Johns Hopkins Engineering

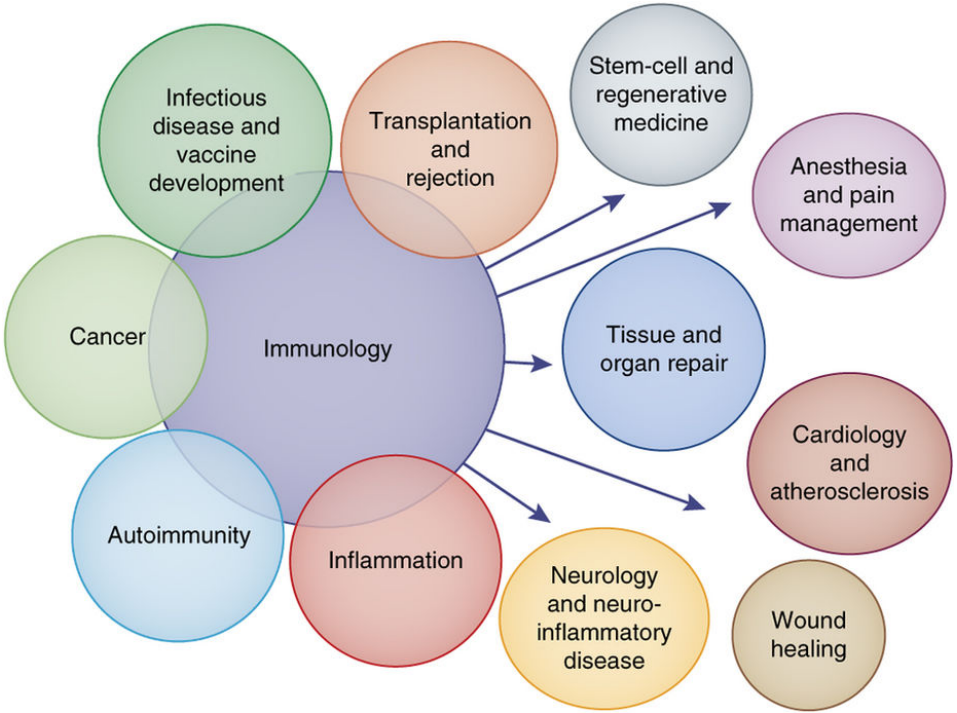
Immunoengineering

Immunoengineering - Immunoprofiling

Systems Biology and Big Data

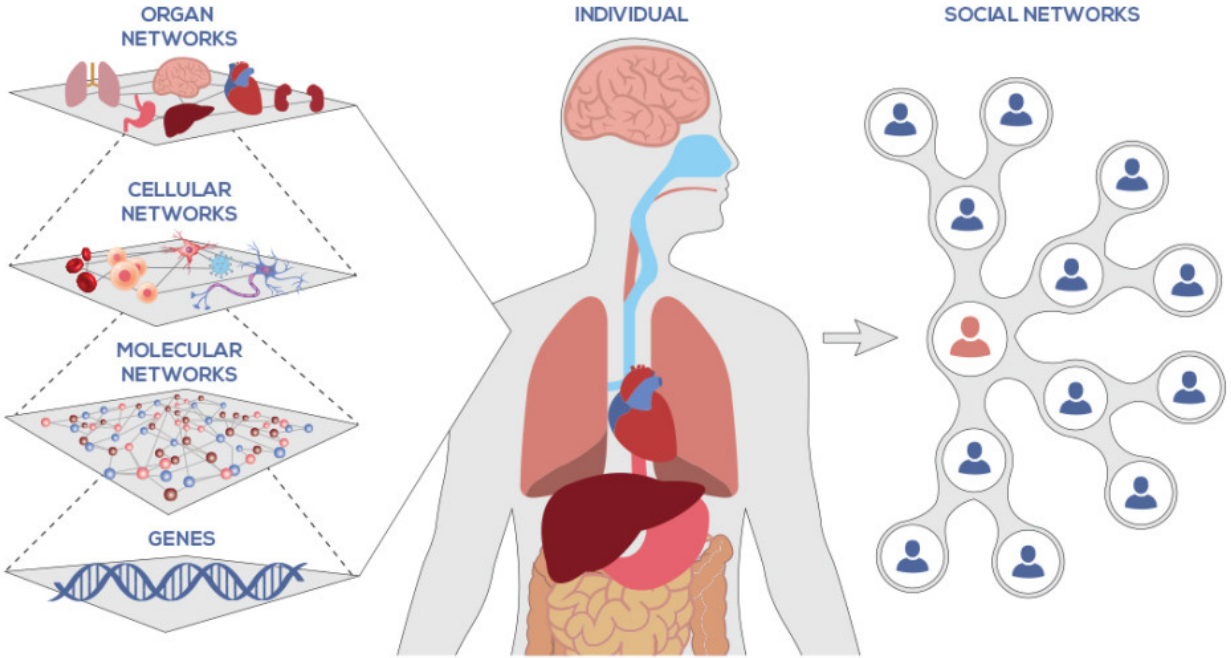
JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Comprehensive View of Health



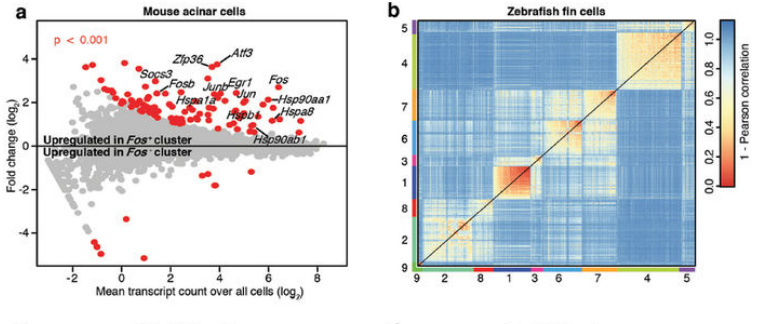
Davis, Mark M., Cristina M. Tato, and David Furman. "Systems immunology: just getting started." *Nature immunology* 18.7 (2017): 725.

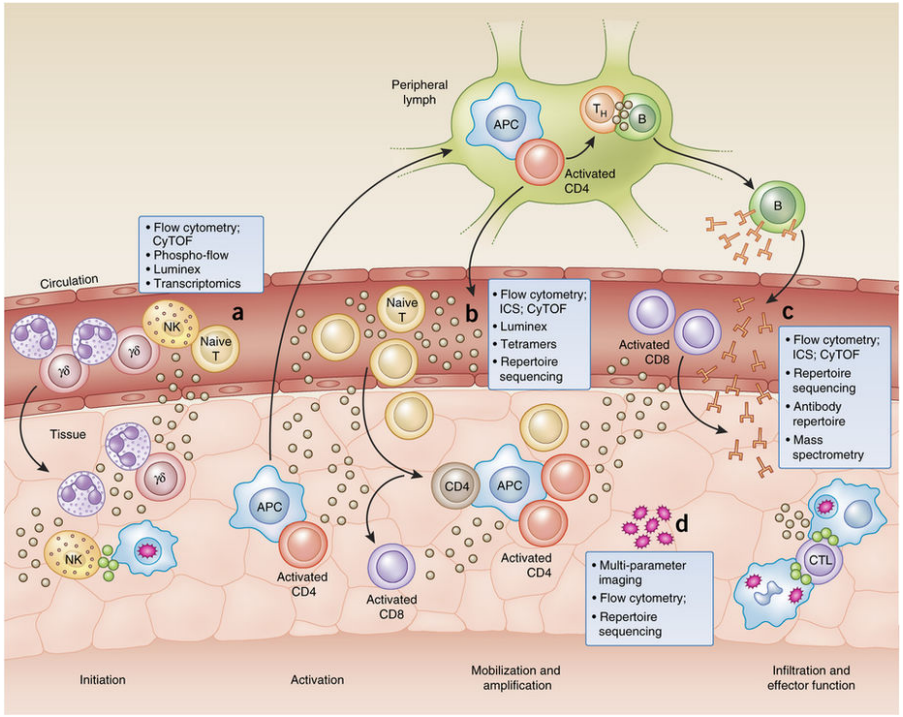
We are made of Networks of Networks



https://www.systemsbiology.org/about/what-is-systems-biology/

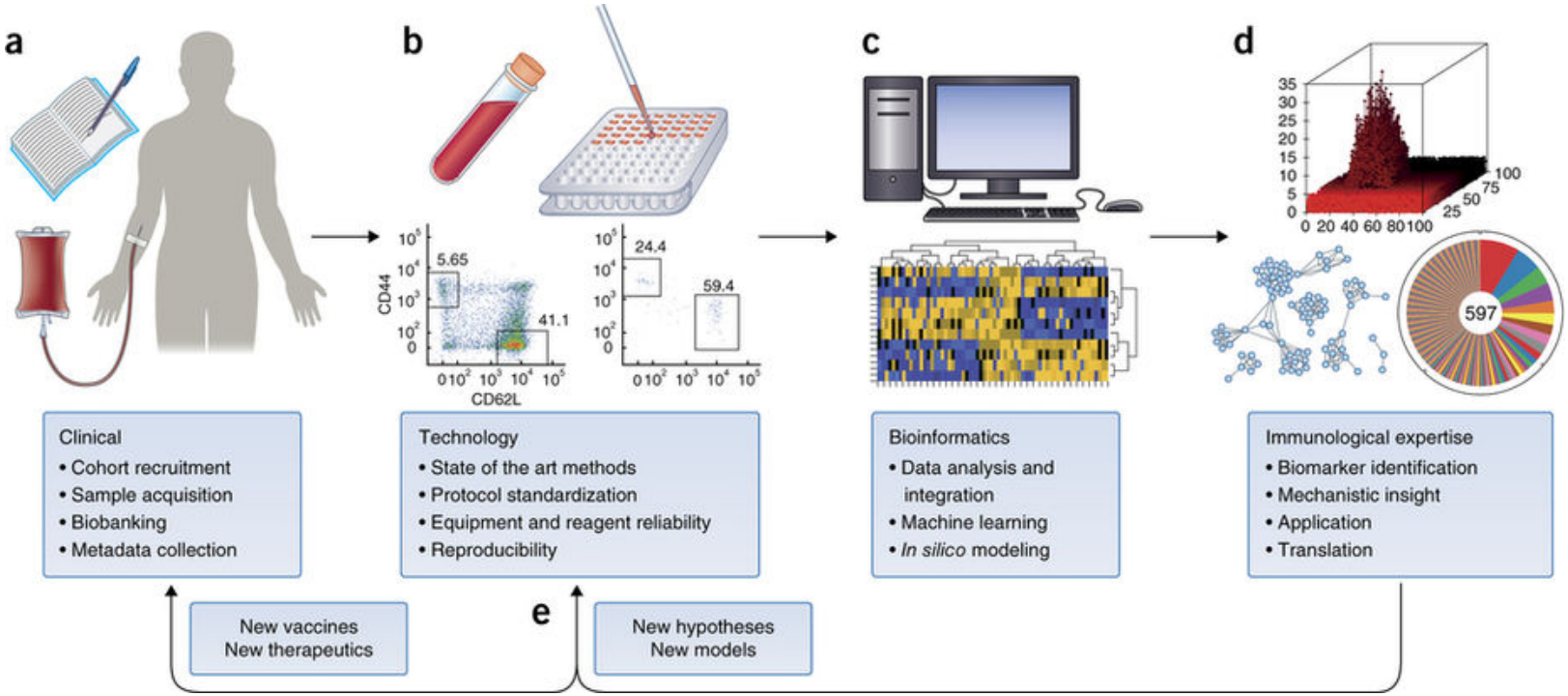
Going from Assays to Mechanistic Pictures





Davis, Mark M., Cristina M. Tato, and David Furman. "Systems immunology: just getting started." *Nature immunology* 18.7 (2017): 725.
van den Brink, Susanne C., et al. "Single-cell sequencing reveals dissociation-induced gene expression in tissue subpopulations." *Nature methods* 14.10 (2017): 935.

Systems Immunology Requires a Team Effort



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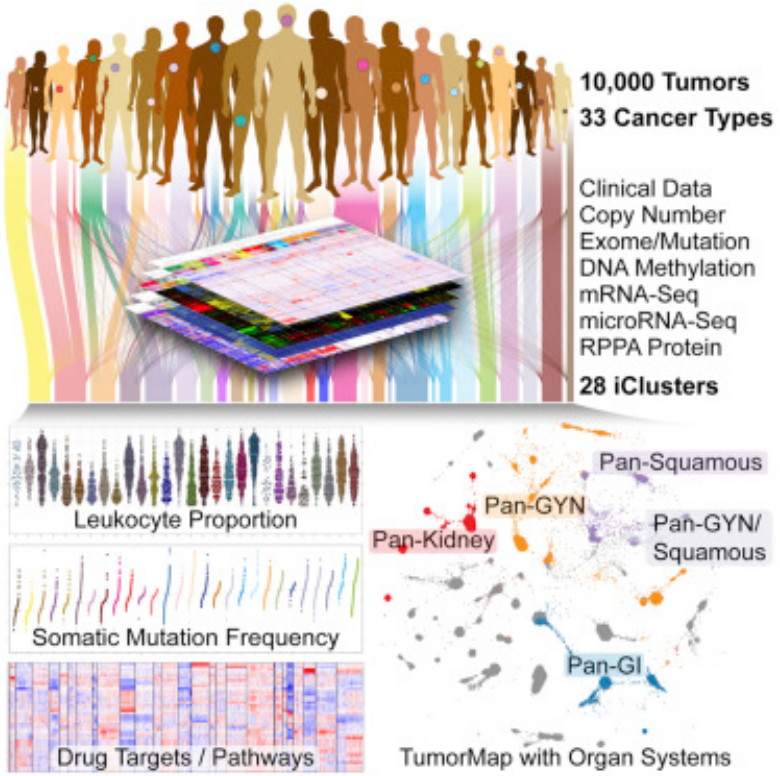
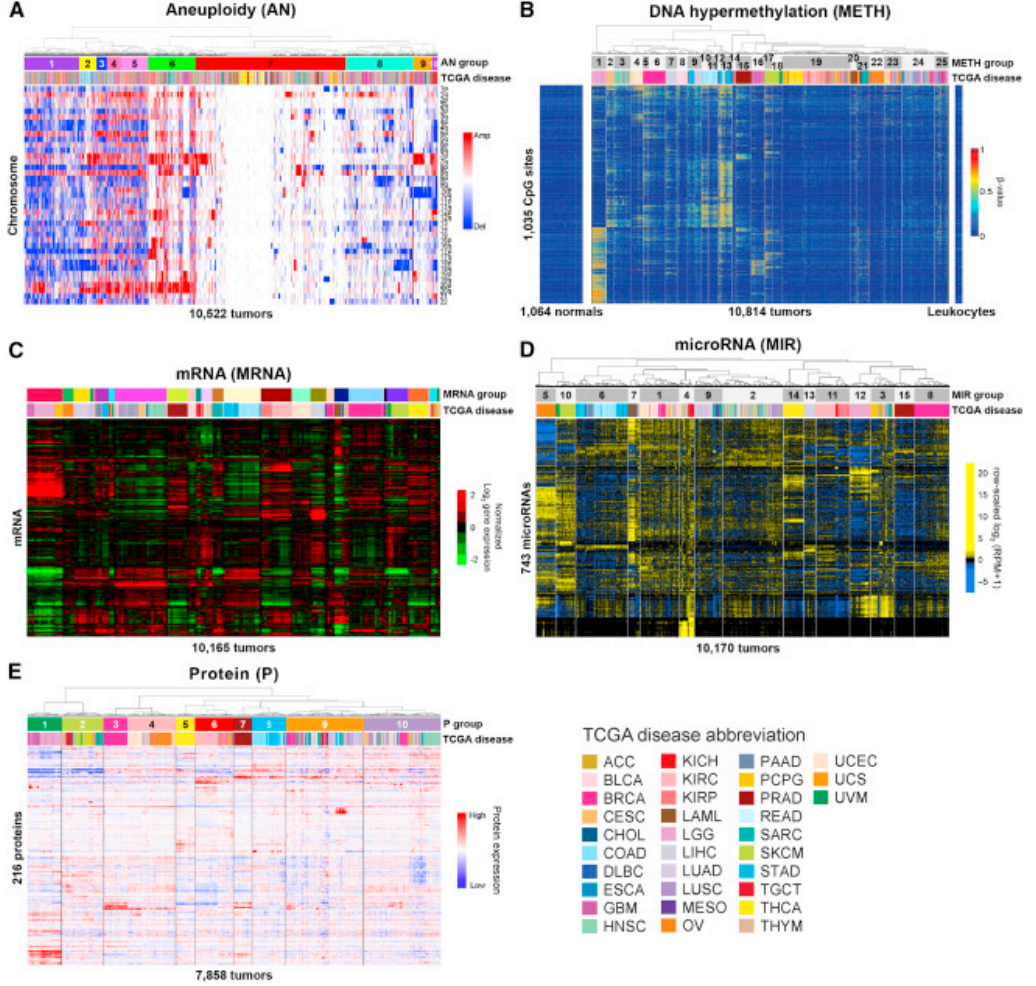
Example: Systems Biology for Cancer

- Cross-institution collaboration between scientists and researchers
- Databases created for sharing information found



Hoadley, Katherine A., et al. "Cell-of-origin patterns dominate the molecular classification of 10,000 tumors from 33 types of cancer." *Cell* 173.2 (2018): 291-304.

Data Display



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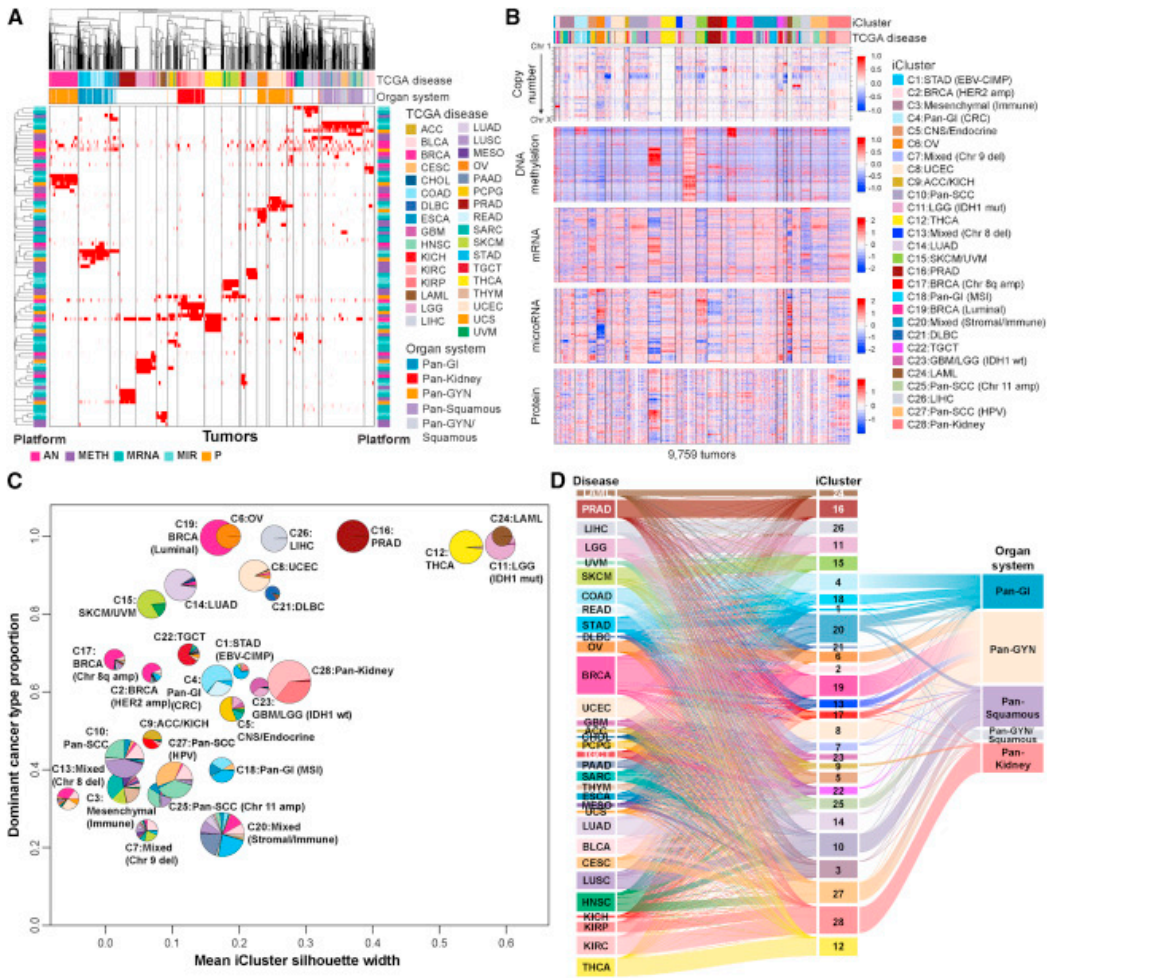

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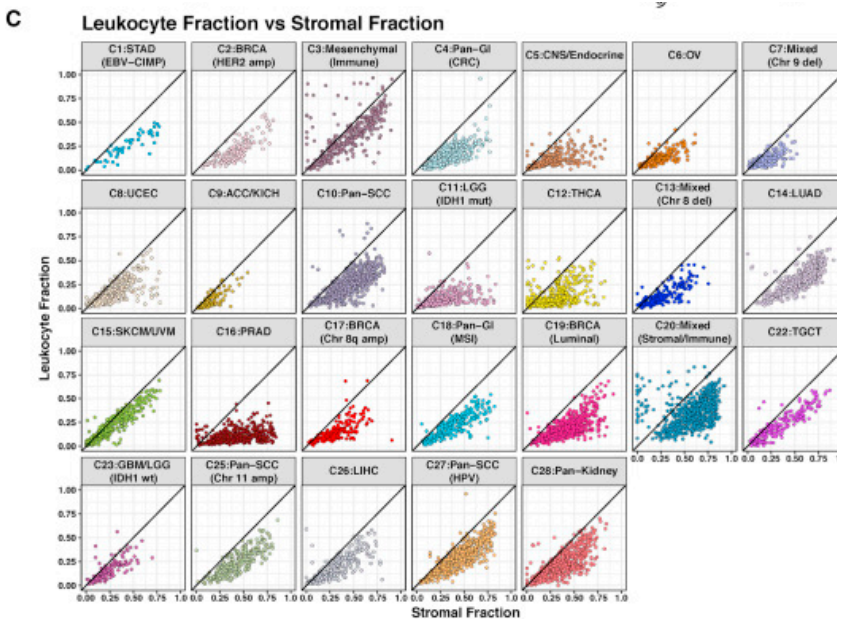

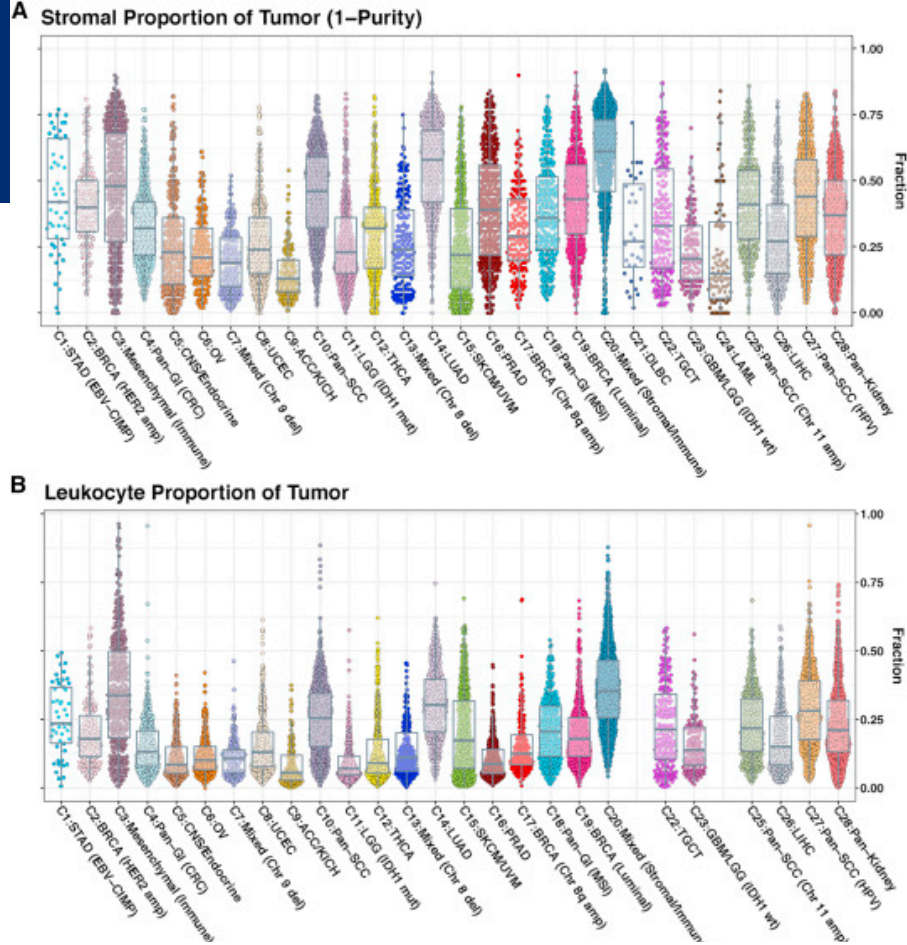

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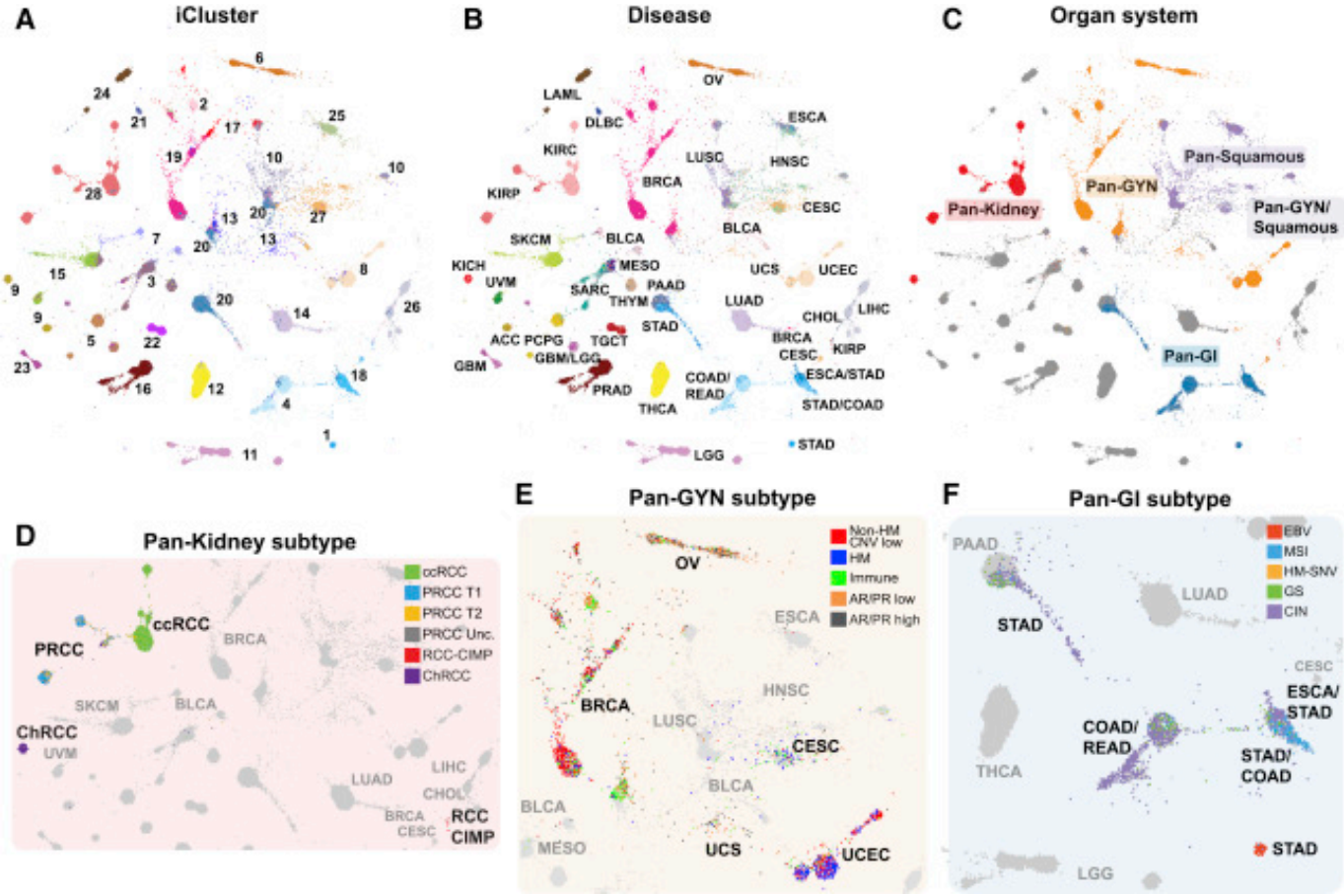

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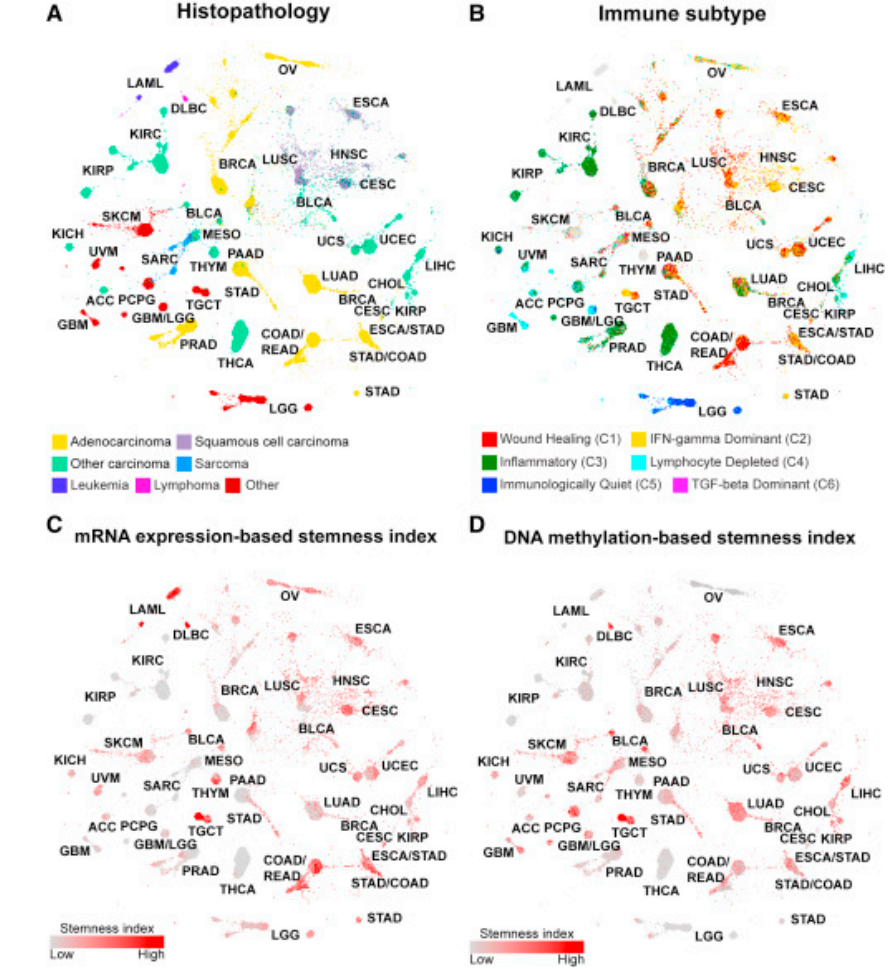

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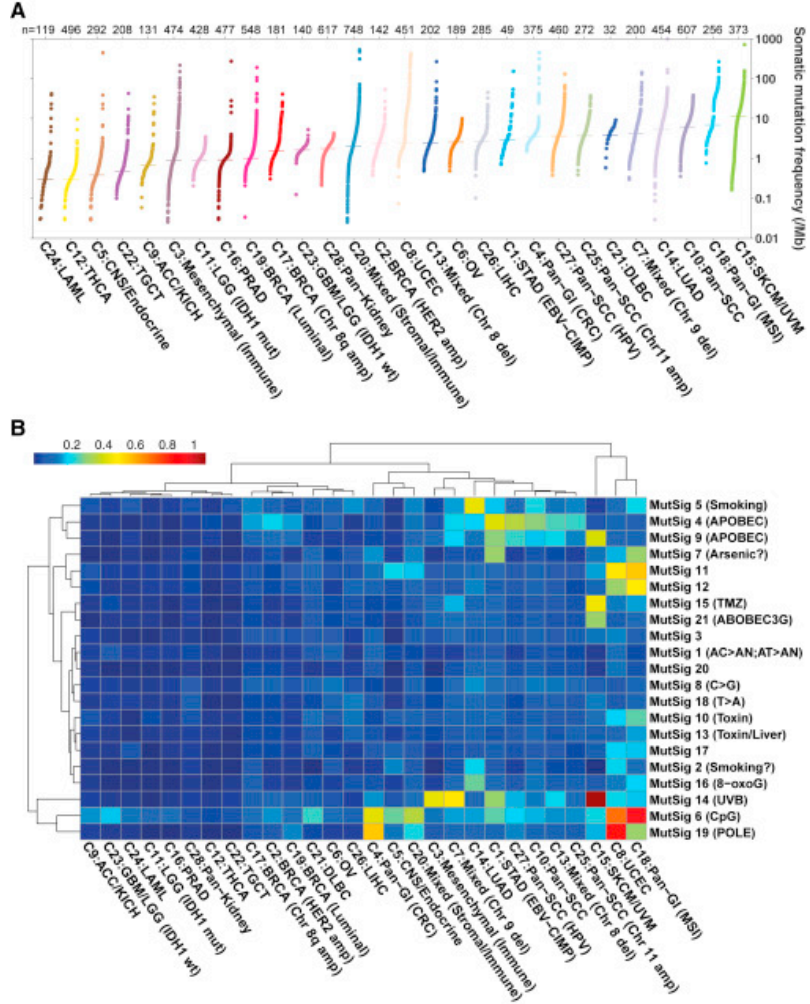

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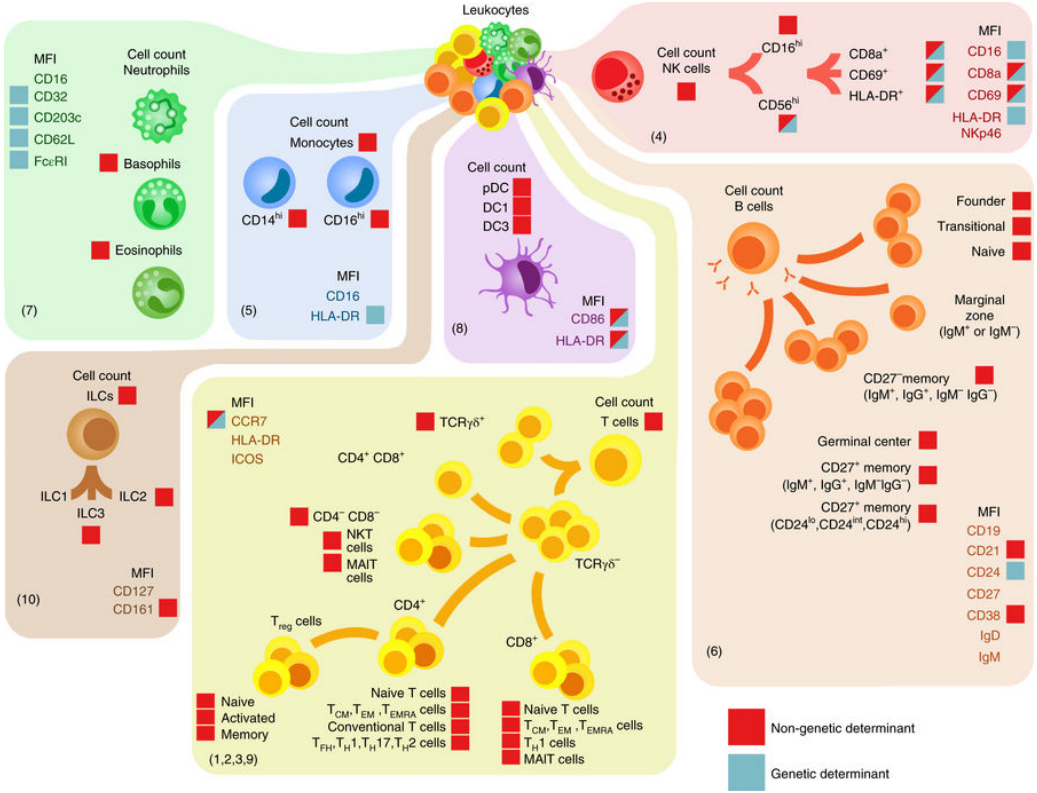
Data Interpretation

- Requires reduction of multi-dimensional data
- Computational tools for networking and present in 2D
- Similar techniques used in social media being used
- Common techniques
  - Principle component analysis
  - Least squares analysis
  - Hierarchal analysis

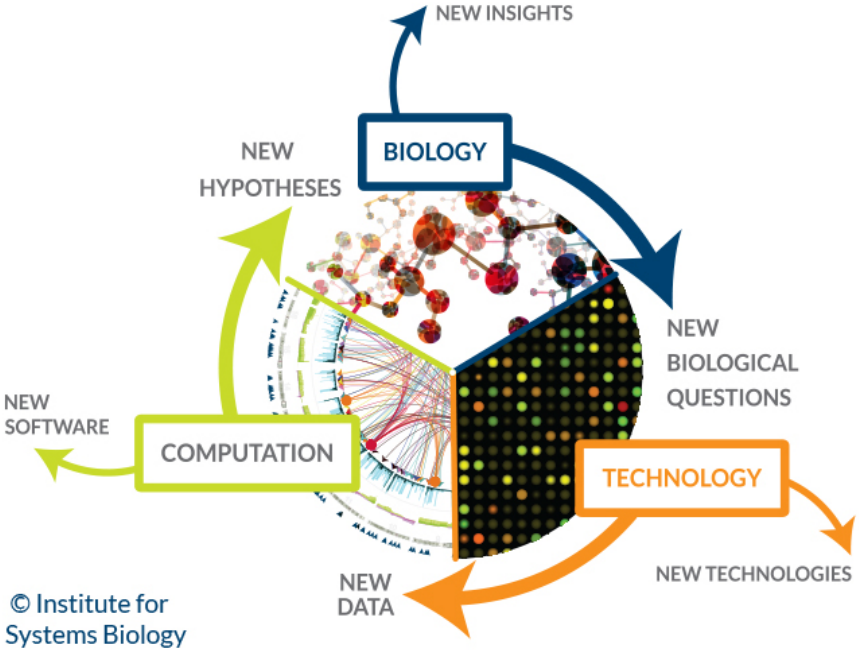
Example: Quantification of Immune Cell and Types

- Collaboration in looking at immune cell states and types in blood of over 1,000 healthy
  - Genetic & environment contributions
  - Flow cytometry of immune cells + genotyping
- Non-genetic: Smoking, age, sex, latent cytomegalovirus infection
- Innate more strongly controlled by genetic variants than adaptive (more environment)



Patin, Etienne, et al. "Natural variation in the parameters of innate immune cells is preferentially driven by genetic factors." *Nature immunology* 19.3 (2018): 302.

Evolving Field



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