



Data Driven Biology + Medicine

Data Science, Analytics, Bioinformatics and Computational Biomedicine

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Ted Laderas, PhD

- Assistant Professor, Division of Bioinformatics and Computational Biomedicine
 - Certified Instructor for Rstudio and the Carpentries
 - Co-founder, Cascadia-R conference, BioData Club
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- ✓ Active Learning in Education
 - ✓ Open Science and Reproducibility
 - ✓ Interactive Visualization
 - ✓ Single Cell Informatics
 - ✓ Systems approaches to understanding precision medicine



The Fourth Paradigm*



First

DESCRIPTIVE



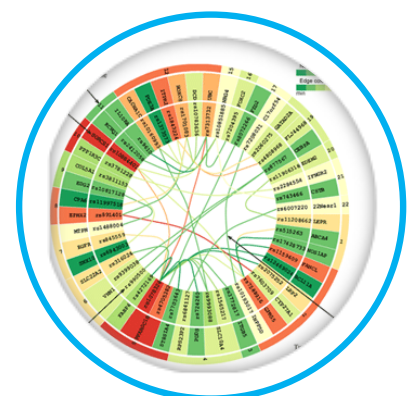
Second

THEORETICAL



Third

COMPUTATIONAL



Fourth

EXPLORATION

*Jim Gray, Microsoft

Quantifying YOUR Data

Exogenous data

(Behavior, Socio-economic, Environmental, ...)

60% of determinants of health
Volume, Variety, Velocity, Veracity

1100 Terabytes
Generated per lifetime

Genomics data

30% of determinants of health
Volume

6 TB
Per lifetime

Clinical data

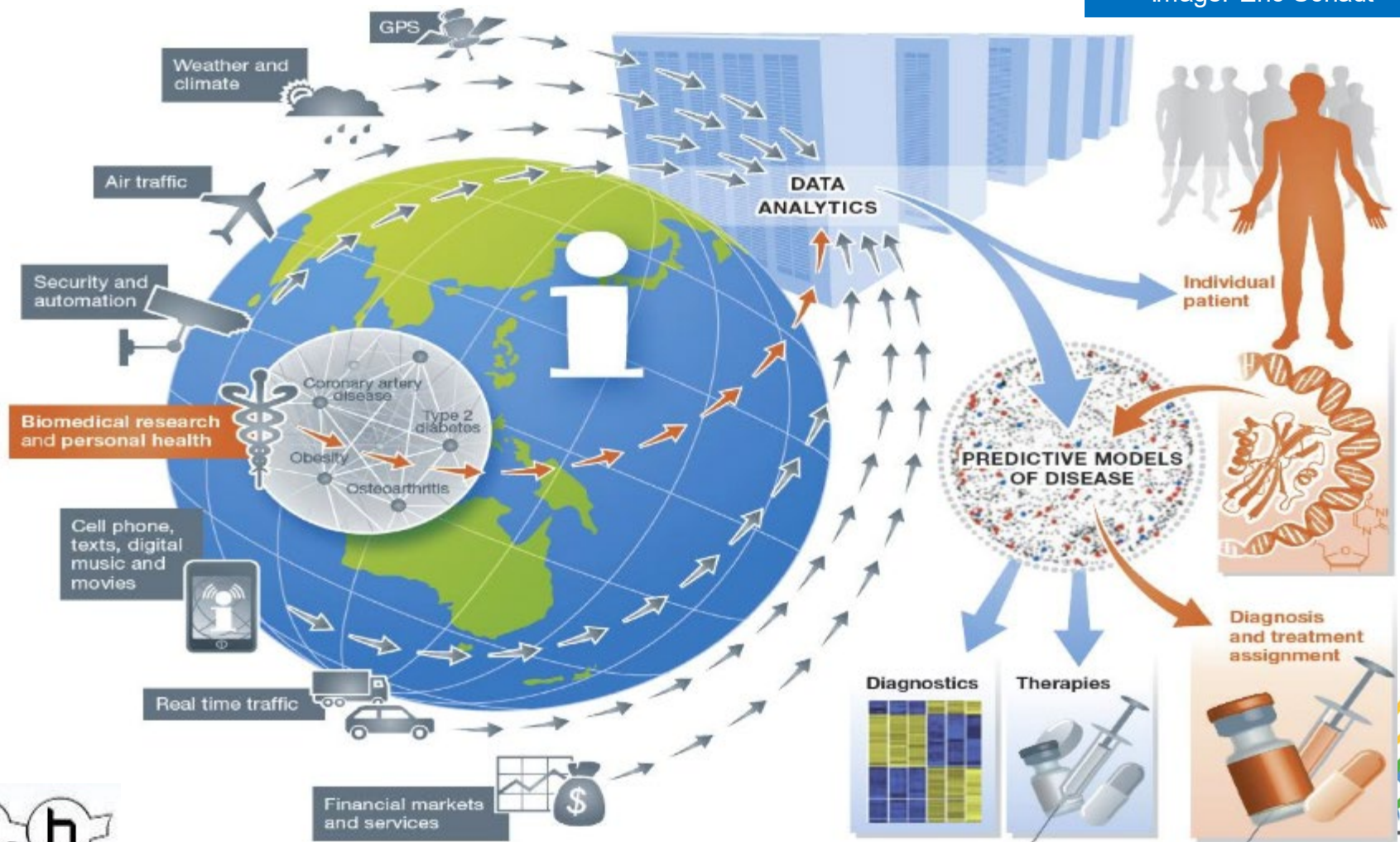
10% of determinants of health
Variety

0.4 TB
Per lifetime

Source: "The Relative Contribution of Multiple Determinants to Health Outcomes", Lauren McGover et al., *Health Affairs*, 33, no.2 (2014)

Data “Ecosystem”

Image: Eric Schadt



Our Motivation



Autumn Boyton

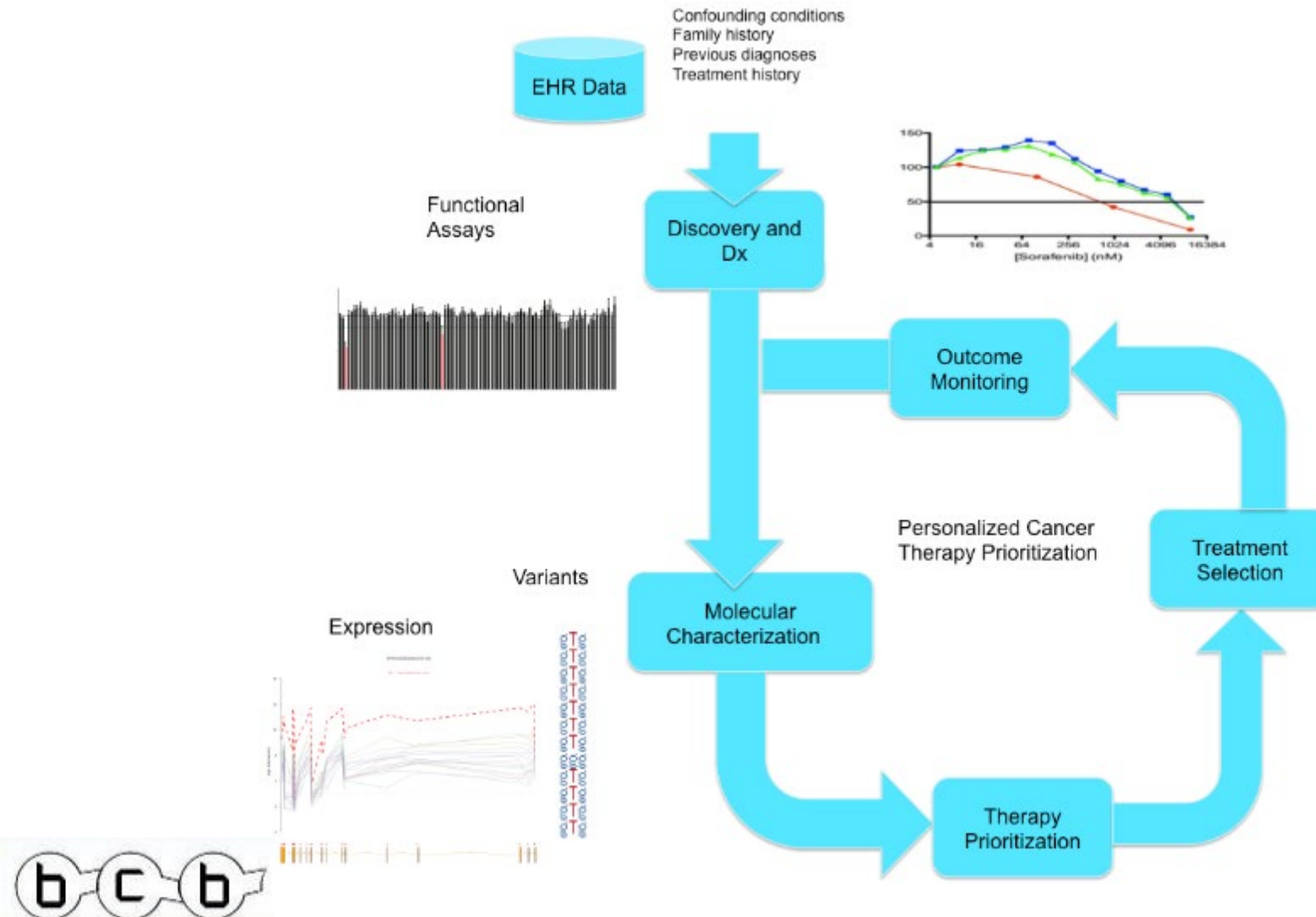
D_x: Bilateral Wilms' tumors in kidneys & abdomen at age 3

- Will the patient respond to standard of care?
- For this patient, what treatment plan is best ?
- If the patient relapses, what is the best choice regarding second line of therapies (for this patient)?



Our Clock Starts at Diagnosis

Precision Medicine at OHSU



“We are each, in effect,
one-person clinical trials”

Op-Ed As I lay dying

By LAURIE BECKLUND

SHARELINES

🐦 ▾ Do patients fail therapies, or do the therapies fail them? #breastcancer

🐦 ▾ Breast cancer is not one disease; there is no one 'cure'

FEBRUARY 20, 2015, 7:45 PM

I am dying, literally, at my home in Hollywood, of metastatic breast cancer, the only kind of breast cancer that kills. For six years I've known I was going to die. I just didn't know when.

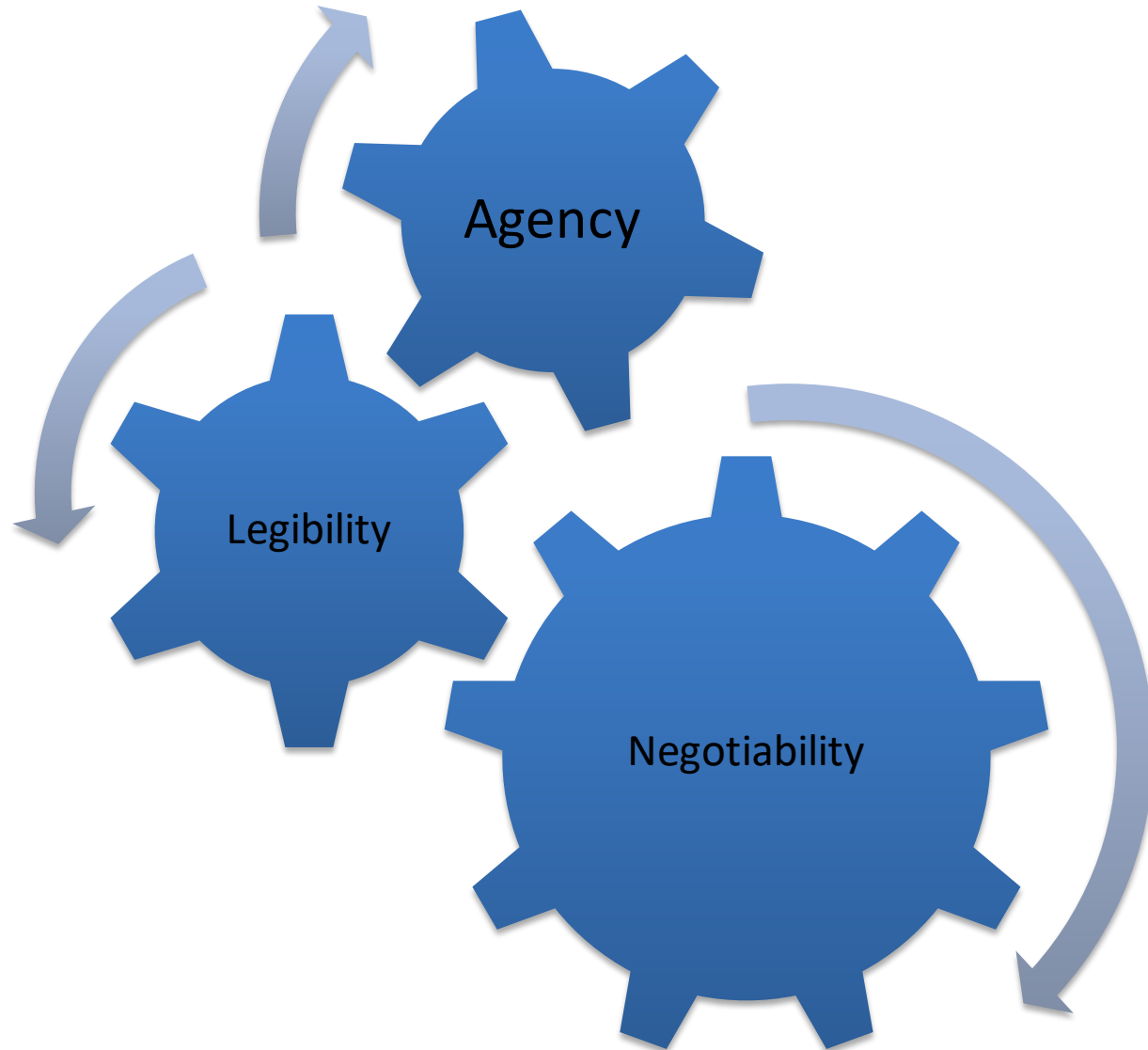
Then, a couple of weeks before Christmas, a new, deadly diagnosis gave me a deadline. No doctor would promise me I'd make it to 2015.



“Yet the knowledge generated from those trials will die with us because there is no comprehensive database of metastatic breast cancer patients.... **In the Big Data-era, this void is criminal.**”

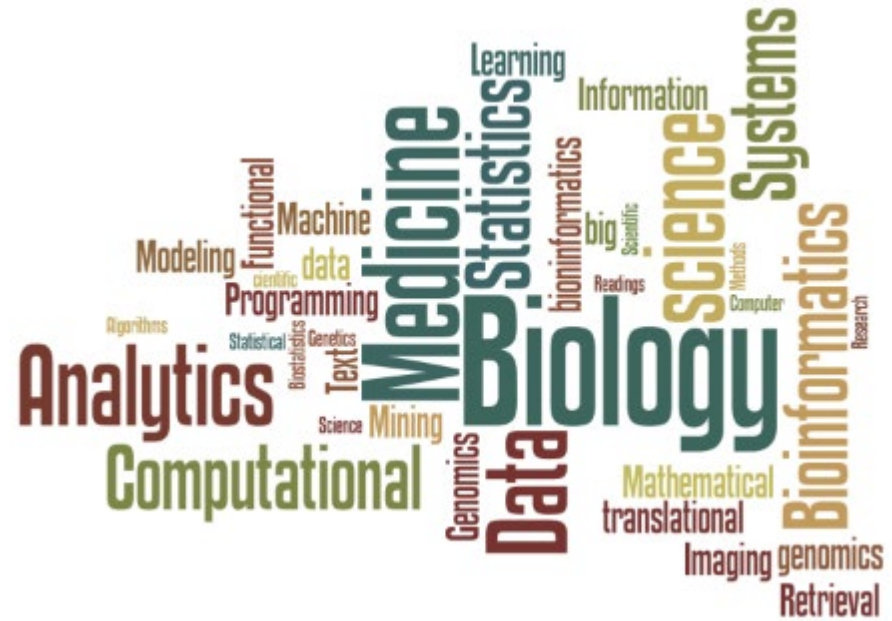
“The unfolding calamity in genomics is that a great deal of life-saving information, though already collected, is inaccessible.” - Antonio Regalado

Where we need to focus: Human-Data Interaction



Active Areas of Study @ OHSU BCB

- Analytics and Data Science
- Machine Learning
- Statistical Genetics
- Text Mining and Information Retrieval
- Imaging
- Systems Biology
- Computational Neuroscience
- Computational Biomedicine



1st Year Framework

- Yr1 Summer: R Bootcamp/Ready for R, Research Rotations
- Yr1 Fall, Winter, Spring: Core Coursework, Research Rotations
- Yr1 Spring: BCB Research Methods (Mentored Research), Planning for Summer Internships
- More info: <https://www.ohsu.edu/school-of-medicine/medical-informatics-and-clinical-epidemiology/course-catalog>

Future Job Prospects

Industry	Academia	Government	Private Firms
Biotech Pharmaceutical	Universities Academic Hospitals Research Centers	National Institute of Health VA Medical Center	Many Opportunities

- Masters Degree
 - Staff Bioinformaticist (Academic and Industry)
 - Analyst (Academic and Industry)
- PhD
 - Postdoctoral Fellowships (Academic and Industry)
 - Faculty Positions (Academic)
 - Senior Analyst (Academic and Industry)
 - Staff Scientist (Academic and Industry)
 - Group Leader (Industry)

Salaries

- Salaries vary by position, the candidates' background +sector
- Examples (survey from Glassdoor)
 - Bioinformatics Engineer @ J Craig Venter Institute \$84,799 (\$74k-\$105k)
 - Bioinformatics Associate @ Genentech \$96,710 (\$94k-\$101k)
 - Bioinformatics Scientist @ Illumina \$93,776 (\$91k-\$98k)
 - Bioinformatics Scientist III @ Applied Biosystems \$111,19 (\$89k-\$125k)

Career Advice

- Be a lifelong learner
- Find your own safe group to support each other's learning
- View your coursework as valuable – skills you can use and master
- Don't be afraid to ask questions
- Don't be afraid of change (foxes versus hedgehogs)
- Interesting data is everywhere – don't fixate
- Seek out research and volunteer opportunities – it will help you clarify what you are drawn to for possible career areas
- **Best path is one that you are good at, that you are passionate about, and that is sustainable**

Get Active!

- BCB focused DMICE seminars
 - YouTube
- BCB Facebook & twitter feeds

Facebook:

www.facebook.com/OHSUBioinformatics

Twitter: www.twitter.com/OHSUBCB

Website: <http://ohsu.edu/bioinformatics>

Data Science Coursework

- Take the R-Bootcamp! (free)
 - <https://r-bootcamp.netlify.app>
- Ready for R (free with registration)
 - <https://ready4r.netlify.app/mailling>