



PMWC 2018

PRECISION MEDICINE WORLD CONFERENCE

Jan 22-24 SILICON VALLEY



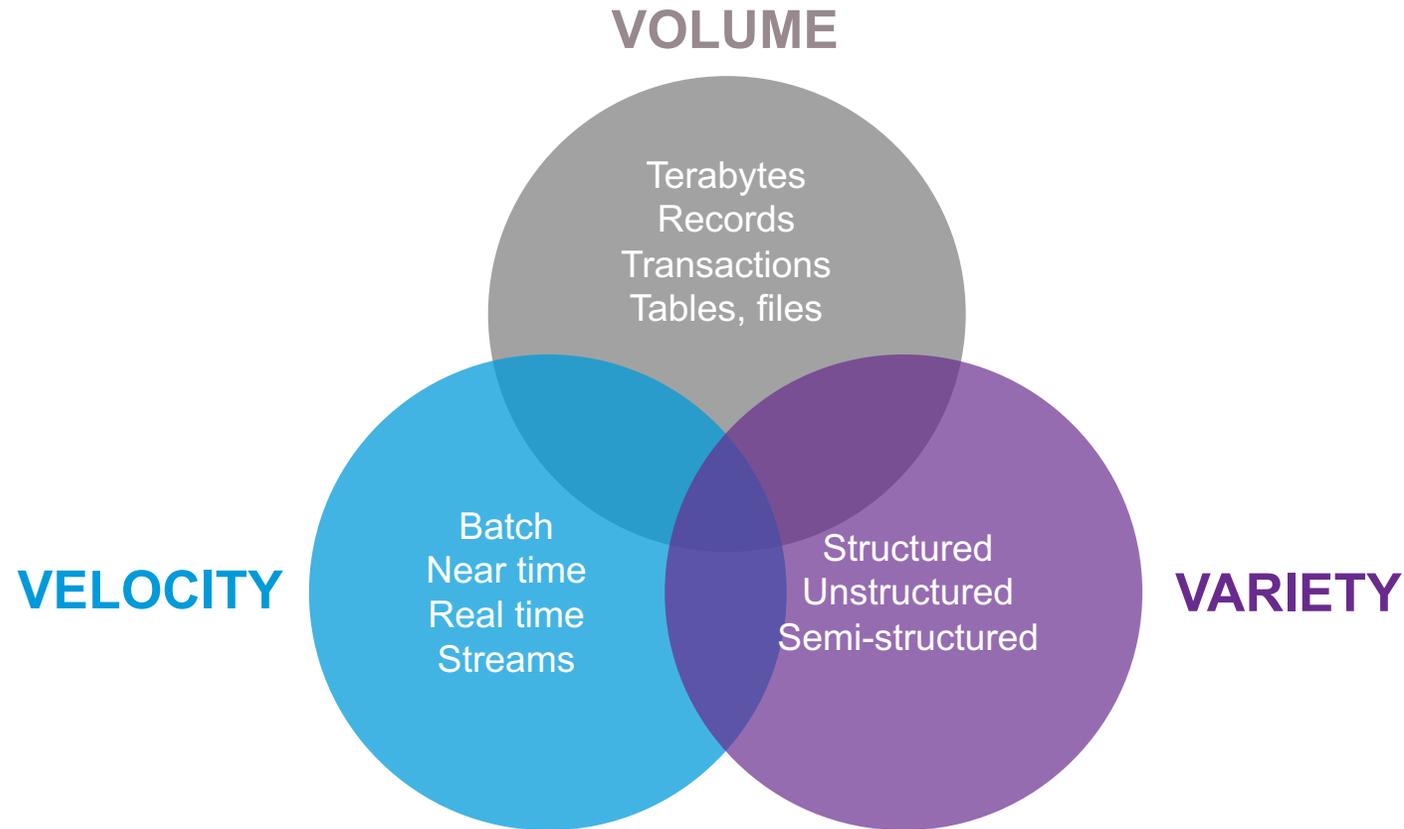
Bringing in the Machines: When Answering Important Clinical Questions Requires Both Big Data and Big Algorithms

Giulia C. Kennedy, Ph.D.
Chief Scientific and Medical Officer

January 23, 2018

Track 5

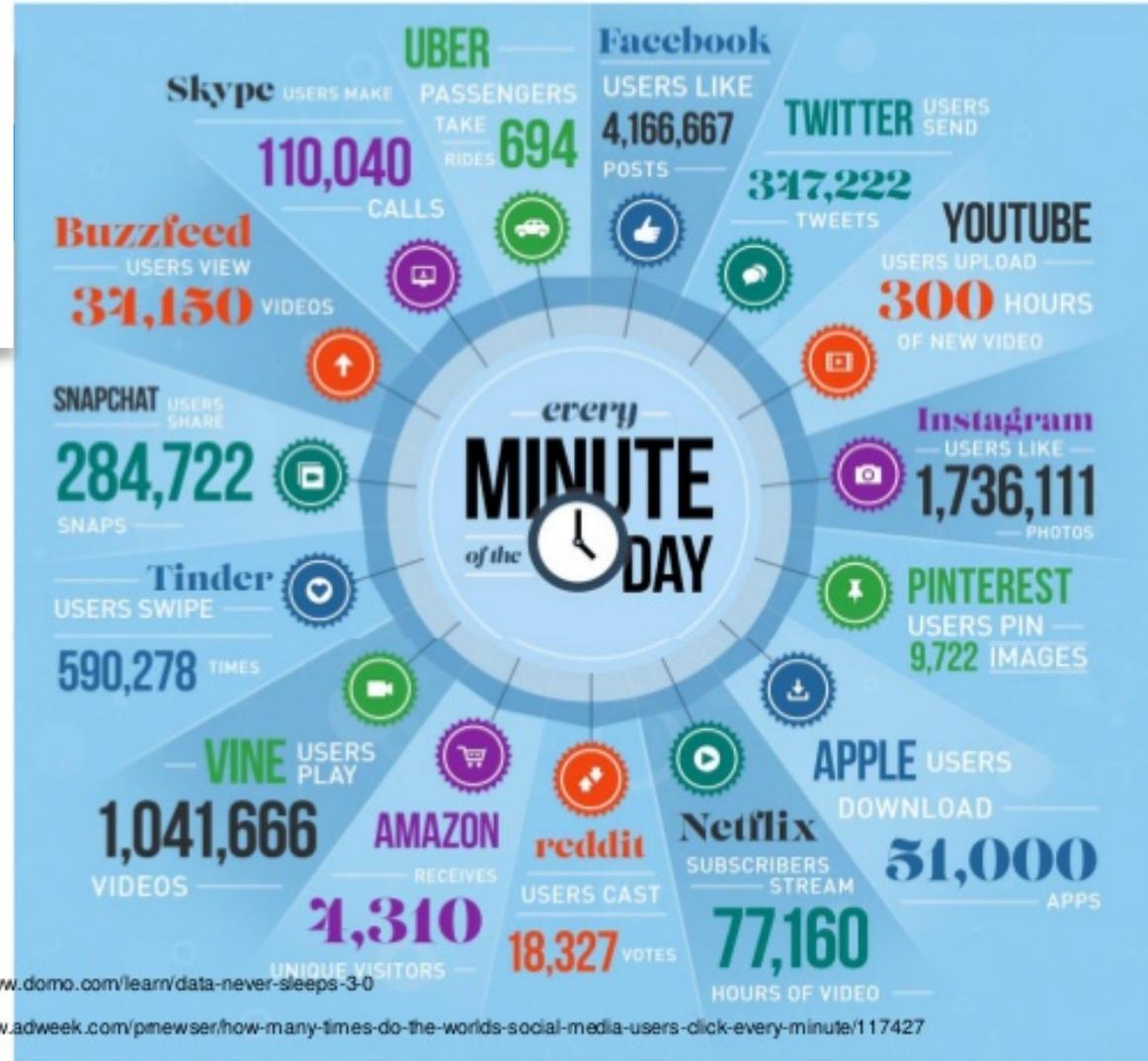
What is Big Data?



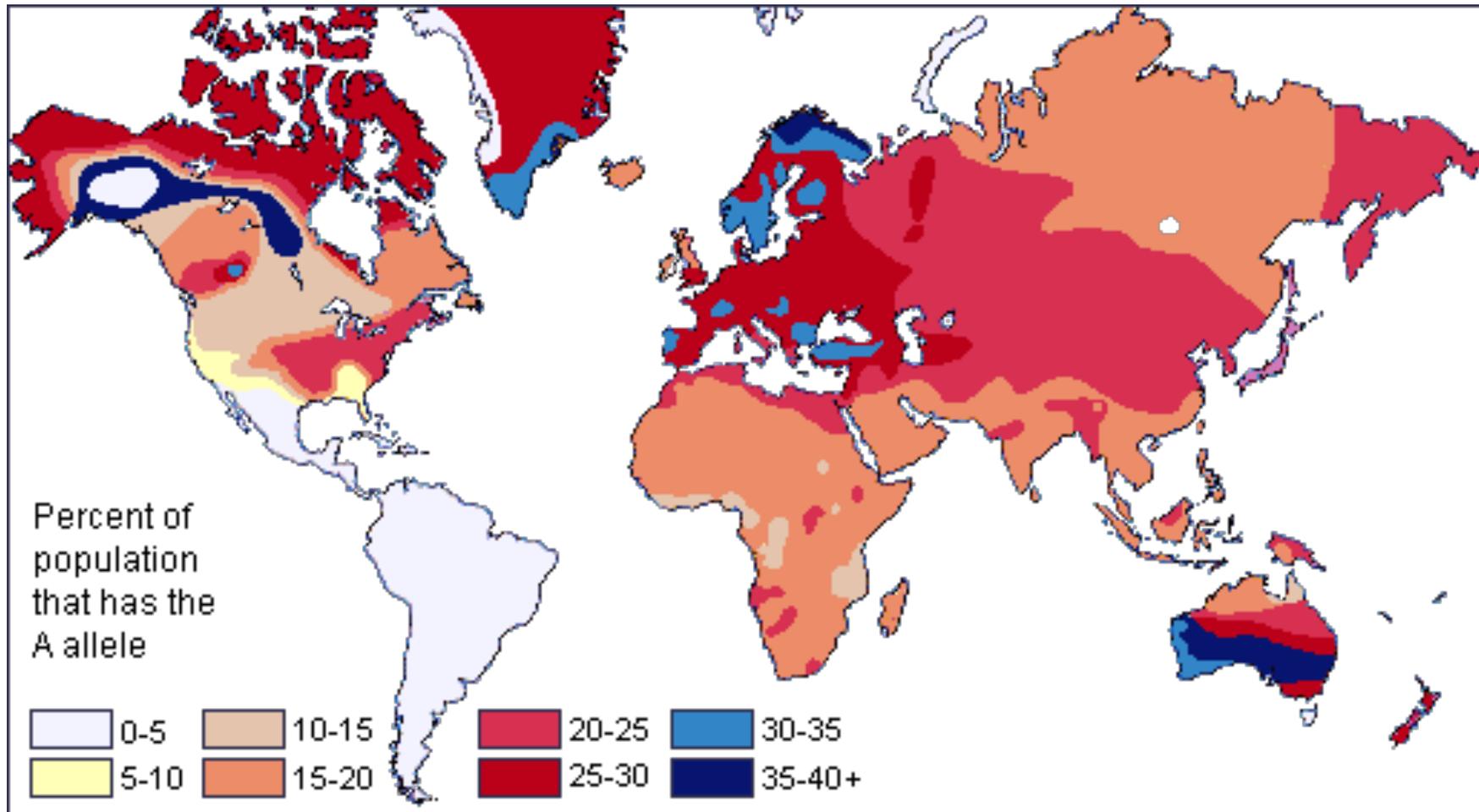
Source — Exist.com 2013



Social Media Data is BIG

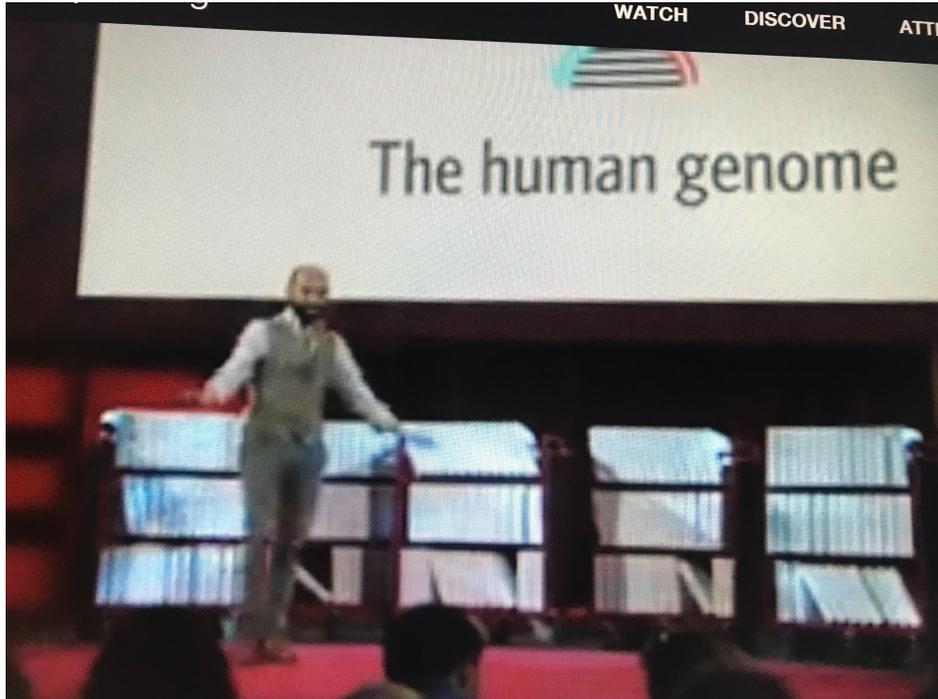


Worldwide Blood Group Data: 100 million people x 5 features



First Human Genome Sequence had 3 billion features x 1 person

Riccardo Sabatini TED Talk



Written out, the Human Genome would stretch 5,592 miles, (9,000 km).

It would take a typist working eight hours a day half a century to type.

It would fill one million pages; 5,000 books stacked 200 feet high; or two hundred telephone directories.

Read out for 24 hours a day, it would take a century to finish.

All this data is from **ONE** INDIVIDUAL



Next Generation Sequencing Vastly Expands Feature Space

AND

Lower Costs Are Slowly Expanding the Number of Patients Analyzed

The Power of RNA Sequencing: A Vast Feature Set

RNA Transcriptome Sequencing (aka RNASeq)



GENE EXPRESSION



MITOCHONDRIAL GENOME



UACAGU

SEQUENCE VARIANTS

AUUCGA

UACAGU

CGUAAC

LOSS OF HETEROZYGOSITY



Normal

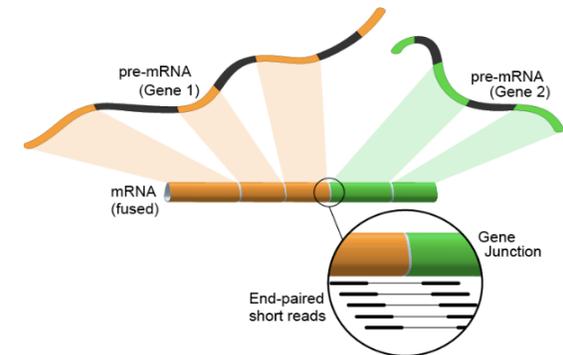
One copy from each parental chromosome



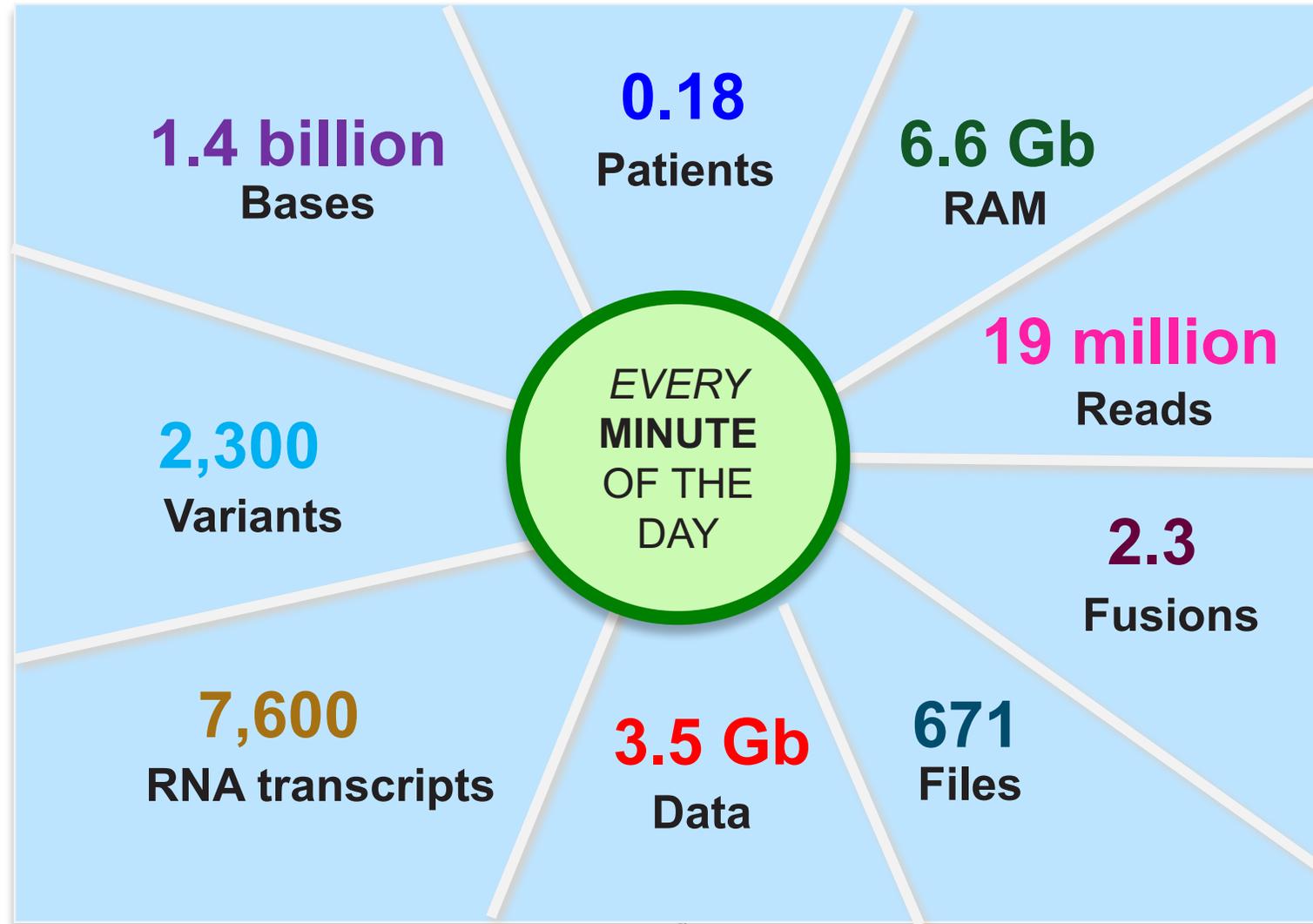
Loss-Of-Heterozygosity (LOH)

One copy from each parental chromosome

GENE FUSION

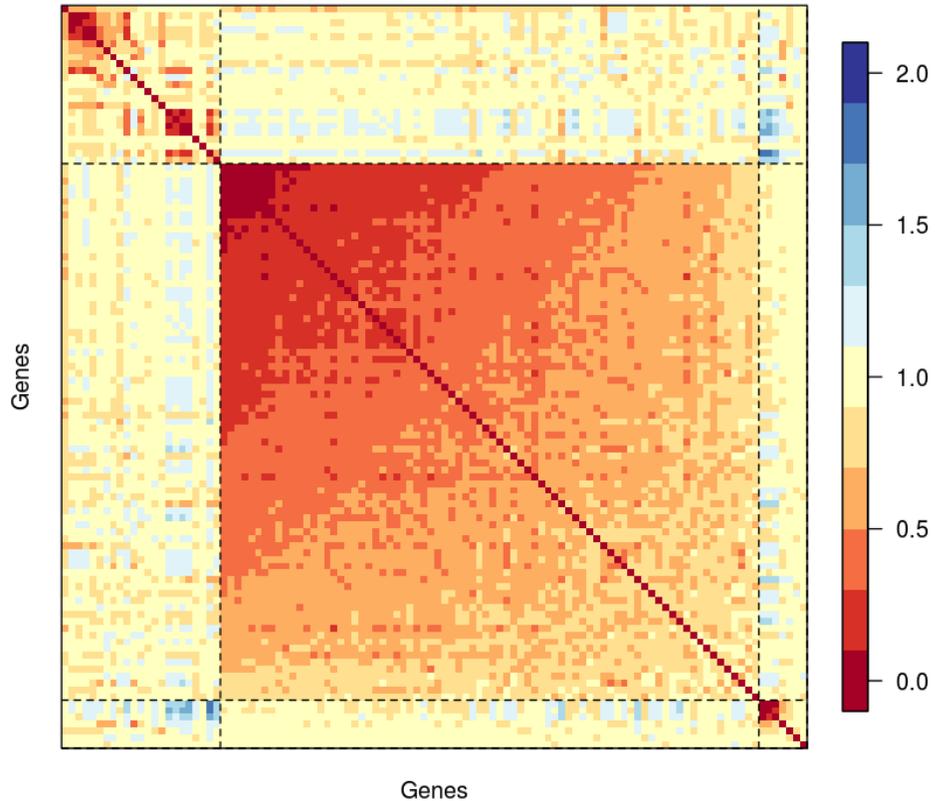


Clinical Molecular Diagnostic Data is Big, But Lopsided



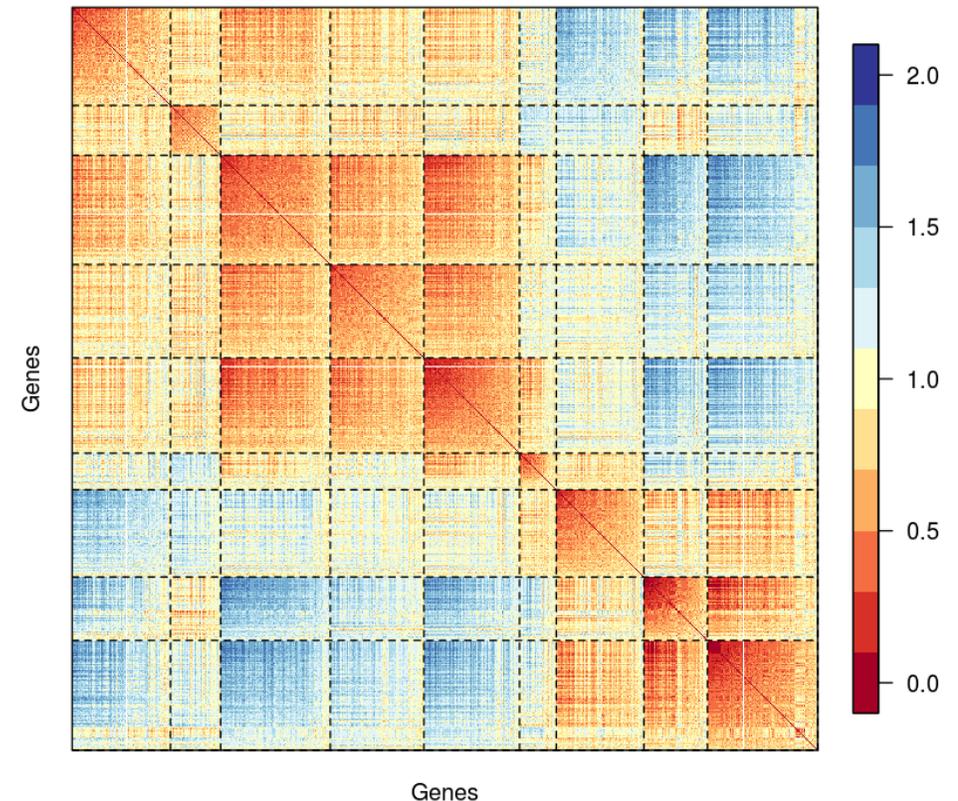
Algorithmic Approach Needs To Fit the Problem

Simple Biology



Very strong unique signature

Complex Biology

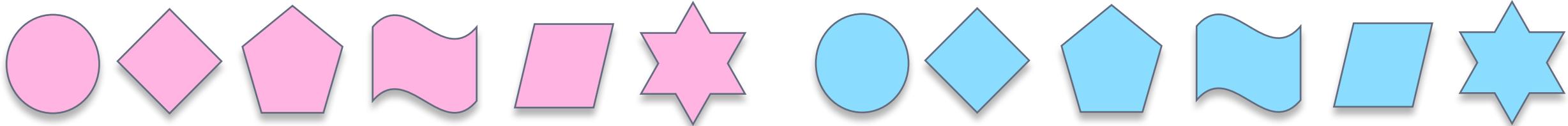


More diverse and complex signature

Ensemble Machine Learning Utilizes Multiple Models Simultaneously

Six **Support Vector Machine** models using different gene sets (shape)

Six **Elastic Net Logistic Regression** models using different gene sets (shape)

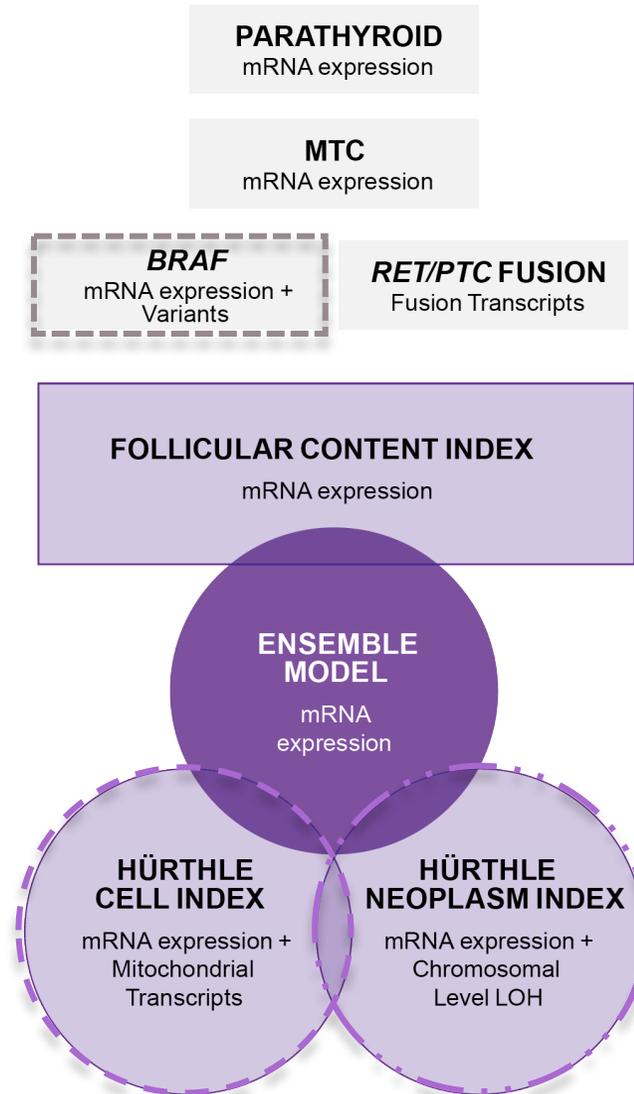


Average scores over 12 individual models

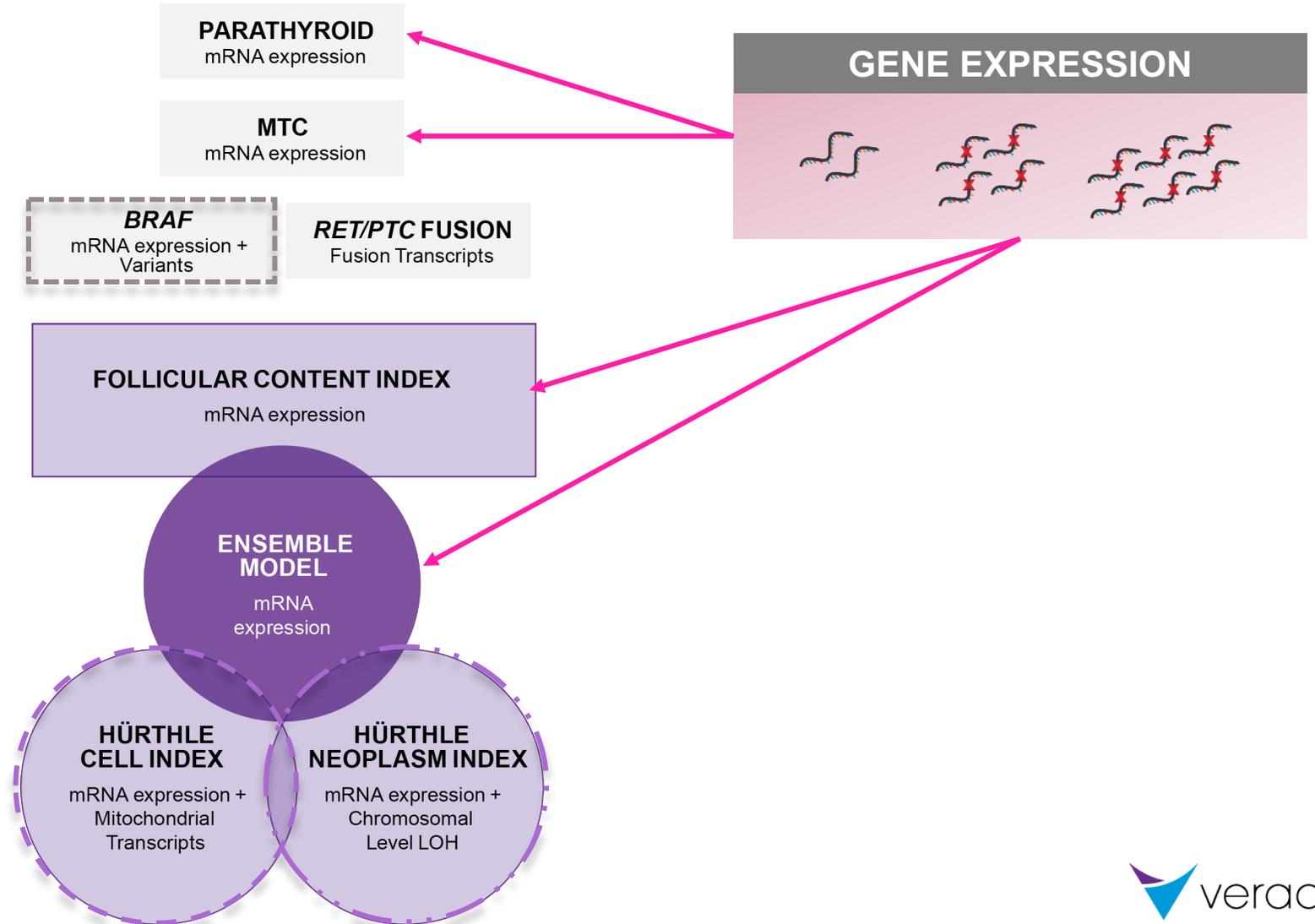


Ensemble Model Score

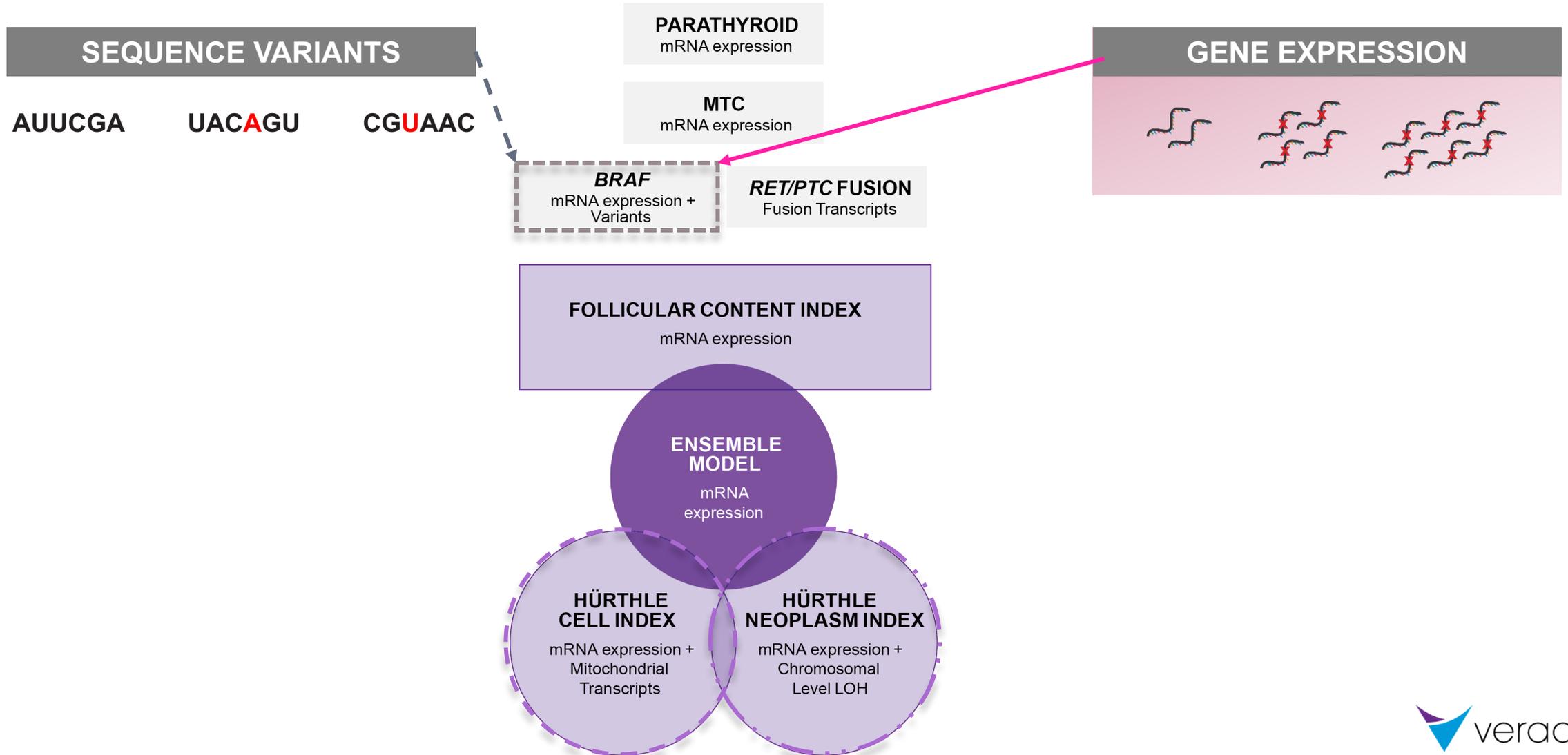
Afirma GSC: An Example of An “Algorithm of Algorithms”



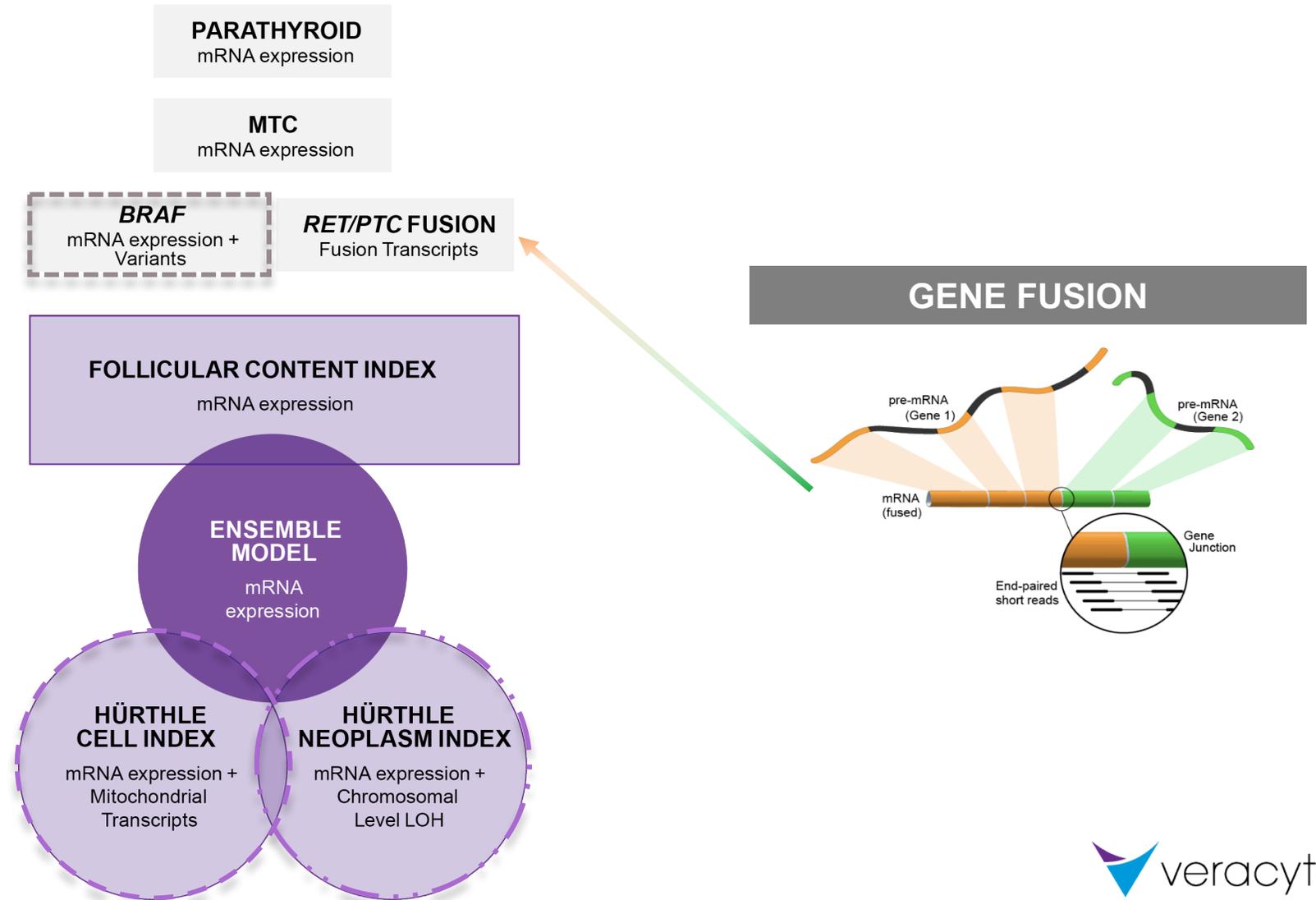
Afirma GSC: Contributing Data Types, Expression Only



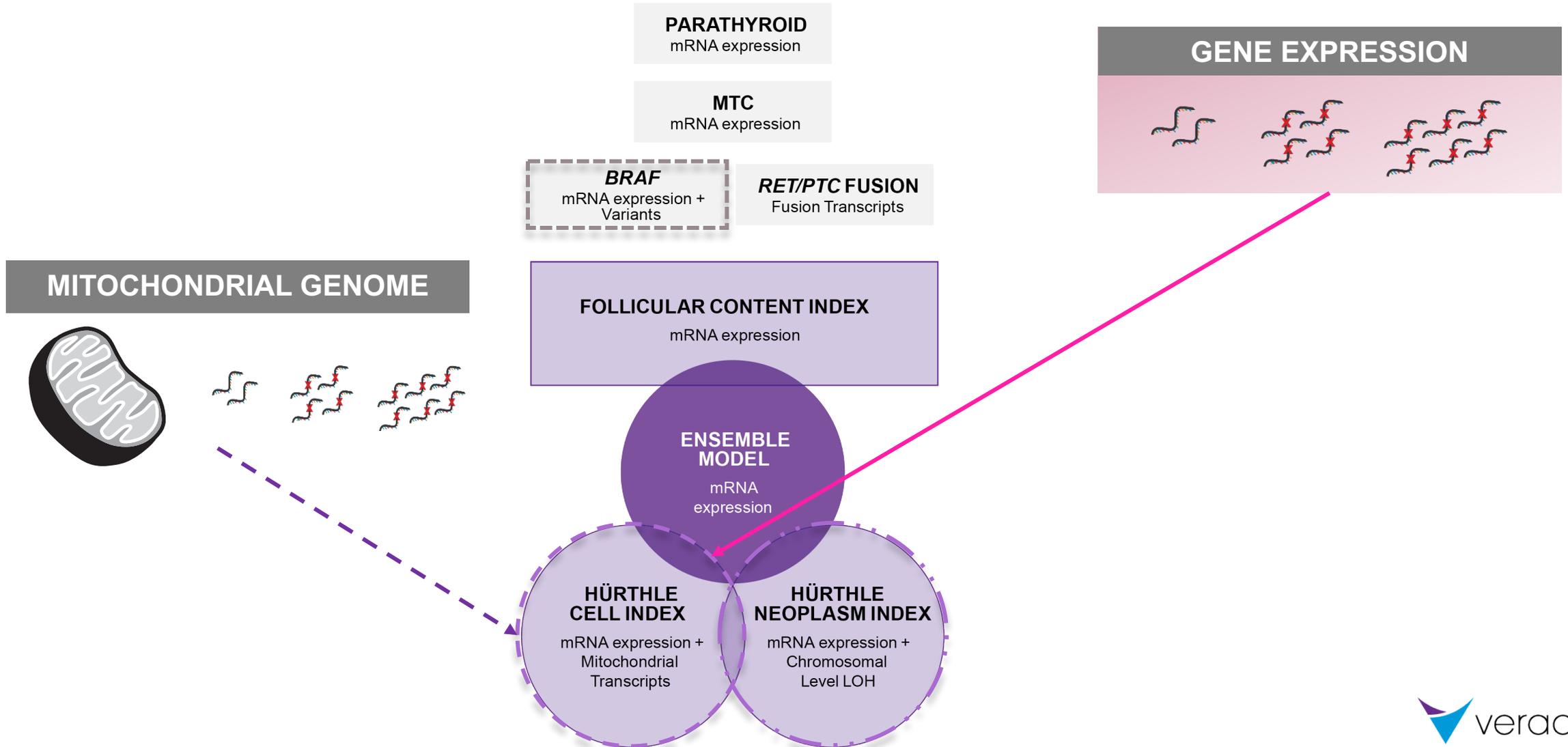
Afirma GSC: Contributing Data Types



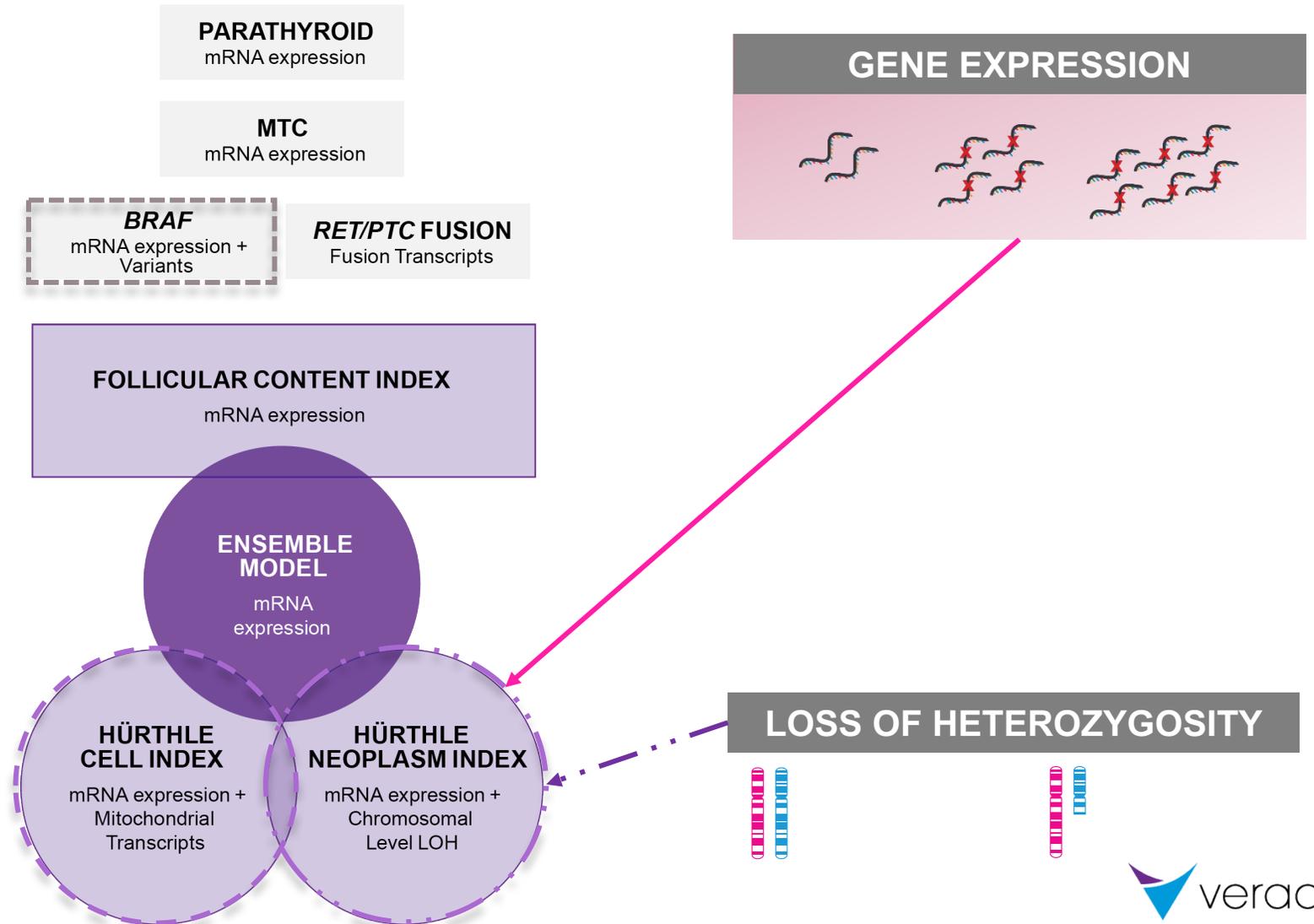
Afirma GSC: Contributing Data Types



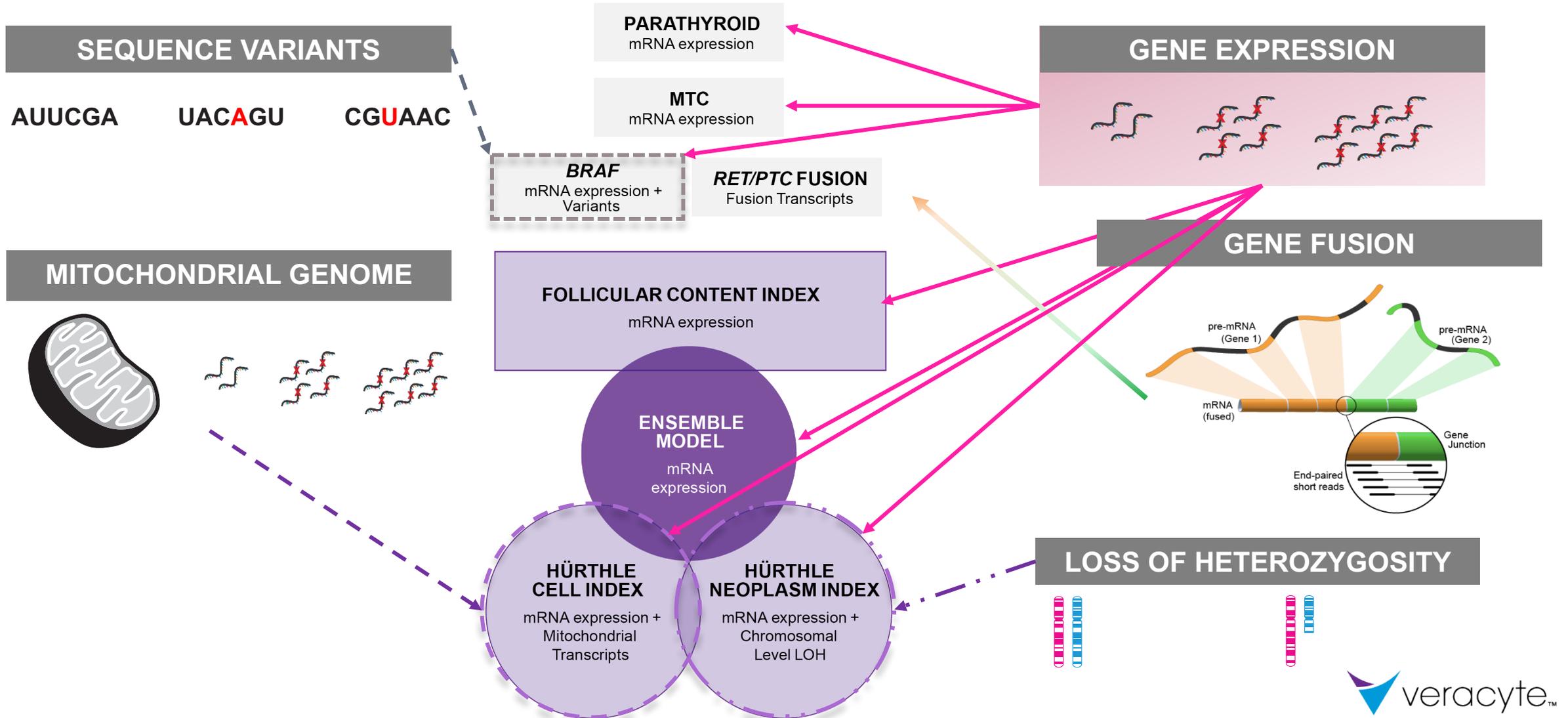
Afirma GSC: Contributing Data Types



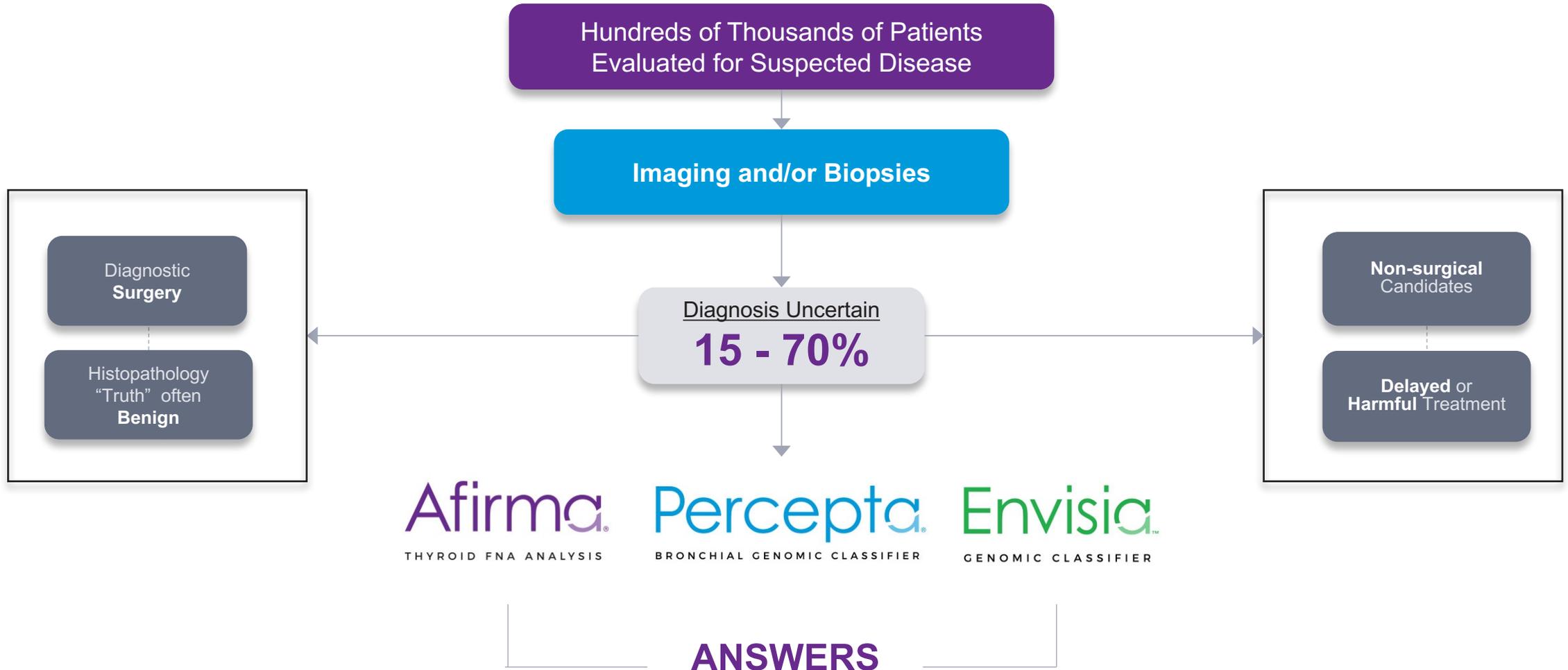
Afirma GSC: Contributing Data Types



Afirma GSC: Contributing Data Types



We Provide ANSWERS that Matter: Integrating into the Clinical Pathway of Care



Leading in the Age of Evidence

Afirma[®]

THYROID FNA ANALYSIS

- **2** clinical validation studies
- **1** analytical verification study
- **18** clinical utility studies, including **3** long-term clinical outcome studies
- **2** cost effectiveness and quality of life studies



The NEW ENGLAND
JOURNAL of MEDICINE

Percepta[®]

BRONCHIAL GENOMIC CLASSIFIER

- **3** clinical validation studies
- **1** analytical verification study
- **2** clinical utility studies
- **1** cost effectiveness study
- PERCEPTA Registry with **600 enrolled patients**



The NEW ENGLAND
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Envisia[™]

GENOMIC CLASSIFIER

- **1** feasibility study published
- **2** clinical validation studies (1 published; 1 submitted)
- **1** analytical verification study (accepted for publication)
- **1** clinical utility patient survey (accepted for publication)
- BRAVE registry and ongoing trial, **360+ patients**

THE LANCET
Respiratory Medicine



Pillars of Success



Relevance

Answer questions that matter
Integrated into current care pathway to
change practice and reduce surgeries



Rigor

Build robust scientific and clinical
evidence; inform guidelines



Resolution

Provide answers that
change care with real clinical
utility and economic value



Reimbursement

Extensive coverage policies and contracted
relationships pave way for additional tests

Proven Execution

- Addressing a **\$2-3B Market**
- **Three commercial products**
- **First mover advantage** in all markets
- Extensive network of payer **coverage policies and contracts**
- Solid revenue growth
- Expanding **pipeline** for sustainable growth

Afirma
THYROID FNA ANALYSIS

*First to Market
Market Leader*

Percepta
BRONCHIAL GENOMIC CLASSIFIER

*First to Market
First To Coverage*

Envisia
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First To Market

STRATEGIC

THANK YOU