Future Epidemiologic Research Using Digital Health Technologies: The Cohort 3.0 Digital Cohort

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Epidemiology is shifting toward earlier and more continuous characterization of disease processes. In medicine, this 'left shift' moves attention to preclinical stages, where subclinical manifestations and pathological changes appear and prevention is feasible. It reframes health and disease as a spectrum, illustrated by prolonged borderline states such as prediabetes (and prehypertension) that can persist for years before diagnosis. This transition mirrors evolving cohort architectures. Cohort 1.0 (Framingham) established prospective follow-up and standardized risk-factor epidemiology. Cohort 2.0 expanded scale and biological depth through biobanking and systematic linkage (HEXA, UK Biobank). HEXA recruited 167,169 adults (2004-2013), collected questionnaires and biospecimens, linked outcomes to death records, cancer registries, and insurance claims, and included a validated 106-item FFQ enabling diet-pattern research. Translation tools such as AI Diet (a shortened, ML-based diet pattern screener) and CancerFree (questionnaire-based Cox risk prediction) operationalize personalized prevention, yet episodic self-report and mostly time-fixed covariates limit sensitivity to within-person variability, short-term dynamics, and early transitions along the health-disease continuum. The Cohort 3.0 digital cohort should embed continuous, context-aware measurement (wearables, smartphones, connected sensors), longitudinal EHR/imaging linkage, and algorithm-assisted phenotyping across the cohort lifecycle. Beyond data volume, it enables time-varying exposure and intermediate-state estimation, principled handling of missingness and device drift, and feedback loops that trigger timely intervention before irreversible pathology. Implementation must address governance, privacy, and equity, since digital access and literacy are socially patterned and could widen disparities if unaddressed. It should also manage participant burden and calibration as devices and software evolve.

Biography

Professor Daehee Kang is a physician and epidemiologist at the Department of Preventive Medicine, Seoul National University College of Medicine. He received his medical and graduate training at Seoul National University and completed his PhD in Environmental Health Sciences at Johns Hopkins University. His work focuses on cancer epidemiology and large-scale cohort studies, including leadership roles in the Asia Cohort Consortium and the WHO IARC Working Groups. Alongside this work, he has contributed to modernizing healthcare delivery by establishing the Korean Telemedicine Society in 2020 and the Asia Telemedicine Society in 2025.

The High-benefit Approach: A New Targeting Strategy in Precision Medicine

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In medicine, treatment or intervention is typically prioritized for individuals at high risk of diseases or mortality. This high-risk approach, which focuses on "high-risk" patients, has been a cornerstone of clinical decision-making. Additionally, recent advancements in precision medicine, especially those using multi-omics data to assess disease risk, have frequently been framed within this approach. However, it is not always the case that individuals at high risk of disease benefit most from the treatment of interest. In this context, we previously proposed a novel targeting strategy called the "high-benefit approach." (Inoue K, Athey S, Tsugawa Y. Int J Epidemiol. 2023 Aug 2;52(4):1243-1256.) By applying machine learning technologies to data from randomized controlled trials or observational studies, this strategy allows us to identify subpopulations likely to experience substantial benefits from the treatment and to target them, rather than those who are simply at high risk of diseases. The high-benefit approach contributes not only to effective resource allocation but also to the potential mitigation of health disparities by identifying individuals with limited or no benefits and offering alternative approaches that would be effective for them. This talk covers the overall concept of the high-benefit approach and its potential for application in healthcare literature, particularly in advancing future precision medicine and public health.

Biography

Professor Kosuke Inoue is a physician and epidemiologist. After graduating from the University of Tokyo Faculty of Medicine and completing clinical training at the National Center for Global Health and Medicine and Yokohama Rosai Hospital, he obtained his PhD from UCLA (Epidemiology), in 2021. Since August 2025, he has served as a full professor of the Department of Health Promotion and Behavioral Sciences at Kyoto University Graduate School of Medicine. He is board-certified in endocrinology and metabolism, and serves as an associate editor of International Journal of Epidemiology and European Journal of Epidemiology.

Persistent gaps in the use of AI for health communications and misinformation

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Despite early research connecting novel sources of social and health data to health behaviours and outcomes, research in infodemiology has degraded in the last decade because of a persistent gap between computer science and epidemiology. Research focused on AI methods rarely connects to real world health behaviours or outcomes or use appropriate epidemiological methods. Applied infodemiology research often relies on off-the-shelf AI tools rather than thoughtfully designed architectures.For observing health attitudes and behaviours quickly and at scale, AI tools work best for making sense of messy and complicated data including text and images where it would not be feasible to ask experts to help, or where decisions are subjective and we expect strong variation from experts.Health communications and misinformation can be useful tasks for testing new data-driven methods because of the availability of data and importance of the problem, but there have been some high-profile cases where flawed data and methods have led to problematic conclusions that appear to have been taken up in policy and decision making.While there is no simple solution to addressing these gaps, some simple reminders may help. Study designs are more useful for making recommendations when: the outcome measures are real health outcomes such as validated surveys or diagnoses; analyses are about people not posts; when people are represented over time; the data actually represent the populations for whom the work is intended, and experts for whom the tool is intended are involved in the design.

Biography

Adam Dunn is Professor of Biomedical Informatics at the University of Sydney. His primary research interests lie in the application of AI in healthcare and the use of clinical trial data in AI-driven clinical research. Adam is an expert in medical informatics, digital health, and transdisciplinary research spanning data science, epidemiology, and public health. He is Editor-in-Chief of npj Digital Public Health and Deputy Editor of npj Digital Medicine.