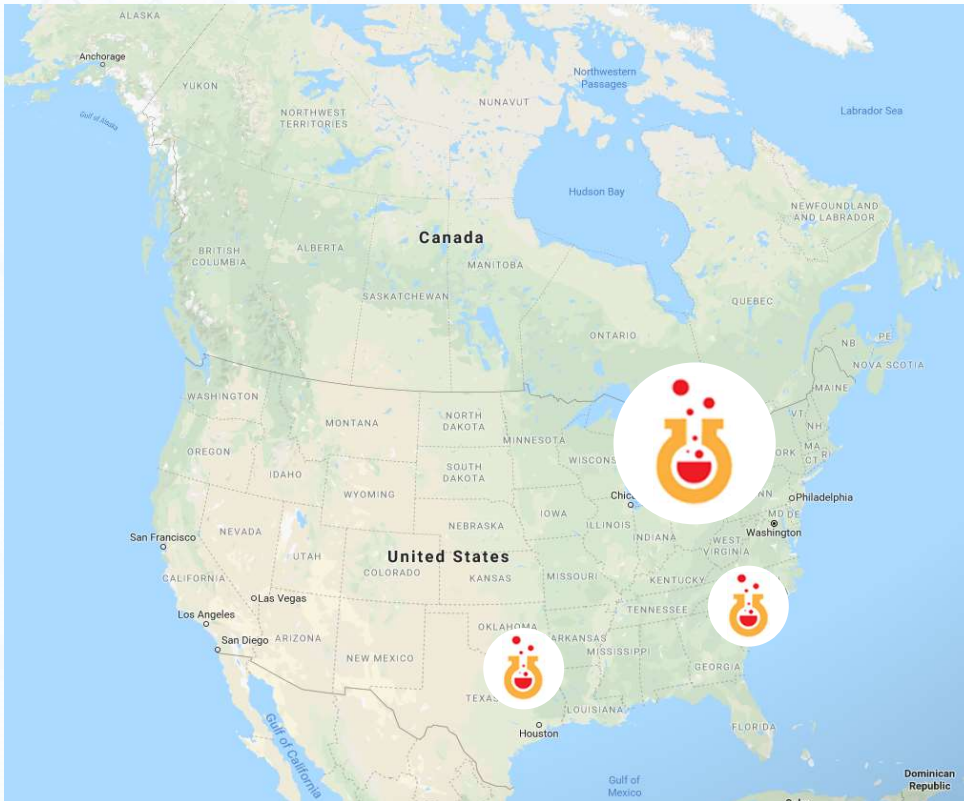# James O'Hara
EVP Strategy, GR & PR

AI for Polypharmacy Management

Clinical Research Association of Canada

Agenda

1. Who we are

2. Applied AI + Polypharmacy

3. Future Development

Seroclinix
lab diagnostics

Introduction

CLIA Approved Laboratories

FDA Cleared Devices

ISO 13485 (Devices)
ISO 15189 (Clinical Labs)

Backed by state-of-the-art **mass spec** technologies and **research evidence**

Driven by **diagnostic experts**

Services

Lab Services	Lab-as-a-Service	Personalized Medicine	Personalized Prescribing
Toxicology	QC/Calibrator Manufacturing	Testing	AI Assisted
Drug Compliance	Management	PGx	Personalized Metabolism
Patient Monitoring	Data Review	Polypharmacy	Prescription Modelling
Product Testing (Cannabis and Pharmaceuticals)	Mechanical Requirements	Biomarker based wellness testing	

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CE-TOF

Multisegmented Injection - Capillary Electrophoresis – Time of Flight – Mass Spectrometry

- Gold-standard technology repurposed to **disrupt healthcare testing**

- **13+ simultaneous** injections
    - **<2 minutes** per sample

- Get the **full picture** with no panel limitations faced by traditional approaches

- With any biological sample, profile **drugs**, **lifestyle markers**, **disease indicators**, and *more*

(2017). *U.S. Patent Application No. 15/293,775.*

Applied AI + Polypharmacy

Drug-Drug Interactions

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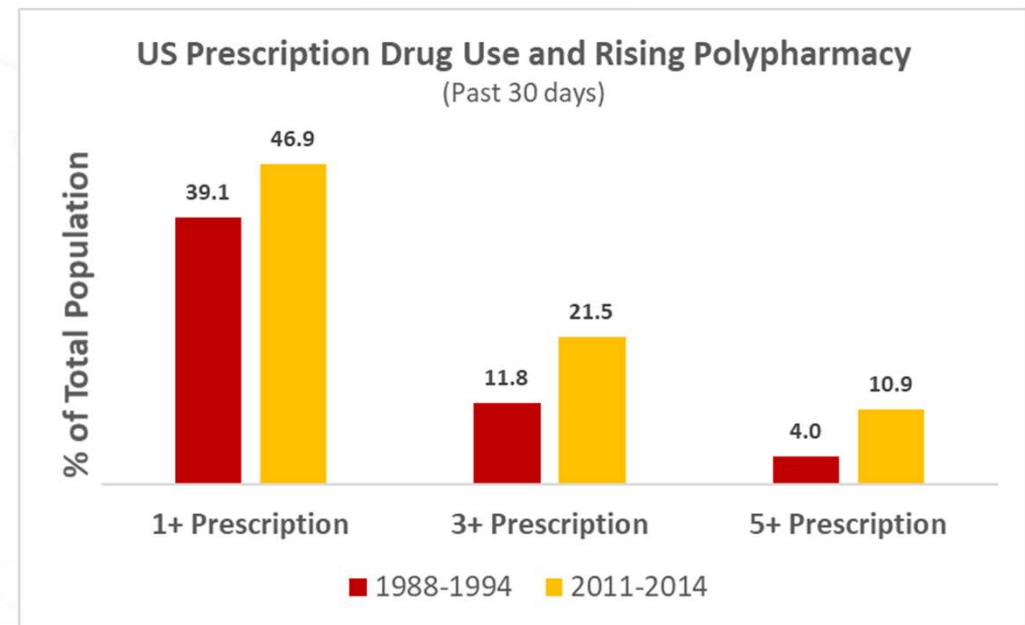# Applied AI + Machine Learning in Healthcare

Machine Learning Definition
- AI is the ability to analyze an environment and take actions to maximize contextual success
- Machine learning (ML) is a subset of AI and the field of algorithms and statistical models
- Seroclinix applies ML to data analysis and insights

How Seroclinix is applying machine learning:
- At Seroclinix, our analytics systems touch every data point we generate
- Our insights get stronger every test we complete
- Modelling compound (drugs, biomarkers, etc.) migration behaviour
- Reinforcement learning of predictive Pharmacogenetics → confirming predicted phenotype
  - Ex. Patient A is a hypermetabolizer of Drug A, we then measure drug-metabolite levels to confirm
- Pathway network analysis of drug-metabolite levels
- Prescription recommendation engine

What we've seen in practice...the impact of DDIs

- Increasing trend of drug-drug interactions (DDI)

- **35.8%** of Americans aged **57-85** take **5+** medications

- **39%** of adverse drug reactions (ADR) were the result of inappropriate drug prescription combinations or drug-drug interactions

- **25%** of patients have an ADR within **3** months of starting a prescription

- Some estimates put ADR as the 4th leading cause of death in the United States

US Prescription Drug Use and Rising Polypharmacy
(Past 30 days)

% of Total Population

1+ Prescription: 39.1 (1988-1994), 46.9 (2011-2014)
3+ Prescription: 11.8 (1988-1994), 21.5 (2011-2014)
5+ Prescription: 4.0 (1988-1994), 10.9 (2011-2014)

■ 1988-1994 ■ 2011-2014

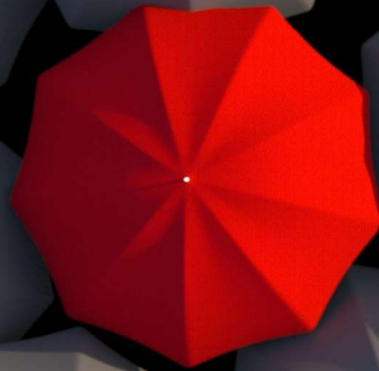# Our analysis on the principal cause….

Root Cause
- The lack of accessible + actionable information
- No objective solution to have the right conversations
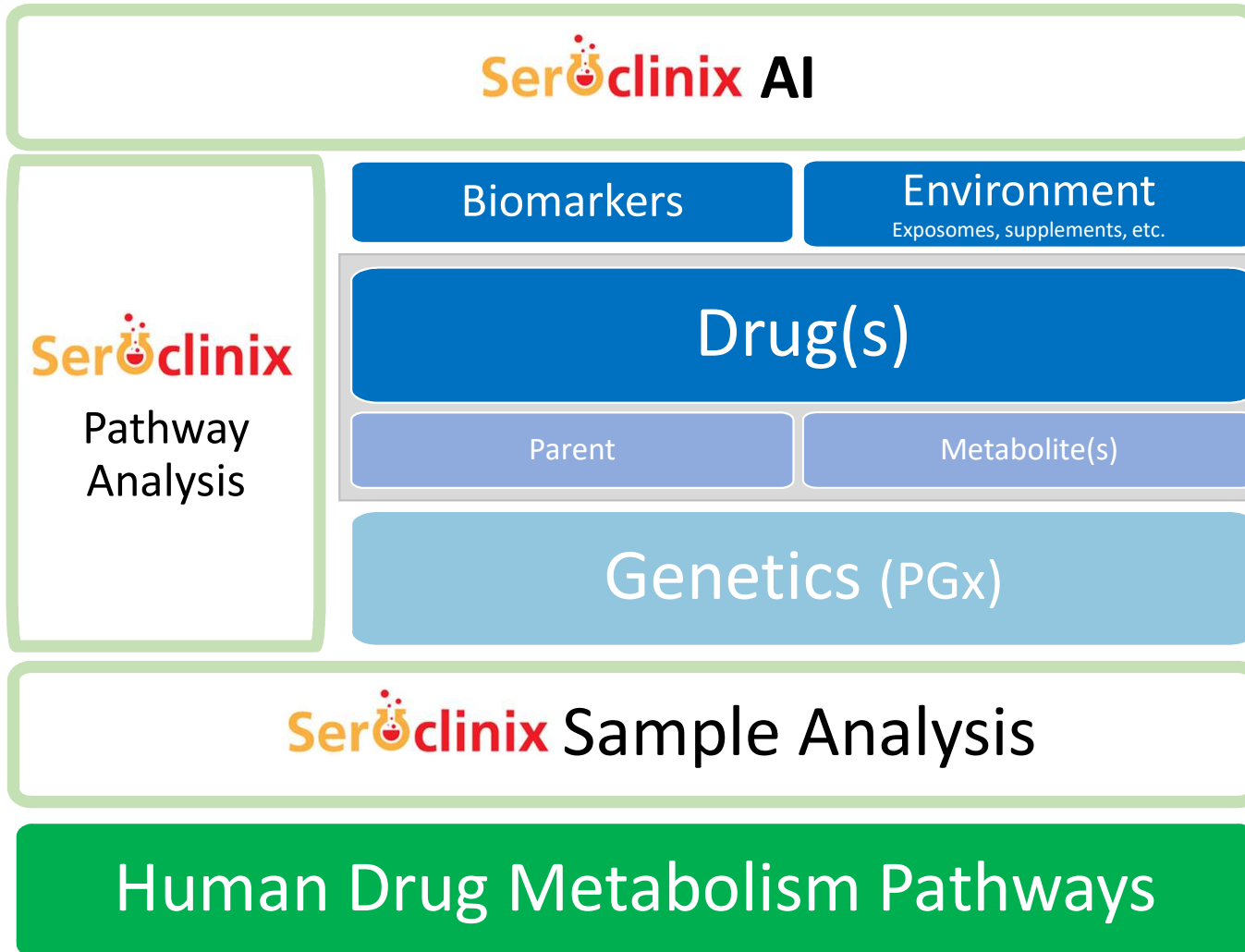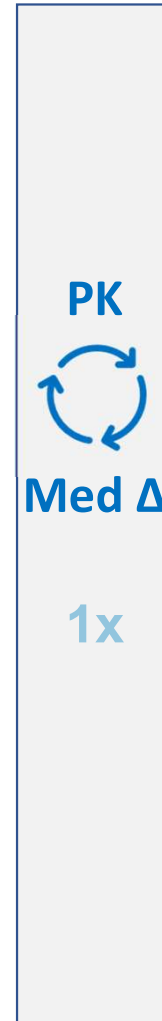- Patient-Doctor-Pharmacist communications
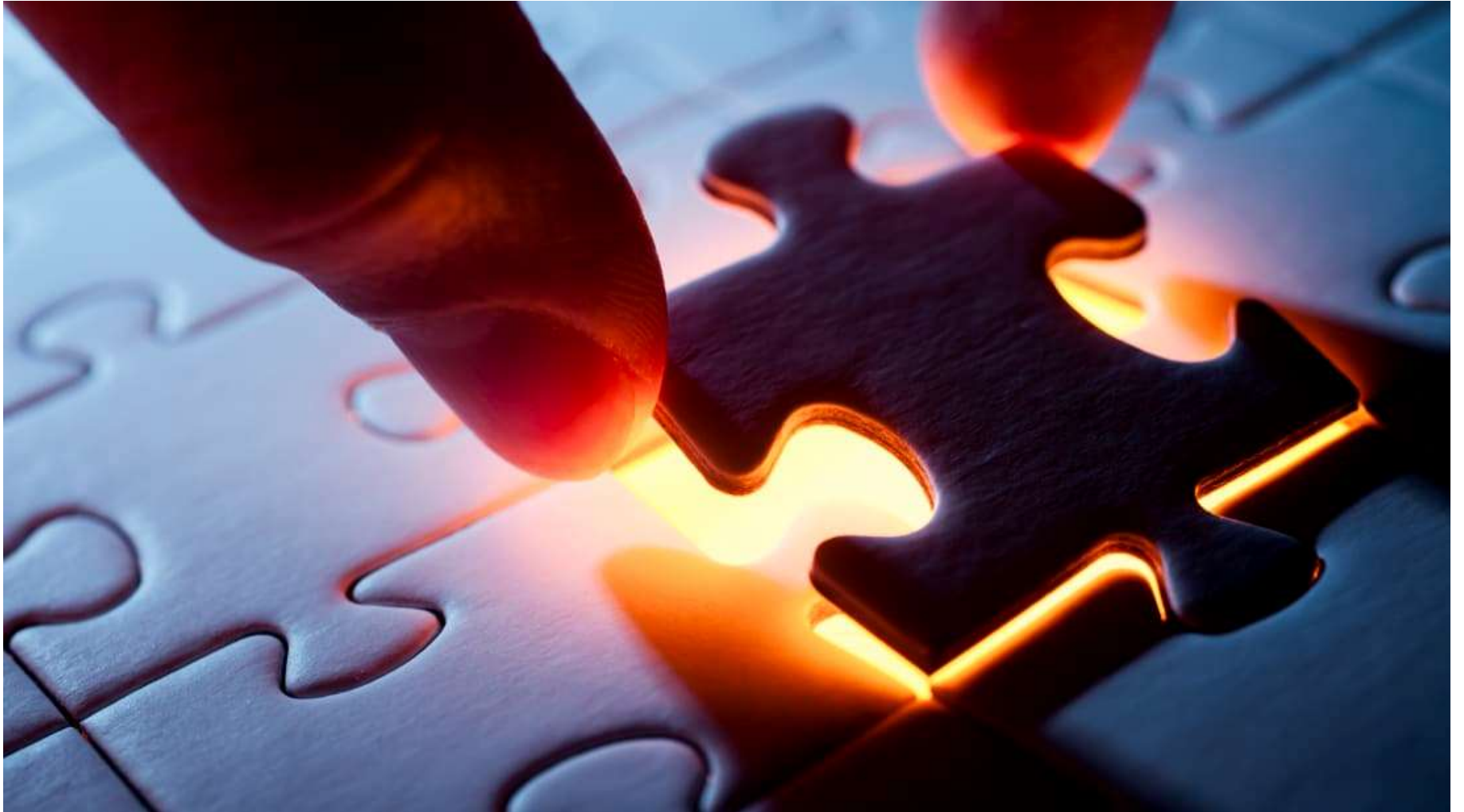
Our Solution

Seroclinix Polypharmacy Solution

Frequency

Results

Seroclinix AI

Biomarkers	Environment Exposomes, supplements, etc.

Drug(s)

Parent	Metabolite(s)

Genetics (PGx)

Seroclinix Pathway Analysis

Seroclinix Sample Analysis

Human Drug Metabolism Pathways

PK

Med Δ

1x

Personalized

Ubiquitous

Seroclinix Polypharmacy Solution

Seroclinix AI

Human Drug Metabolism Pathways

Results

Personalized

Ubiquitous

Seroclinix Polypharmacy Solution

Seroclinix AI

Seroclinix Sample Analysis
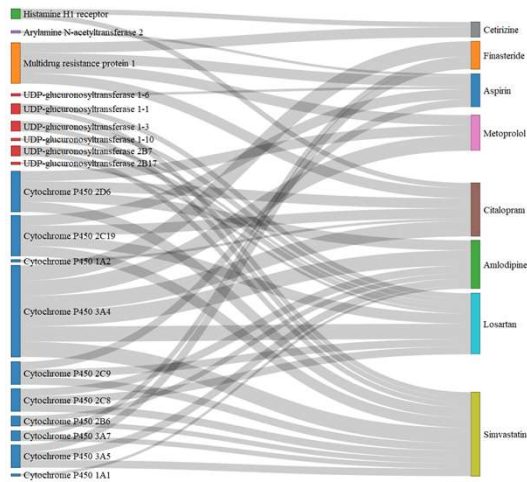
Human Drug Metabolism Pathways

Results

Personalized

Ubiquitous

15

Seroclinix Polypharmacy Solution

Results

Seroclinix AI

Pathway Analysis

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Human Drug Metabolism Pathways

Personalized

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Seroclinix Polypharmacy Solution

Seroclinix AI

Seroclinix Pathway Analysis
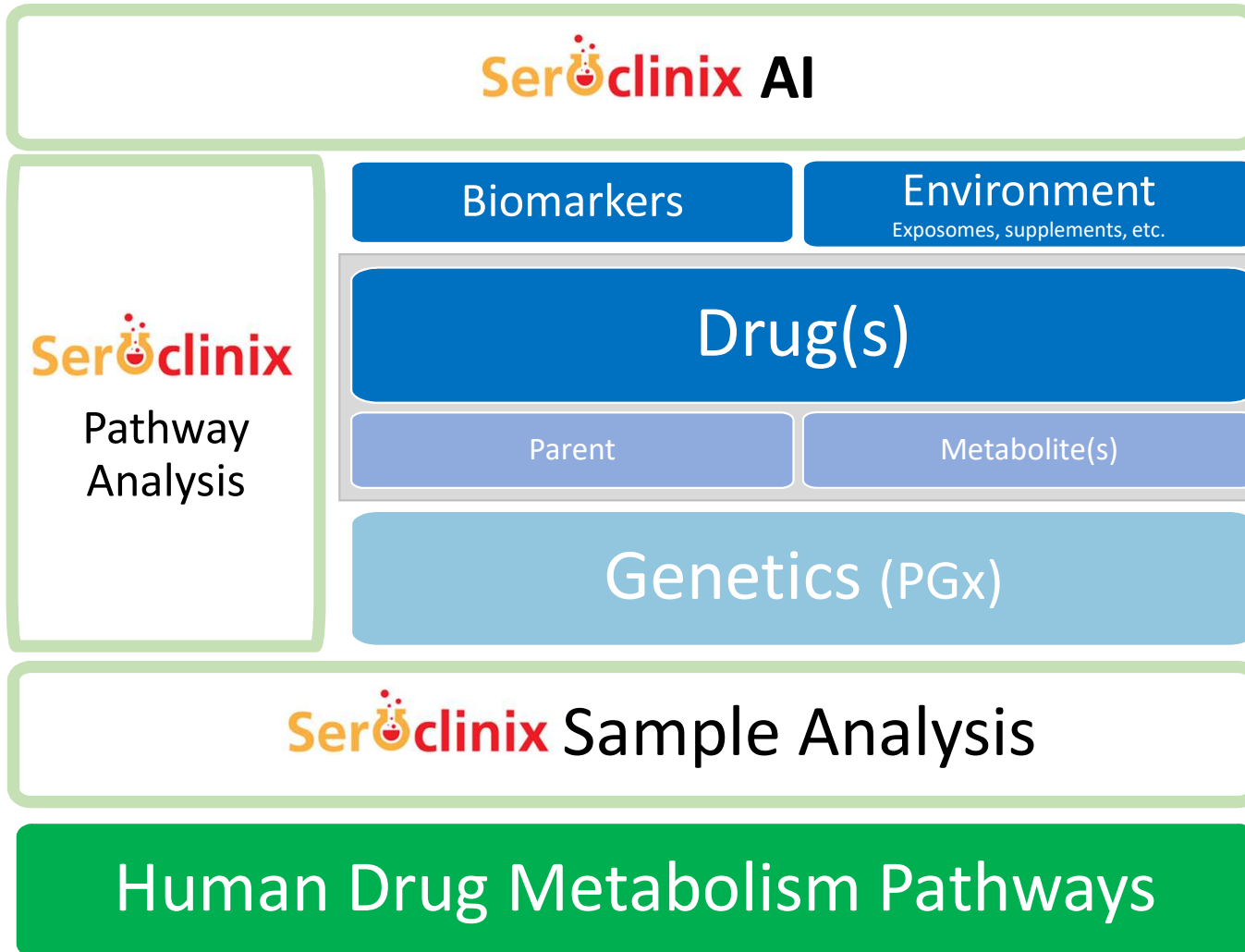
Genetics (PGx)

Seroclinix Sample Analysis

Human Drug Metabolism Pathways

Results

Personalized

Ubiquitous

Seroclinix Polypharmacy Solution

Seroclinix AI

Seroclinix Pathway Analysis

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	Exposomes, supplements, etc.

Drug(s)

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Seroclinix Sample Analysis
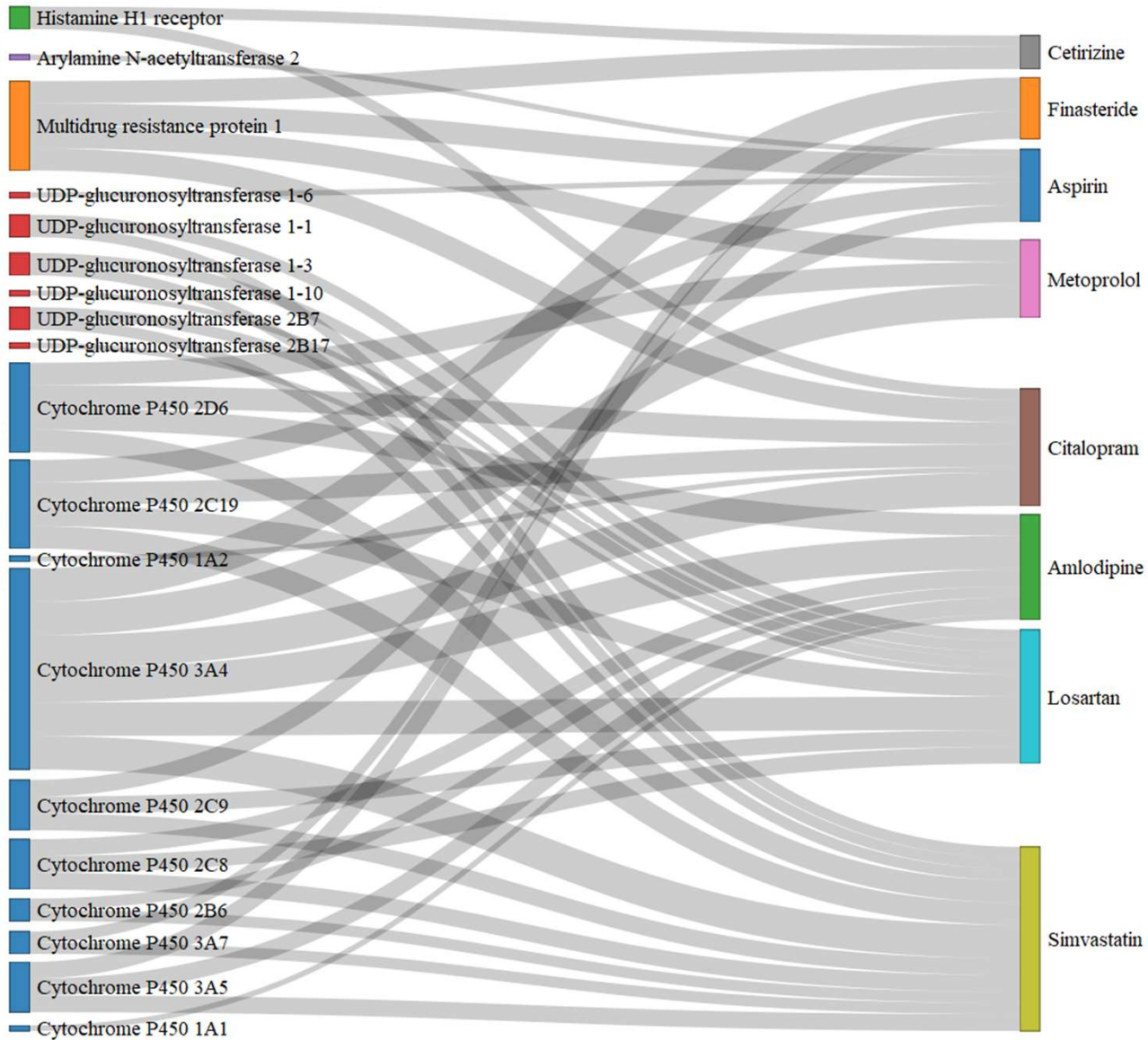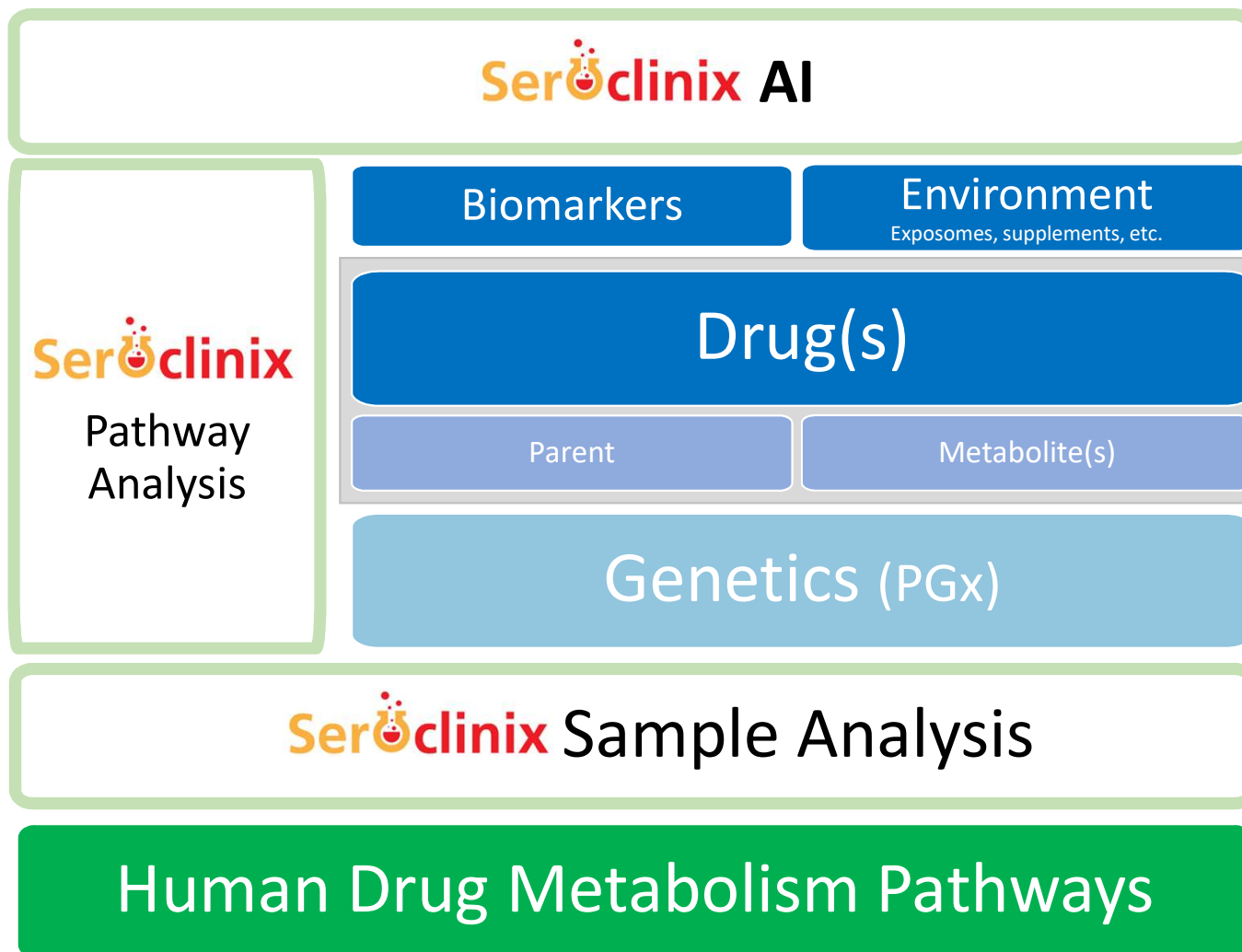
Human Drug Metabolism Pathways

Results

Personalized

Ubiquitous

DDIs

- Enzymes
- Transporters
- Targets
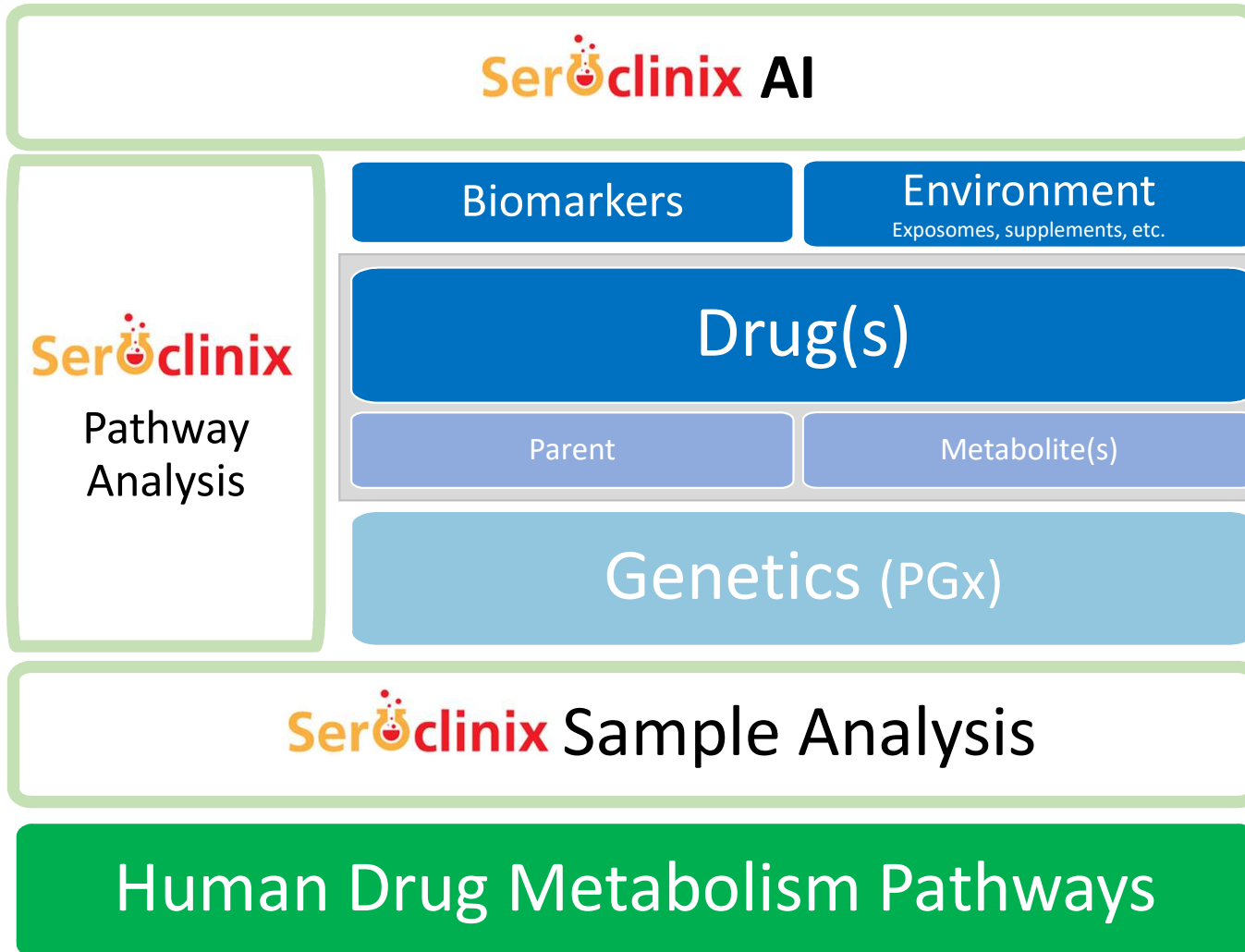- Biointeractions
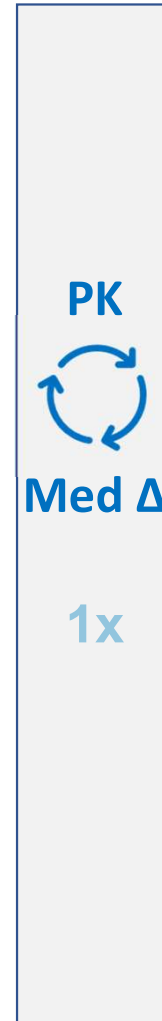
Drugs

19

Seroclinix Polypharmacy Solution

Frequency

Results

Seroclinix AI

Biomarkers

Environment
Exposomes, supplements, etc.

Drug(s)

Parent

Metabolite(s)

Seroclinix Pathway Analysis

Genetics (PGx)

Seroclinix Sample Analysis

Human Drug Metabolism Pathways

PK

Med Δ

1x

Personalized

Ubiquitous

Significance of our Machine Learning

Test Results

Test Results

Test Results

Test Results

Test Results

Test Results

Continuous data integration to improve service quality

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Actionable Findings

Machine Learning

Biomarkers
- Kidney health
- Concussion
- Organ function
- **Wellness + diagnostic testing**

Compounds
- Urine: Yes/No for metabolized drug presence
- Blood: **concentration levels** for drug + metabolites
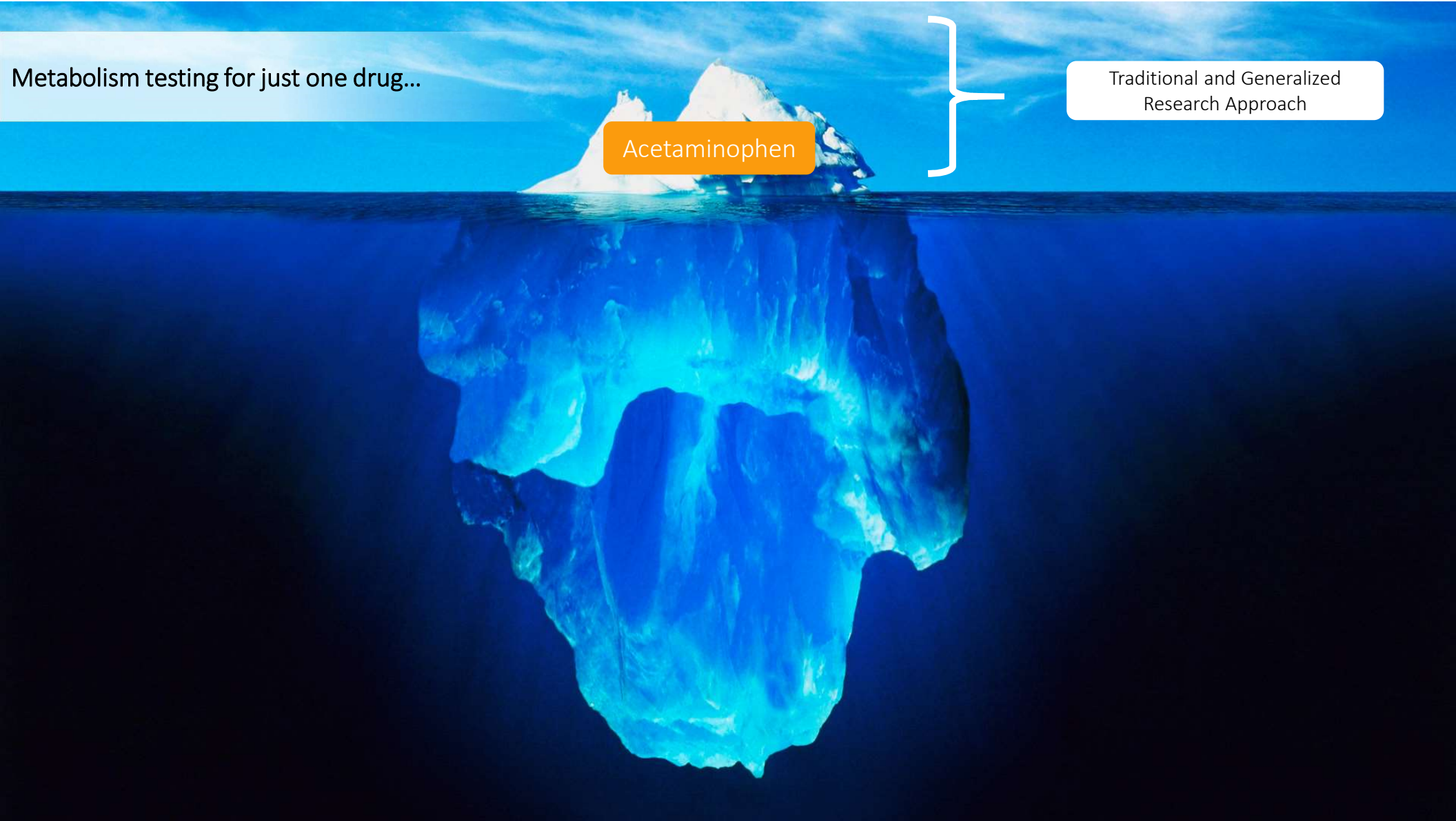- Ex. Drugs, OTC, supplements

PGx
- DNA mutations impacting drug metabolism
- **Slow/Rapid Metabolizer**
- CYP and other metabolic enzymes
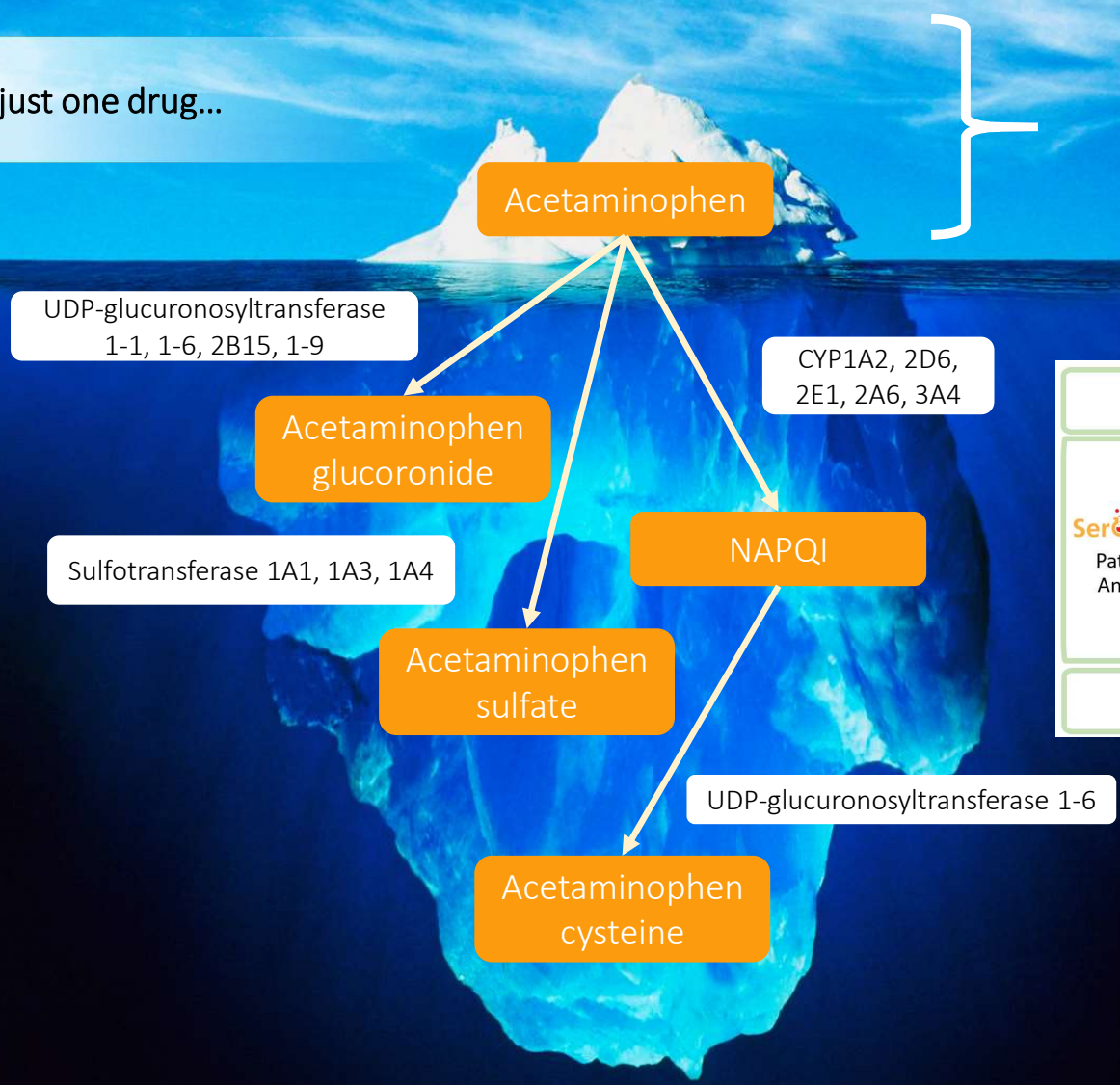
Drug Pathway Analysis

Metabolism testing for just one drug...

Acetaminophen

Traditional and Generalized Research Approach

Metabolism testing for just one drug...

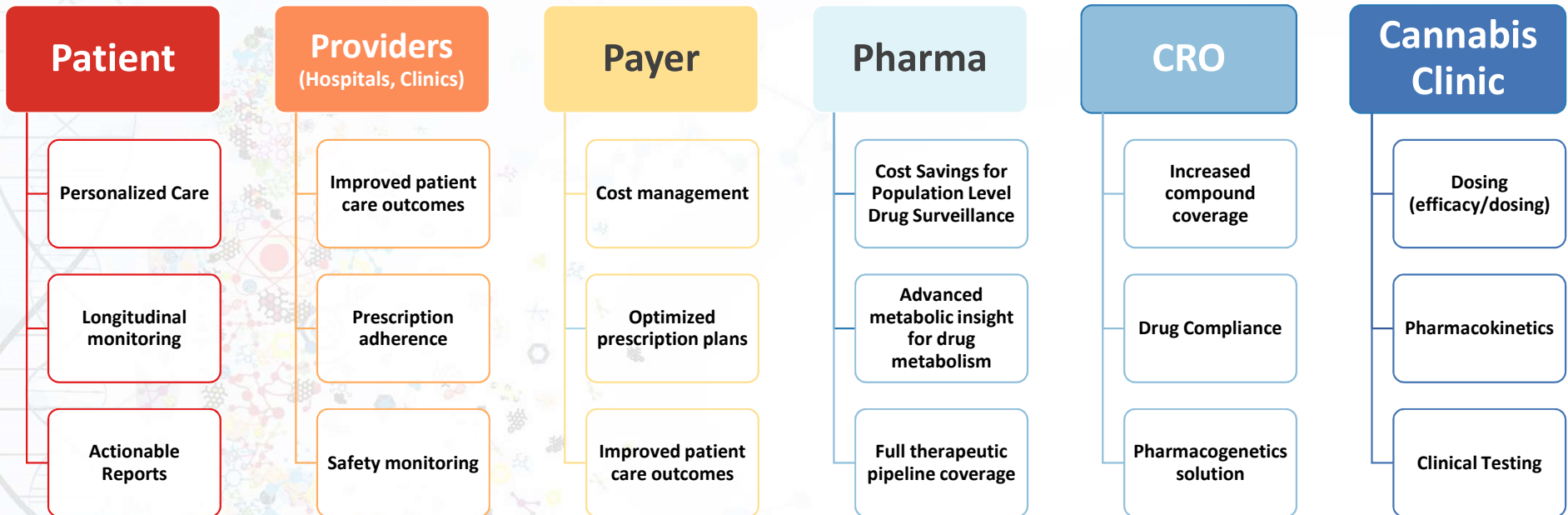Traditional and Generalized Research Approach

Acetaminophen

UDP-glucoronosyltransferase 1-1, 1-6, 2B15, 1-9

CYP1A2, 2D6, 2E1, 2A6, 3A4

Seroclinix Personalized Approach

Acetaminophen glucoronide

Sulfotransferase 1A1, 1A3, 1A4

NAPQI

Acetaminophen sulfate

UDP-glucuronosyltransferase 1-6

Acetaminophen cysteine

Seroclinix AI

Biomarkers | Environment
Exposomes, supplements, etc.

Seroclinix Pathway Analysis

Drug

Parent | Metabolite

Genetics (PGx)

Seroclinix Sample Analysis

Service Applications

Patient	Providers (Hospitals, Clinics)	Payer	Pharma	CRO	Cannabis Clinic
Personalized Care	Improved patient care outcomes	Cost management	Cost Savings for Population Level Drug Surveillance	Increased compound coverage	Dosing (efficacy/dosing)
Longitudinal monitoring	Prescription adherence	Optimized prescription plans	Advanced metabolic insight for drug metabolism	Drug Compliance	Pharmacokinetics
Actionable Reports	Safety monitoring	Improved patient care outcomes	Full therapeutic pipeline coverage	Pharmacogenetics solution	Clinical Testing

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Our next big challenge in addressing DDIs…

We can do this in hospitals and clinics today – but we wanted to make this technology broadly available to the masses.

At-home Test Kits – Polypharmacy + PGx (DNA)

SeroSpot^{TM} Dried Urine Collection Kit

- Re-sealable Specimen Bag
- SeroSpot^{TM} Collection Device
- Exact Volume Pipette

SeroDrop^{TM} Dried Plasma Collection Kit

- Re-sealable Specimen Bag
- SeroDrop^{TM} Collection Device
- Lancets, Band-aid, Alcohol Wipe

Oral Fluid Collection Kit
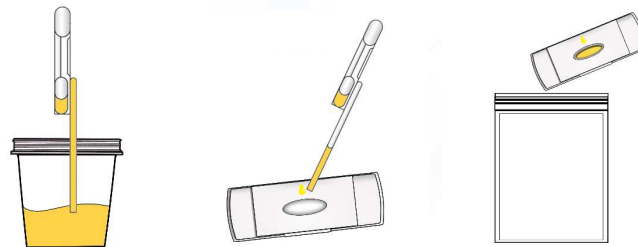
- Specimen Bag
- Oral Fluid Collection Tube

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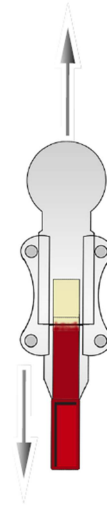# Collection Procedure

Oral Fluid
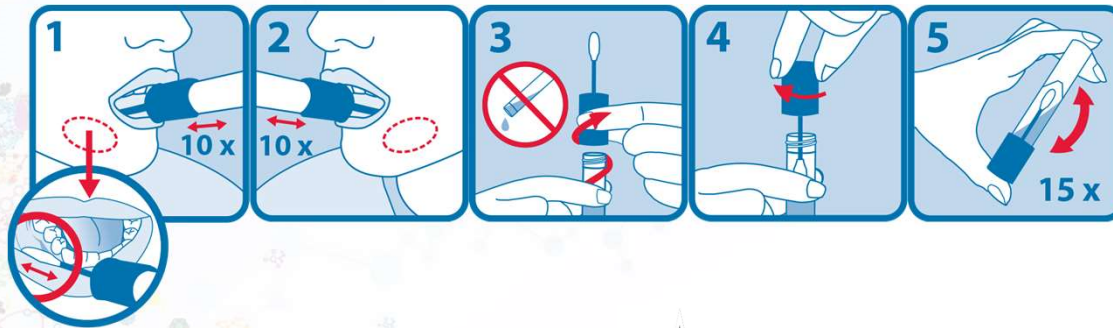
Blood-Plasma
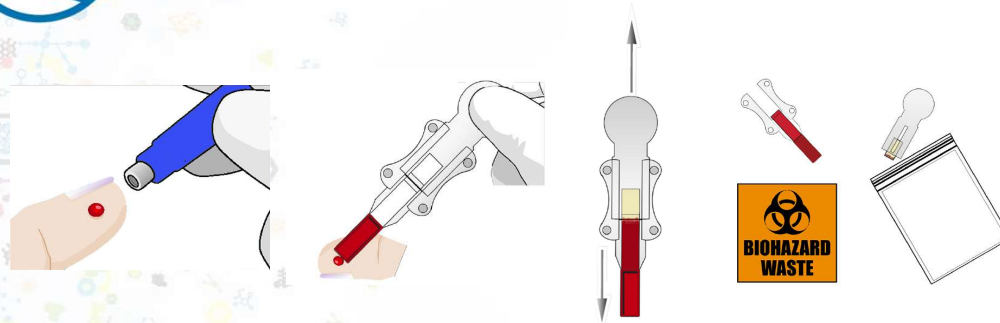
Urine

SeroDrop™

Plasma Collection Device
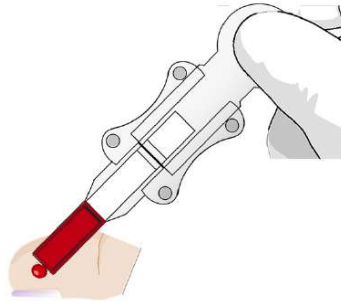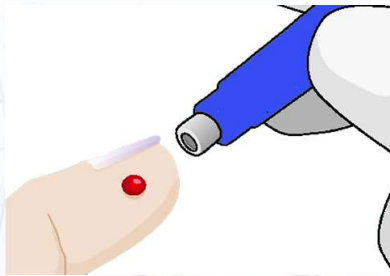
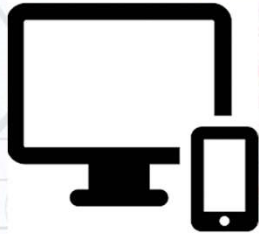| Prick | Collect | Separate | Ship |

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Logistics

1 Create an account Activate your test

2 Collection samples (Blood/Urine/Oral) using provided collection device

3 Place collected sample back in device package

4 Mail Sample to our lab

5 Access results online

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Sample Collection Device Comparison

	Phlebotomy	Dried Blood Spot	SeroDrop™	Urine Collection Cup	SeroSpot™
Sample Volume Required	5-10mL	4-5 Drops	1-2 Drops	30-50 mL	0.1 mL
Ease of Use	Professional	Self Collection	Self Collection	Self Collection	Self Collection
Integrity	Low	Low	High	Low	High
Stability	Unstable	Stable	Stable	Unstable	Stable
Hematocrit Effect	No	Yes	No		
Ease of Transportation	Burdensome	Simple	Simple	Burdensome	Simple
Cost	High	Low	Low	High	Low

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The right conversations reduce the impact of DDI's

Patient

- First and foremost it democratizes testing and empowers patients

- They can then take this information and have informed discussions with their pharmacist and doctor

- Enables patients to become more involved in their care path

Pharmacist

- Enable pharmacists to have insightful, fact-based, meaningful, patient medicine reviews

- Provide new revenue-generating opportunities for pharmacists

- Annual and/or intermittent drug reviews

Doctors

- It's like having an MRI of a patients drug metabolism
  - It provides extremely powerful patient insight
  - Provides the basis for personalized medicine

Future Development

Applications

- Infrastructure + expertise to leverage forward with new kits
  - Kidney health foundation
  - Concussion
  - Cannabis
- Affordable enabler of clinical research + focused research
- Enables healthcare in remote areas
  - Seeing significant interest and uptake
- Global reach for countries, enable countries who normally can't engage in this work
- Democratizing medicine – proactive medicine vs reactionary

Applications - Intelligent Prescriptions

- Leveraging our AI

- Traditional doctor writing a script vs prescription modelling (pharmaco-modelling)

- Specialty pharmacy application (PharmD)

- AI recommended prescription solutions

- Ongoing machine learning

- Clinical data driven decision making

- Outcome – less DDIs, less adverse events, optimal therapeutic outcomes, (exponentially) less risk

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Takeaways

1. This is how AI and Machine Learning can be used in clinical practice

2. Keep in mind though, it's ultimately about people

3. The final takeaway is a takeaway itself…

Thanks!