Stanford MEDICINE | Department of Biomedical Data Science

Precision in Chaos: Emergency Medicine as Multiscale Prediction Problem

David Kim, M.D., Ph.D
Assistant Professor, University Medical Line
Department of Emergency Medicine
Stanford University

February 12th, 2026
1:30PM-2:50PM
****R358****

Abstract:

Emergency Medicine is the art of decision-making under extreme uncertainty. Clinicians must continuously evaluate noisy, incomplete signals to determine patient trajectories: who will require admission, who will decompensate, and who can safely return home. While modern health systems now collect vast streams of high-resolution physiologic and multimodal data, these signals remain disconnected from real-time clinical decisions. This talk frames Emergency Medicine as a multi-scale prediction and resource allocation problem, presenting active research across three scales of intervention: (1) The Visit: real-time ensemble and deep learning models that continuously forecast decompensation and disposition from irregular, multimodal time series within the ED; (2) The Transition: extending the prediction horizon beyond hospital walls by integrating wearable sensors to characterize post-acute trajectories and predict revisits; and (3) The System: using discrete-event simulation to optimize how predictions are operationalized, as in AI-driven radiology queue prioritization. Throughout, I will highlight open methodologic challenges, including calibration under temporal distribution shift, informative observation processes, and the gap between offline model discrimination and deployed decision utility. These projects sit atop a large-scale, continuously-growing multimodal data resource with a direct path to prospective validation and deployment.

Reading list:

- Kareemi H, Yadav K, Price C, et al. Artificial intelligence–based clinical decision support in the emergency department: A scoping review. *Acad Emerg Med*. 2025; 32: 386-395. doi:10.1111/acem.15099
- Marika M. Kachman, Irina Brennan, Jonathan J. Oskvarek, Tayab Waseem, Jesse M. Pines, How artificial intelligence could transform emergency care,The American Journal of Emergency Medicine, https://doi.org/10.1016/j.ajem.2024.04.024.
- Chen, E., Prakash, S., Janapa Reddi, V. *et al.* A framework for integrating artificial intelligence for clinical care with continuous therapeutic monitoring. *Nat. Biomed. Eng* 9, 445–454 (2025). https://doi.org/10.1038/s41551-023-01115-0
- Sundrani, S., Chen, J., Jin, B.T. *et al.* Predicting patient decompensation from continuous physiologic monitoring in the emergency department. *npj Digit. Med.* 6, 60 (2023). https://doi.org/10.1038/s41746-023-00803-0
- Kansal, A., Chen, E., Jin, B.T. *et al.* MC-MED, multimodal clinical monitoring in the emergency department. *Sci Data* 12, 1094 (2025). https://doi.org/10.1038/s41597-025-05419-5
- Boyang Tom Jin, Raj Palleti, Siyu Shi, Andrew Y Ng, James V Quinn, Pranav Rajpurkar, David Kim, Transfer learning enables prediction of myocardial injury from continuous single-lead electrocardiography, *Journal of the American Medical Informatics Association* https://doi.org/10.1093/jamia/ocac135