cell resolution** *ELIFE*
  Olivieri, J., Dehghannasiri, R., Wang, P. L., Jang, S., de Morree, A., Tan, S. Y., Ming, J., Wu, A., Consortium, T., Quake, S. R., Krasnow, M. A., Salzman, J.

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- **Cell-autonomous immune gene expression is repressed in pulmonary neuroendocrine cells and small cell lung cancer.** *Communications biology*
  Cai, L., Liu, H., Huang, F., Fujimoto, J., Girard, L., Chen, J., Li, Y., Zhang, Y., Deb, D., Stastny, V., Pozo, K., Kuo, C. S., Jia, et al
  2021; 4 (1): 314

- **Single-cell meta-analysis of SARS-CoV-2 entry genes across tissues and demographics.** *Nature medicine*
  Muus, C., Luecken, M. D., Eraslan, G., Sikkema, L., Waghray, A., Heimberg, G., Kobayashi, Y., Vaishnav, E. D., Subramanian, A., Smillie, C., Jagadeesh, K. A., Duong, E. T., Fiskin, et al
  2021

- **Ageing hallmarks exhibit organ-specific temporal signatures.** *Nature*
  Schaum, N. n., Lehallier, B. n., Hahn, O. n., Pálovics, R. n., Hosseinzadeh, S. n., Lee, S. E., Sit, R. n., Lee, D. P., Losada, P. M., Zardeneta, M. E., Fehlmann, T. n., Webber, J. T., McGeever, et al
  2020

- **Axon-like protrusions promote small cell lung cancer migration and metastasis.** *eLife*
  Yang, D., Qu, F., Cai, H., Chuang, C., Lim, J. S., Jahchan, N., Gruner, B. M., S Kuo, C., Kong, C., Oudin, M. J., Winslow, M. M., Sage, J.
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