



A data science framework for learning health systems

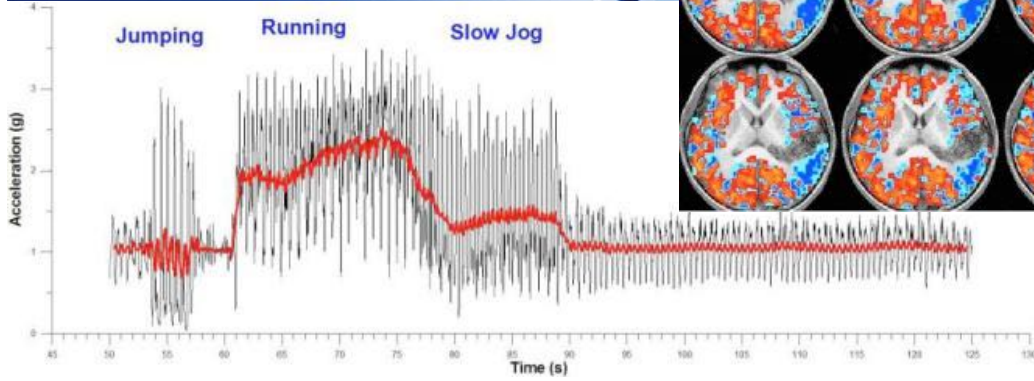
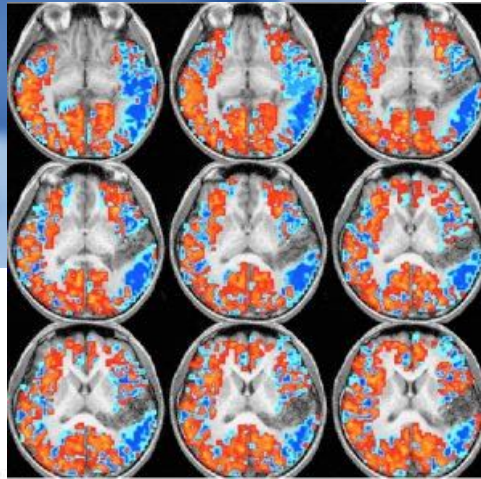
Yates Coley, PhD

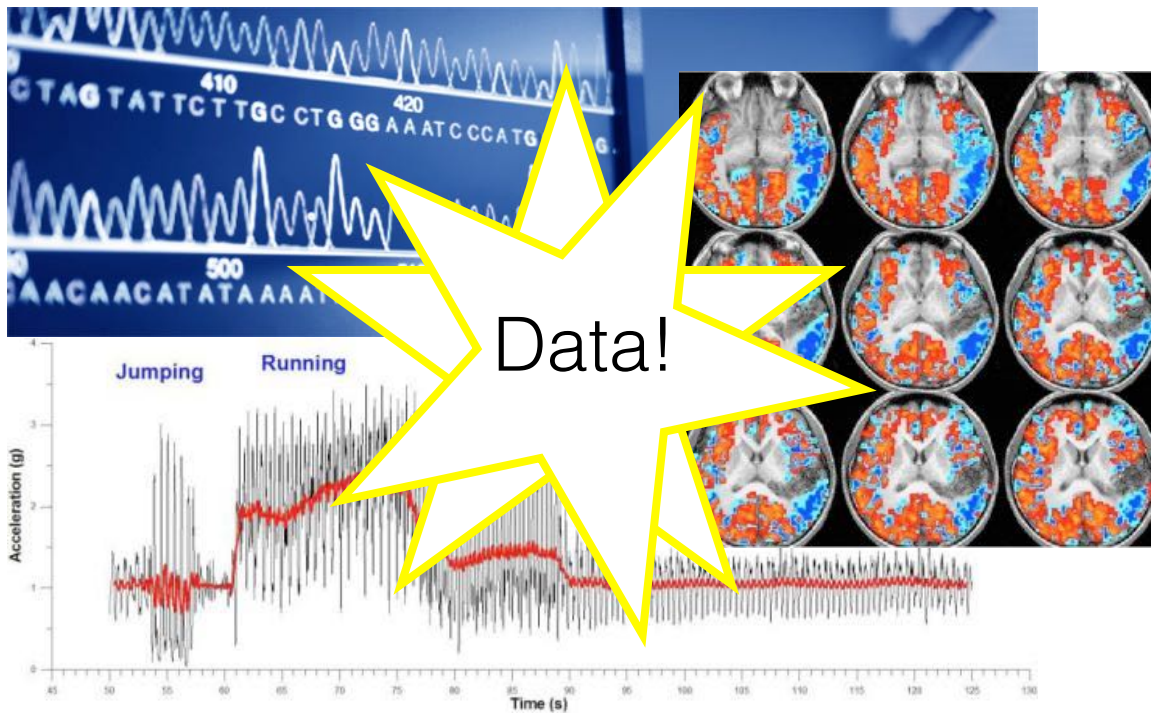
Assistant Investigator

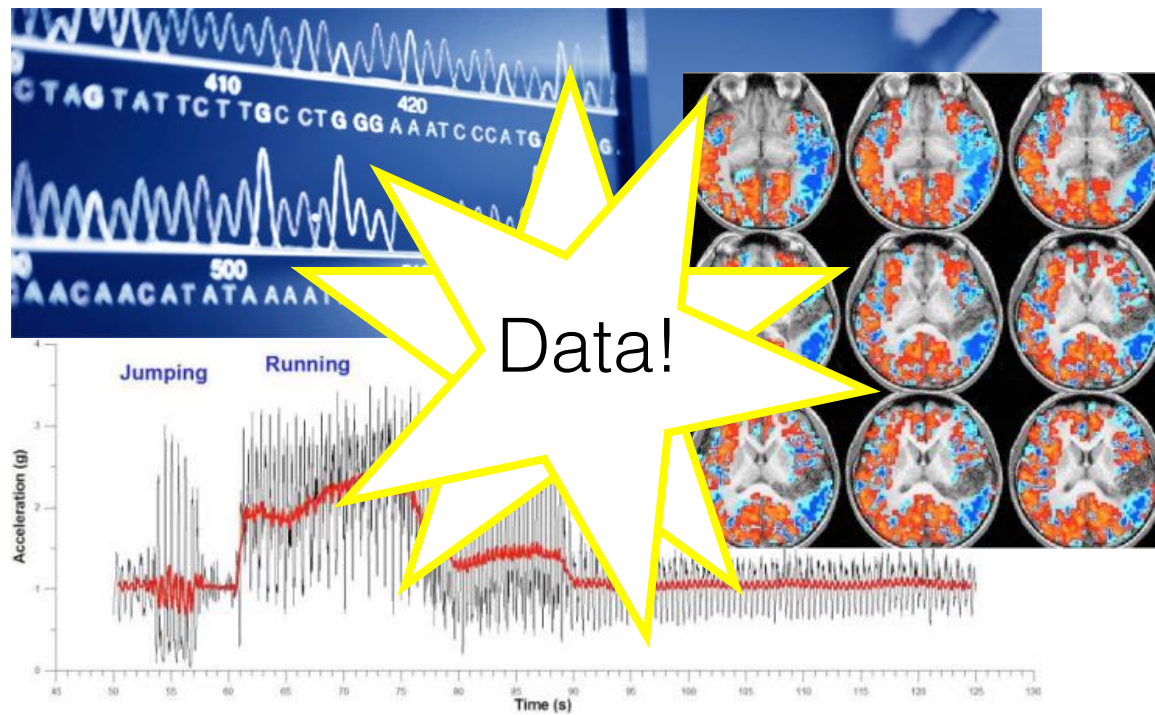
Kaiser Permanente Washington Health Research Institute

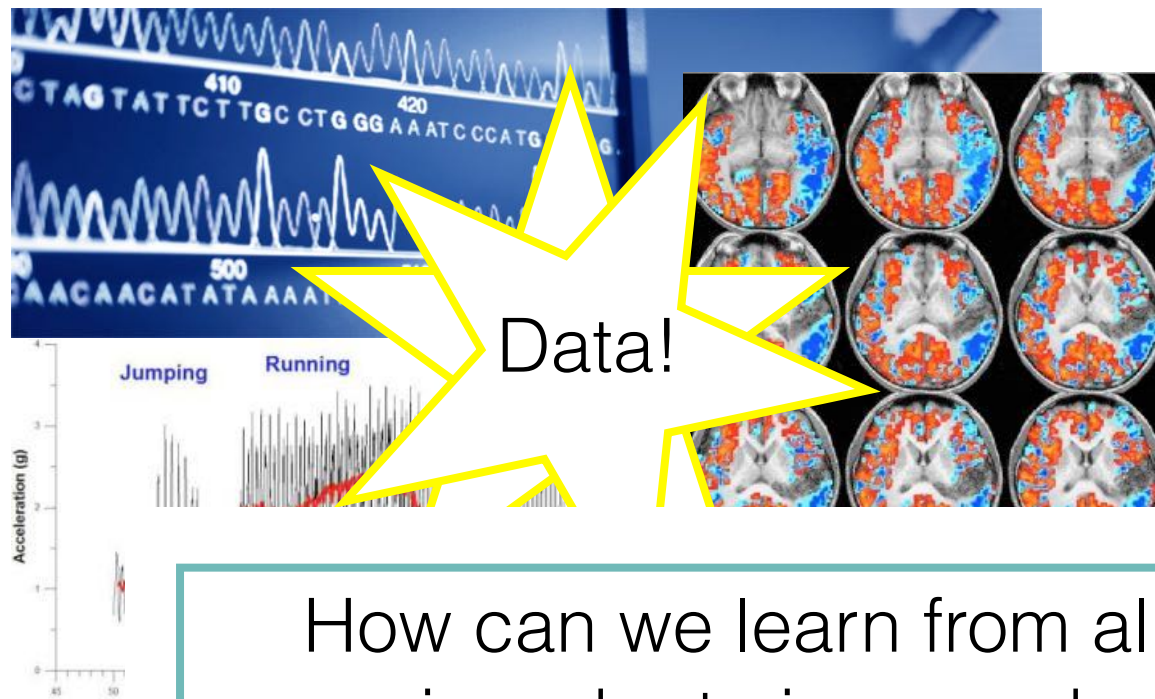
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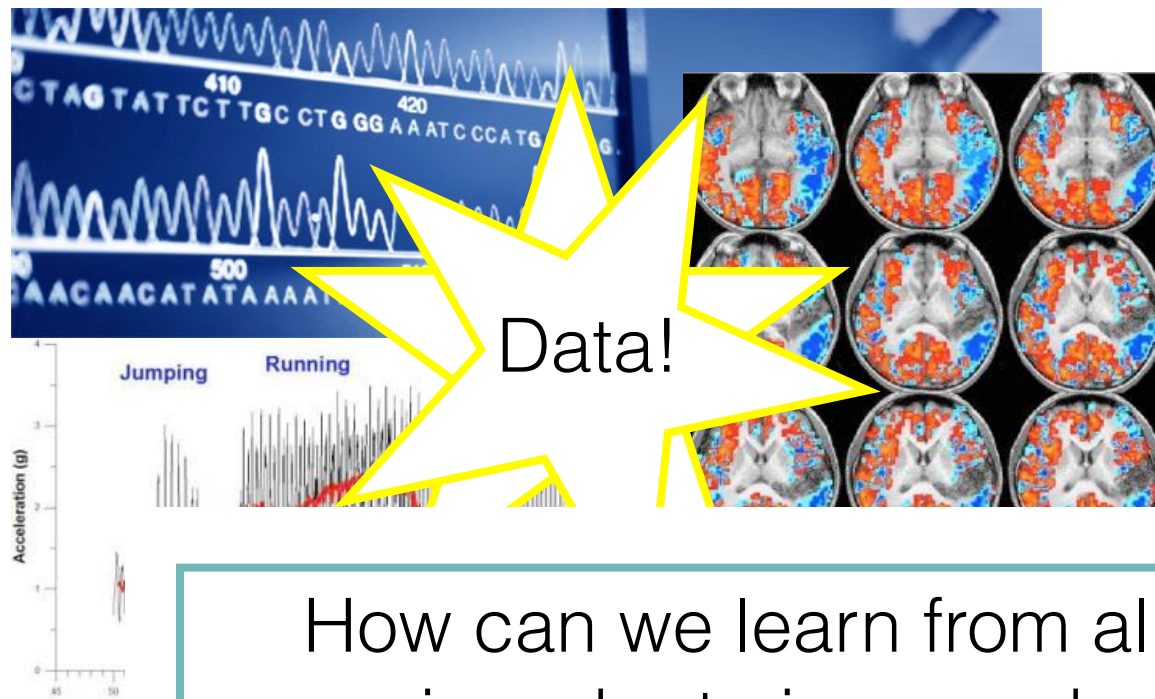




Data!

How can we learn from all available data in order to improve health care?



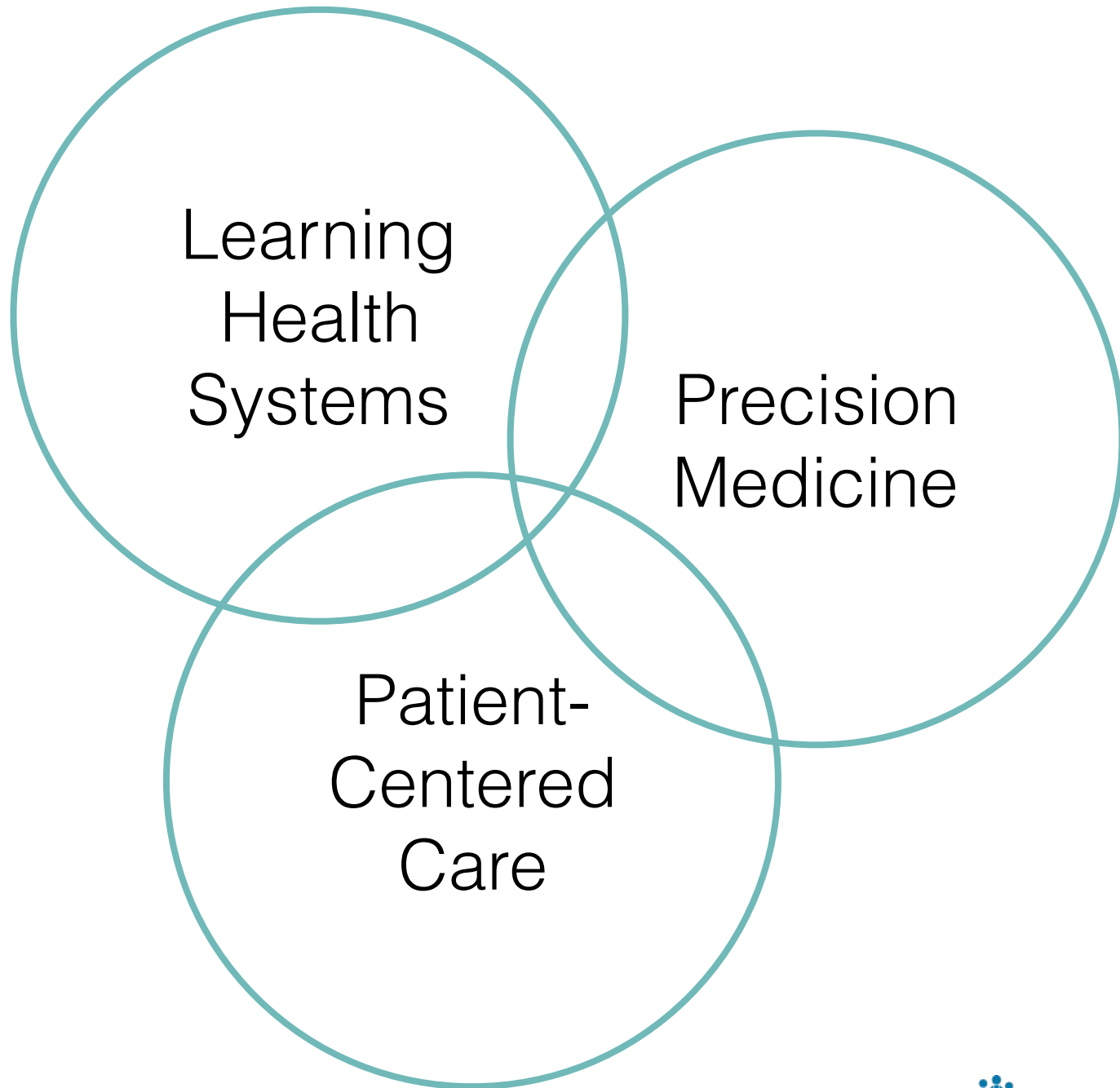


How can we learn from all available data in order to improve health care?



... and how do we actually influence care delivery?

THE PRECISION MEDICINE INITIATIVE





What do statisticians need to know?



Medicine

Patient-
Centered
Care



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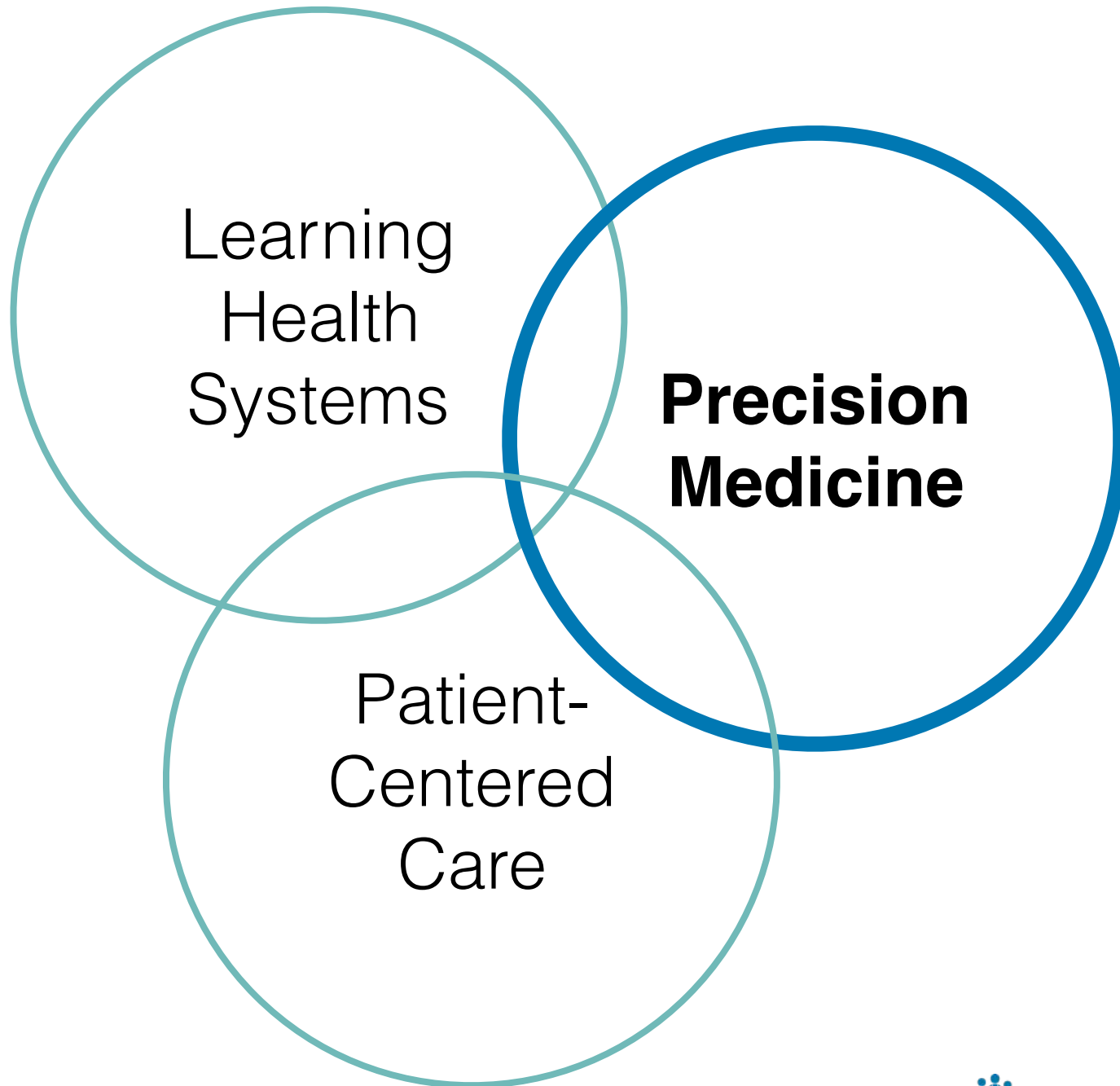


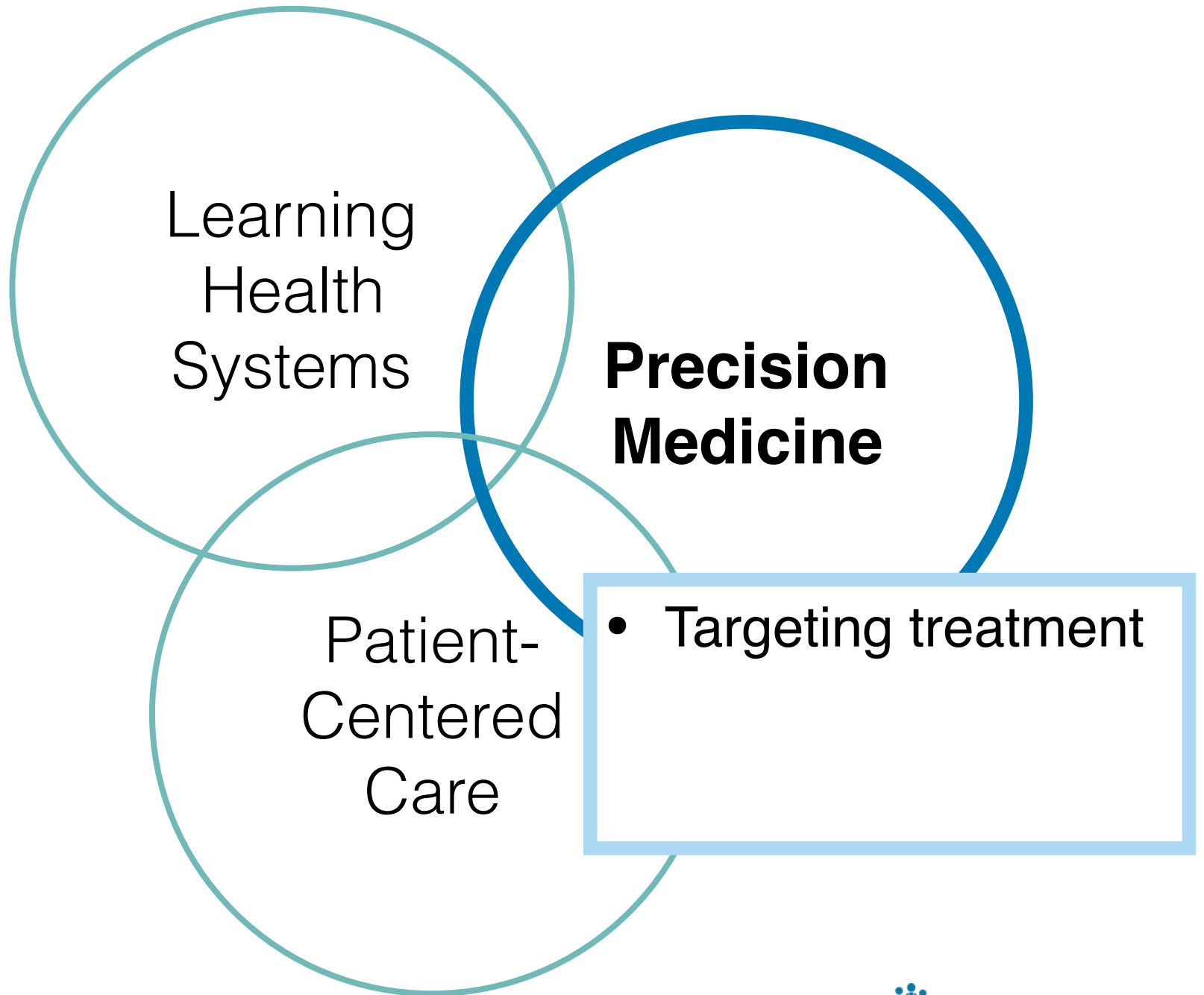
Medicine

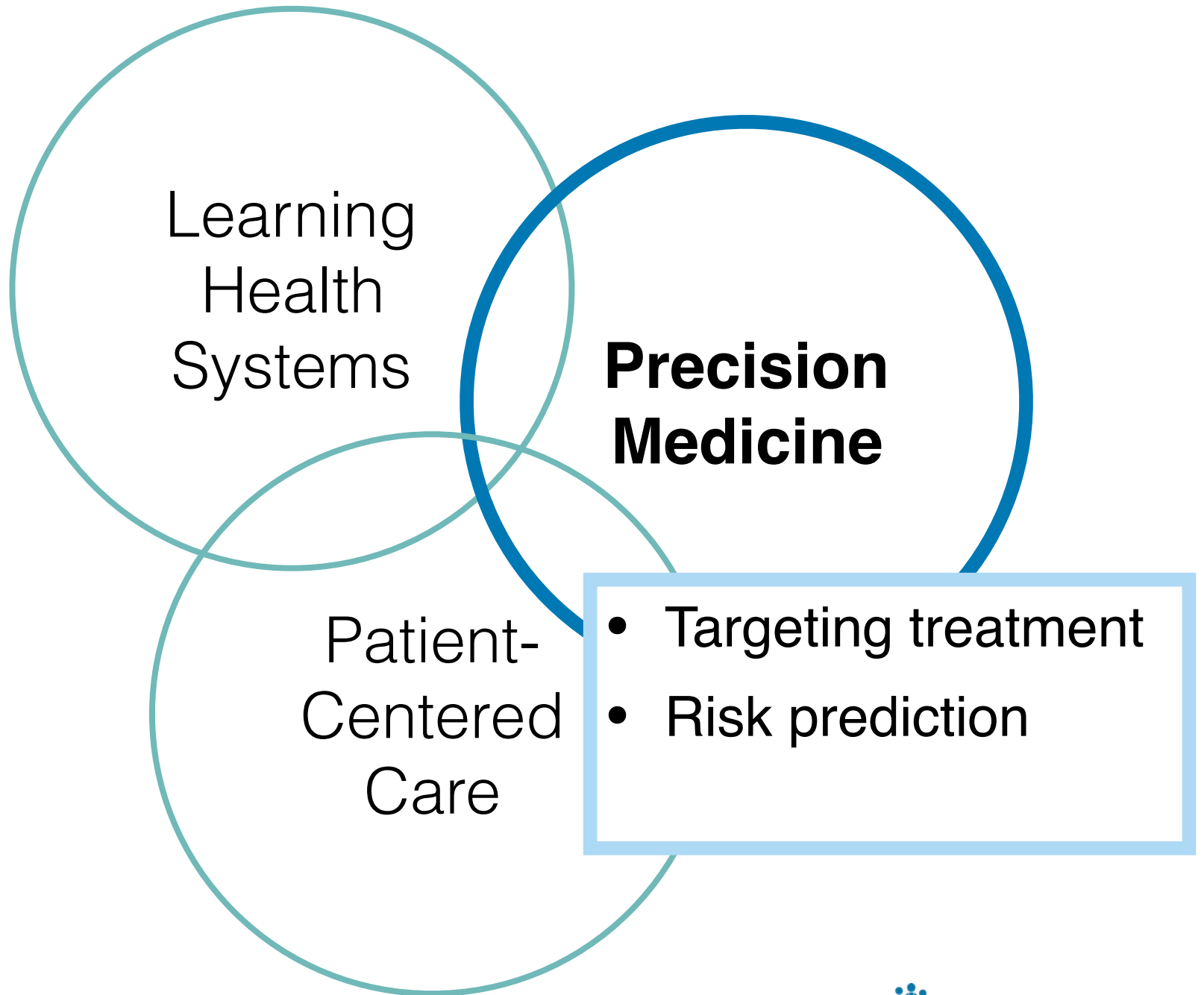
Patient-

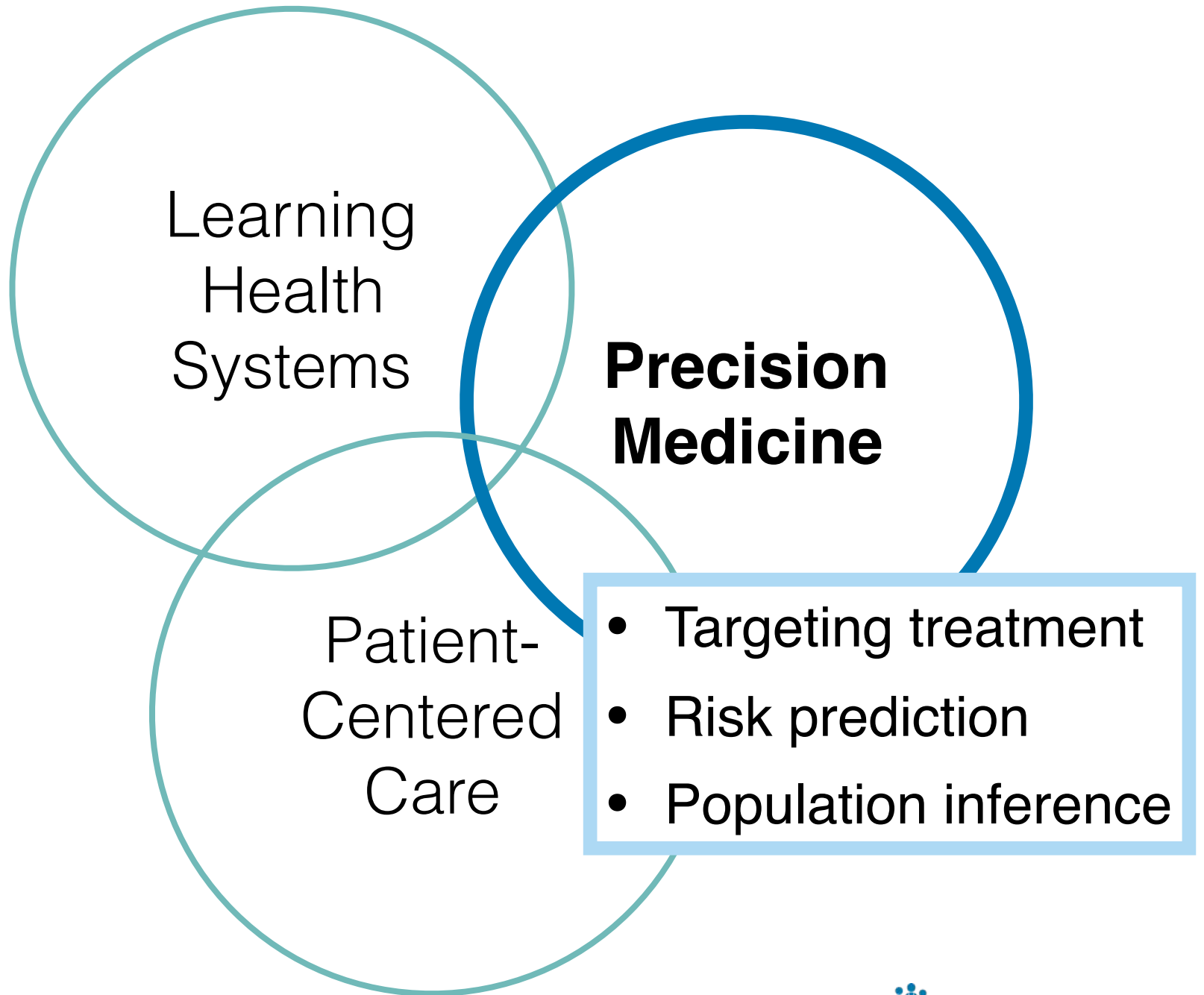
What role do statisticians play?

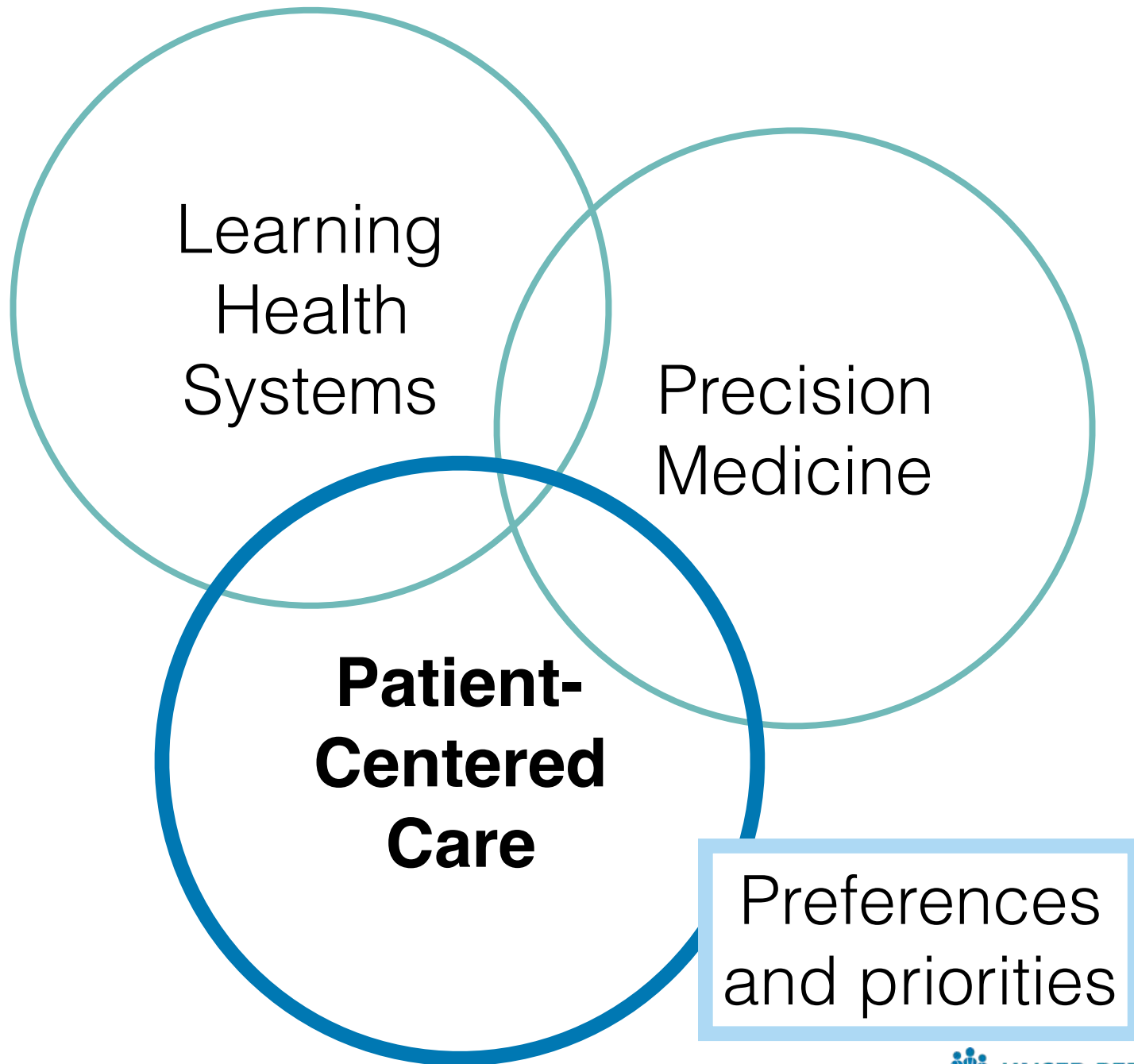




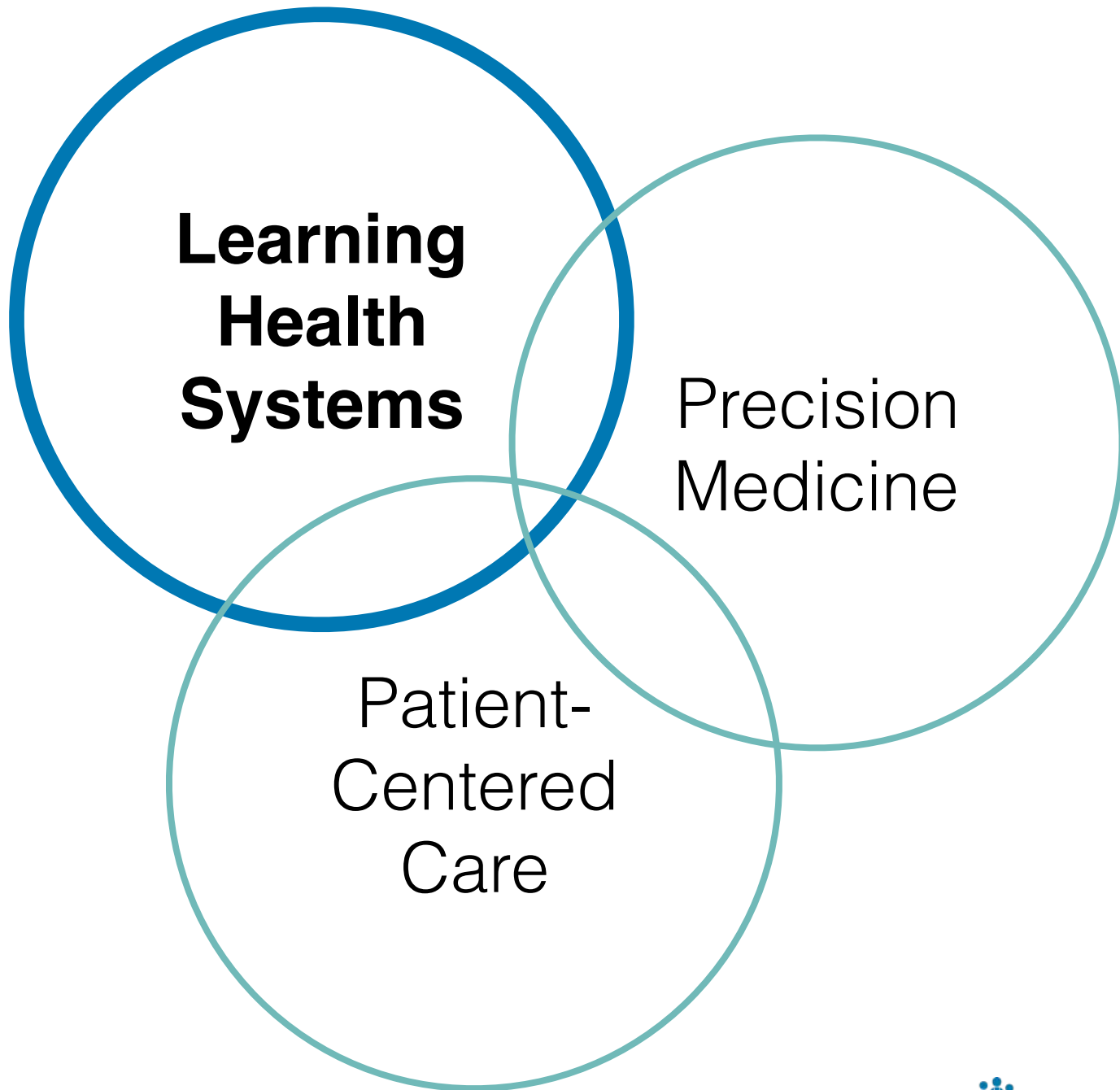










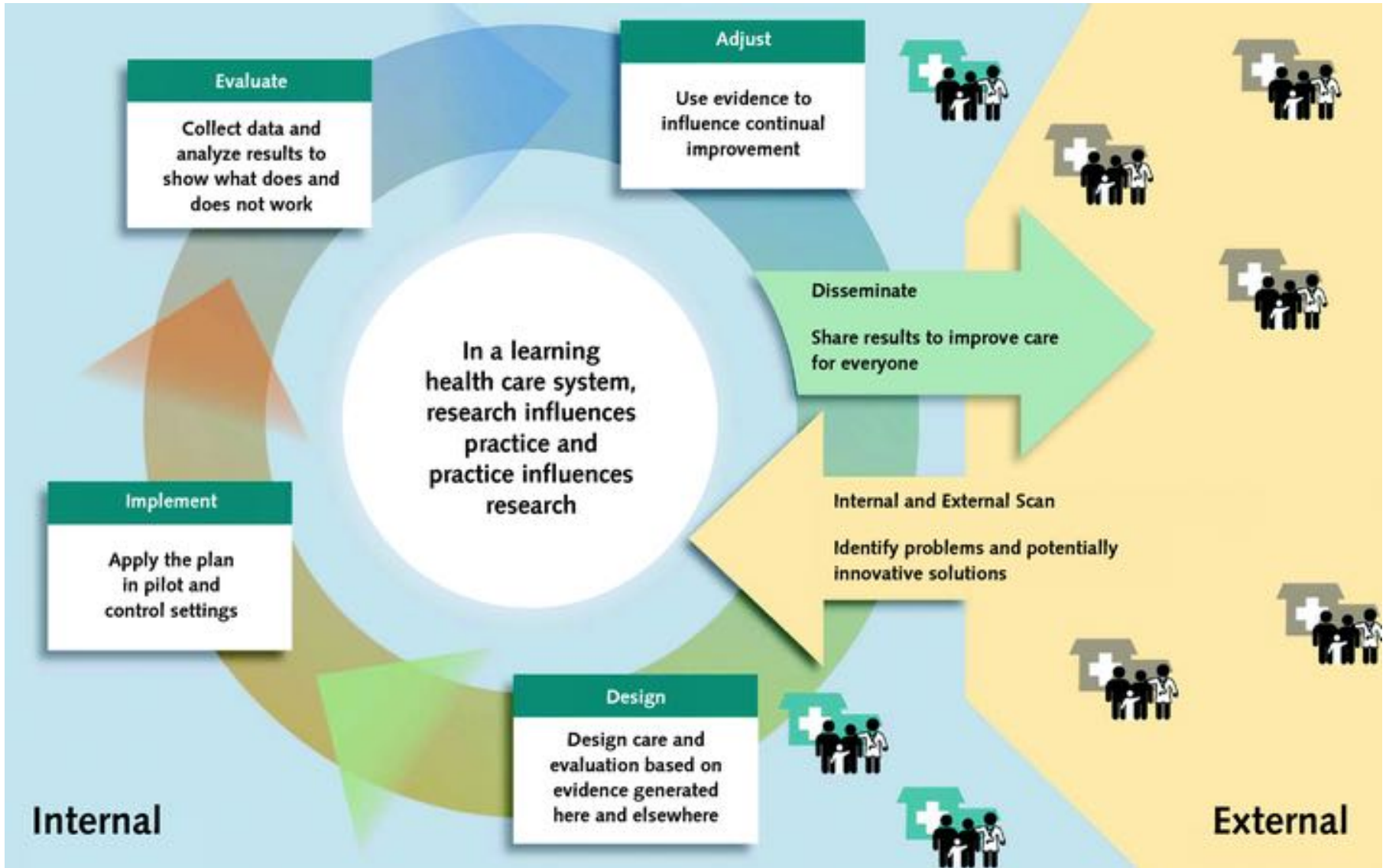


**Learning
Health
Systems**

Precision
Medicine

Patient-
Centered
Care

Learning Health Systems



Greene et al. Implementing the Learning Health System: From Concept to Action. *Ann Intern Med.* 2012;157(3):207-210.

Data systems to enable decision support

Statistical models to learn from health data

Dissemination via clinical decision support

Curation for improvement and adaptation

Non-statistical considerations

Data Systems to Enable Learning

- Electronic health record (EHR)

Data Systems to Enable Learning

- Electronic health record (EHR)
 - Captured as part of care process, not research
 - Contain data on encounters, diagnoses, procedures, prescriptions, vitals, lab results, provider notes
 - Collaborate with content-area experts, EHR users
 - Informative missing data—cross-section, longitudinal
 - Research-quality requires investment, commitment
 - Potential for wonderfully big datasets

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- Electronic health record (EHR)
- Supplemental data sources
 - Registries- immunization, disease, mortality
 - Geographic, environmental data
 - Supplemental research data collection
 - Prior research studies

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- Electronic health record (EHR)
- Supplemental data sources
- Clinical use, iterative process of LHS
 - Sustainable data source for continued monitoring
 - Retrospective analysis vs. real-time availability

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Statistical models to learn from health data

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- Reflect traditional sources of bias
- Reflect EHR-specific sources of bias
- Accommodate different sources of data

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Clinical decision support tool

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- Integration with database and prediction model- no manual entry of patient data

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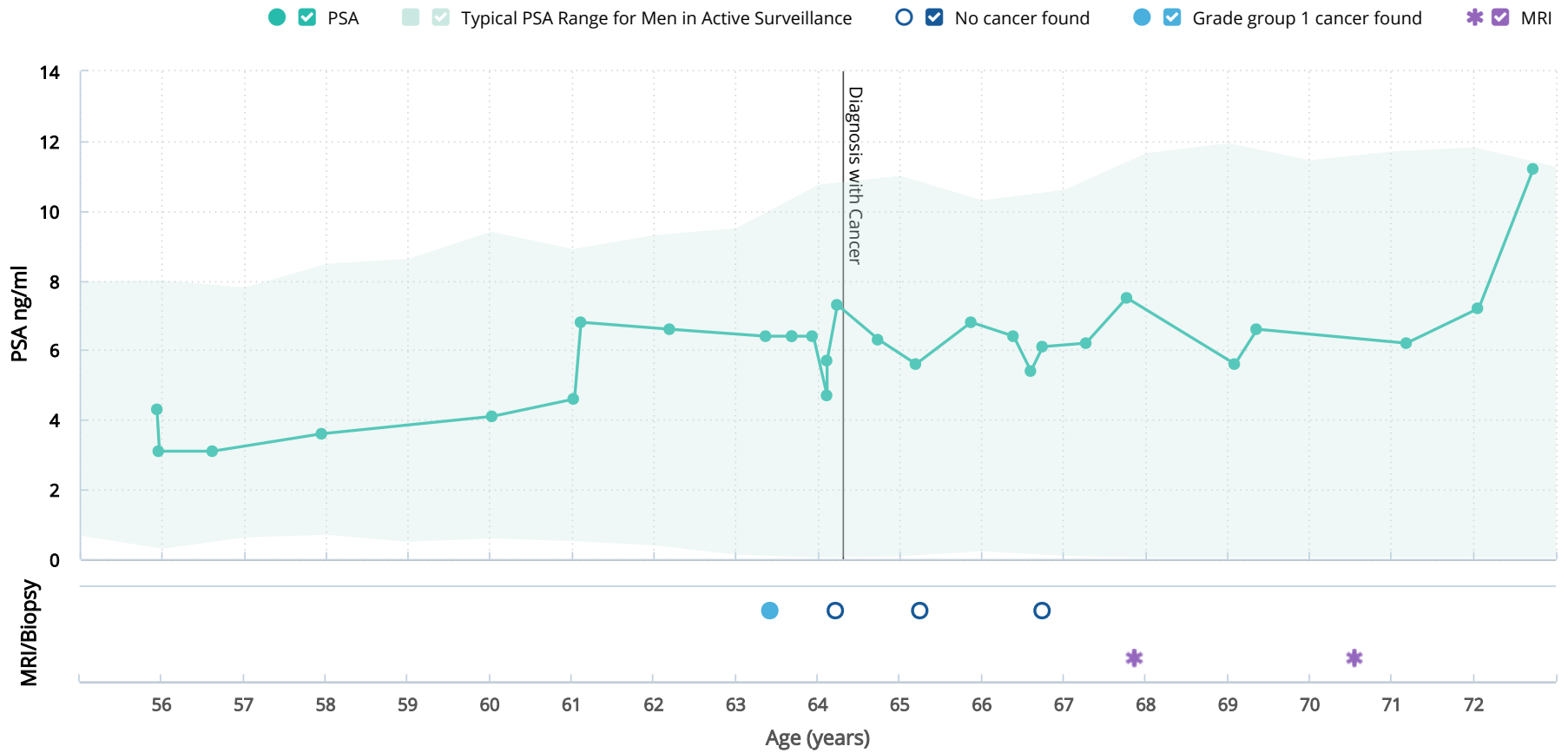
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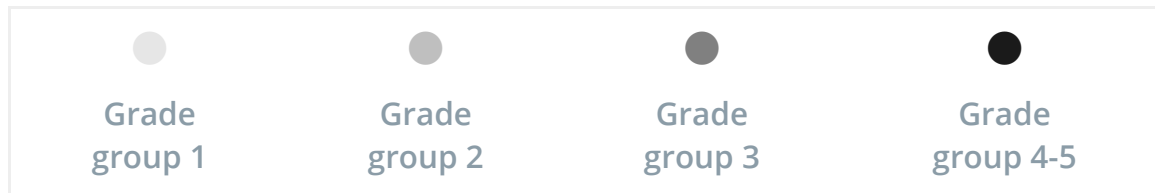
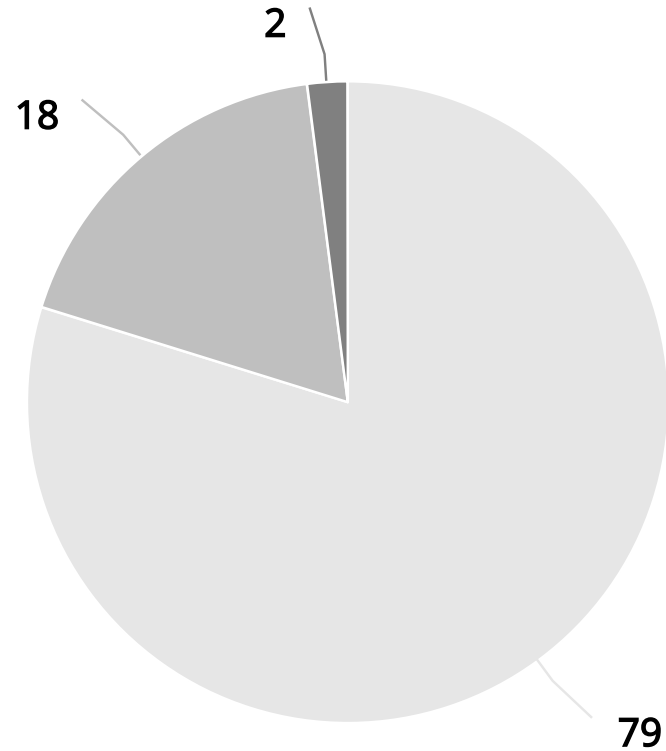
Clinical decision support tool

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- Focus on outcomes of interest to patients and relevance to care plan

PSA/Biopsy Summary



If 100 men with a similar age, diagnosis, and PSA and biopsy history had their prostate surgically removed today, **what cancer grade would be found?**



5 Years

If 100 men like you had their prostates surgically removed today, after 5 years...



97

WOULD BE CURED

3

WOULD HAVE PSA
RECURRENCE

< 1

WOULD HAVE METASTATIC
DISEASE

NOTE: BECAUSE OF ROUNDING TO THE NEAREST WHOLE NUMBER COUNTS MAY NOT MATCH GRADE GROUP TOTALS

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 - Document any intervention in EHR
 - Evaluate accuracy of estimates, predictions
 - Prevent harmful feedback loops

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- Accommodate impact of interventions
- Accommodate differences in population
- Incorporating new data sources

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Non-Statistical Considerations

- Investment, enthusiasm from clinicians
- Patient and user stakeholders
- Interdisciplinary team
- Project management
- Time and funding
- Incentive structure
- Institutional support
- IRB strategy

Acknowledgments

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