aaps PharmSci 360

OCT 22–25 2023

Patient Centricity: One Blood Draw at a Time

October 23, 2023

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Keynote Speaker

Bill and Melinda Gates Medical Research Institute

Session Description and Objectives

- Over the past decade, microsampling techniques have been adopted to collect small volumes of blood (without the need for venipuncture) to support PK analysis during drug development.
- This presentation will focus on the broader adoption of such techniques across clinical trials and in healthcare practice, globally.

Learning objectives:

- Why and how we collect blood
- What types of analyses are conducted using blood
- Is blood = blood?
- Why we should collect smaller volumes of blood and how
- What are the challenges

Overview

- Why do we collect blood
- How much blood is collected vs needed
- Challenges conducting clinical trials
- Technologies available for blood sampling
- What can we measure (using a small sample)
- Making patient centricity a reality

Biography and Contact Information

- Enaksha has over 20 years of bioanalytical experience in quantitative LC/MS/MS supporting all phases of drug development (discovery through clinical development).
- His expertise also includes microsampling (preclinical and clinical studies), patient centric sampling, pediatric studies, and blood sampling for decentralized clinical trials.
- He is also an experienced ADME project leader and been responsible for both preclinical and clinical development of several oncology assets including abemaciclib (Verzenio®), baricitinib (Olumiant®) and selpercatinib (Retevmo™).
- He is the past co-chair of the AAPS Bioanalytical community and current co-chair of the AAPS Microsampling and Patient Centric Sampling subgroup.
- He is a member of the ICH M10 Expert Working Group, representing PhRMA.

Contact Info: enaksha.wickremsinhe@gatesmri.org

Trivia

How many vacutainers are sold globally

Source: BD - Plymouth Makes

Trivia: How much water does an Olympic-size pool hold?

Take a guess

Why BLOOD

Blood testing is a cornerstone of the medical diagnostic process ➔ provides important information about countless aspects of health

Venipuncture

Blood samples used to:

- Assess general state of health
- Check if you have an infection
- Cholesterol levels
- Liver and kidney function
- Monitor the activity and severity of certain conditions
- Help diagnose a variety of health conditions, including HIV, cancer, diabetes, etc.
- Screen for certain genetic conditions
- Therapeutic drug monitoring, drug testing

- **CLINICAL TRIALS**

Clinical trials:

Pharmacokinetics

- Drugs & metabolites
- mAbs
- Peptides, SiRNAs
- ADCs, AOCs
- Combination drugs
- *ADA*

Safety Labs

- Chemistry
- Hematology
- Liver panel
- Lipid panel

Special labs

- Biomarkers
- Disease specific
- Cytokines
- PGX, Omics
- Exploratory

Healthy volunteers, Patients, Pediatric

Blood collected via venipuncture

- Requires trained phlebotomist
- Inconvenient (requires travel)
- Distressing for many patients
- Painful
- Can exacerbate anemia
- Waste (extra blood >90%)
- People with trypanophobia

- Majority of children
- 20-50% adolescents
- 20-30% young adults

The fear of needles: A systematic review and meta-analysis - PubMed (nih.gov)

Volumes of blood collected

Purpose	Total volume (mL)
Screening tests	**45**
Clinical laboratory tests	**256**
PK drug	**189**
Pharmacogenetics	**10**
Total	**500**

Purpose	Total volume (mL)
Screening tests	**40**
Clinical laboratory tests	**256**
Other lab tests	**40**
PK Drug (vacutainer A)	**144**
PK Drug (vacutainer B)	**68**
PK Drug (vacutainer C)	**180**
Biomarker	**120**
Total	**848**

Multiple number of vacutainers are collected during a single clinic visit

Multiple visits for blood collection

	Screening	Day 1	Day 2	Day 3	Day 8	Day 15	Day 16	Day 22
Hematology	X	X			X	X		X
Clinical chemistry	X	X			X	X		X
Urinanaysis	X	X			X	X		X
Pharmacokinetics	X	X	X	X		X	X	

Clinic visits scheduled just for PK blood collection

Recruitment (and retaining) patients is challenging

Approximately 30% patients drop out of clinical trials

A major reason for trial delays and failures

Inconvenience

- Site is far from patient's home or workplace
- Multiple visits
- Scheduling conflicts – work, family

Studies with higher levels of difficulty – study procedures

Financial costs

- Missed work, single parents, childcare

Travel challenges

- Elderly, non-urban areas

(21) Patients,Clinical Trials,Retention | LinkedIn

Recruitment (and retaining) is expensive

Cost of Patient Recruitment

- **$ 7 billion** spent on clinical trials
- **27%** related to patient recruitment

- **~$6,500** to recruit one patient
- **~$20,000** to replace one during a trial

Understanding Why Patients Drop Out of Clinical Trials (patientcentra.com)
The True Cost Of Patient Drop-outs In Clinical Trials - mdgroup

Cater to patient's needs (listen to the patient)

Design trials to be "patient centric"

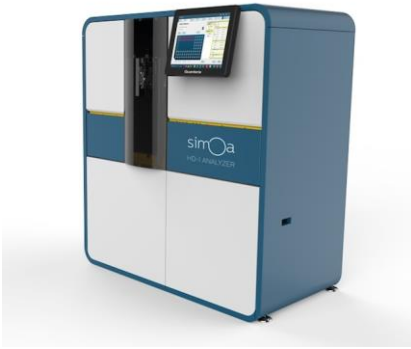
- "Visits" – fewer, more convenient
- Blood sampling – convenient, less invasive
- Digital technologies – eDiaries, PROs

Advancements in analytical technologies

High sensitive, high throughput, low volume

PK analyses
Safety panels
Hematology
Biomarkers
qPCR
Flow cytometry
Special assays

LC-MS
HRMS
MSD
Gyrolab
Quanterix Simoa®
Clinical analyzers



Volume of blood used for analysis

Assay	Volume used for analysis
PK assays (LC-MS/MS)	**10 - 50 µL**
Hematology, Chemistry	**200-300 µL**

- **Draw 3-5 mL blood - by nurse/phlebotomist at clinic**
- **Blood sampling technology has not kept up with advances in analytical technology**

Trivia

How many vacutainers are sold globally

10,300,000,000

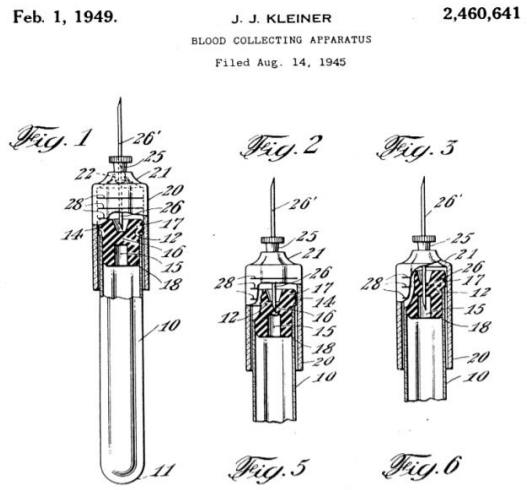
If each vacutainer draws 3 mL of blood, how much blood is collected?

30,000,000 Liters

Source: BD - Plymouth Makes

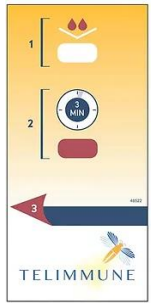
Vacutainers

- **Vacutainer** technology: developed in **1947** by Joseph Kleiner
- Marketed by Becton Dickinson (B-D)



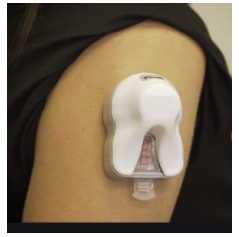
Vacutainer PLUS - developed by B-D in the early 1990s

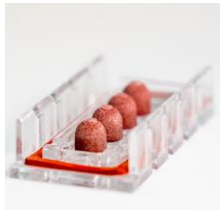
Innovation…









BLOOD

Liquid blood

Dried blood

PLASMA/SERUM

Liquid plasma/serum

Dried plasma/serum

“Patient-centric” blood collection options

1. At home - by trained professional (mRn)
2. At a local pharmacy or local clinic
3. Self sampling using a novel device

Key questions….

- How much blood is needed for the test?
- Does it need to be collected via venipuncture?
- Does it have to be collected at the clinic?
- Can it be collected at home and sent to the lab?
- When does it need to be collected?
- How many samples are needed?
- *Does it have to be blood?*

Why Patient Centric Sampling (microsampling)

Reduce patient burden – especially in vulnerable patients

- Oncology patients, elderly,
- Pediatric – birth to 18 years
- Privacy*

Collect samples without visiting a clinic/phlebotomist

- At home or local pharmacy

Access to a more diverse patient population

- Conduct trials in resource limited locations
- Better popPK

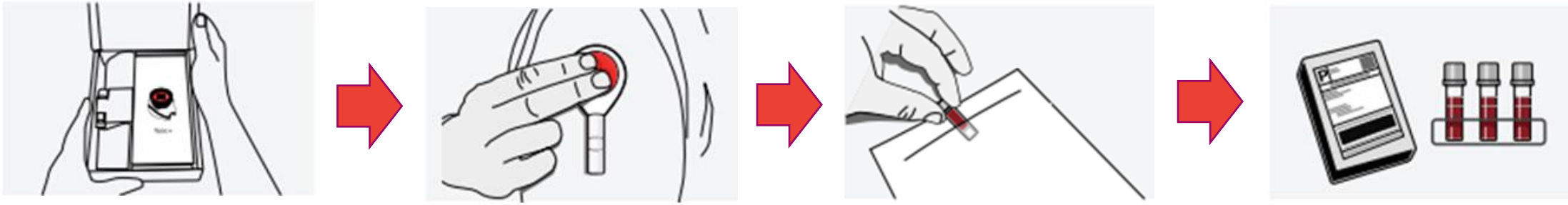
Collect samples during a "clinical event"

- Episodic events - migraine, heart failure patients,

Better compliance, fewer drop-outs, faster trial completion

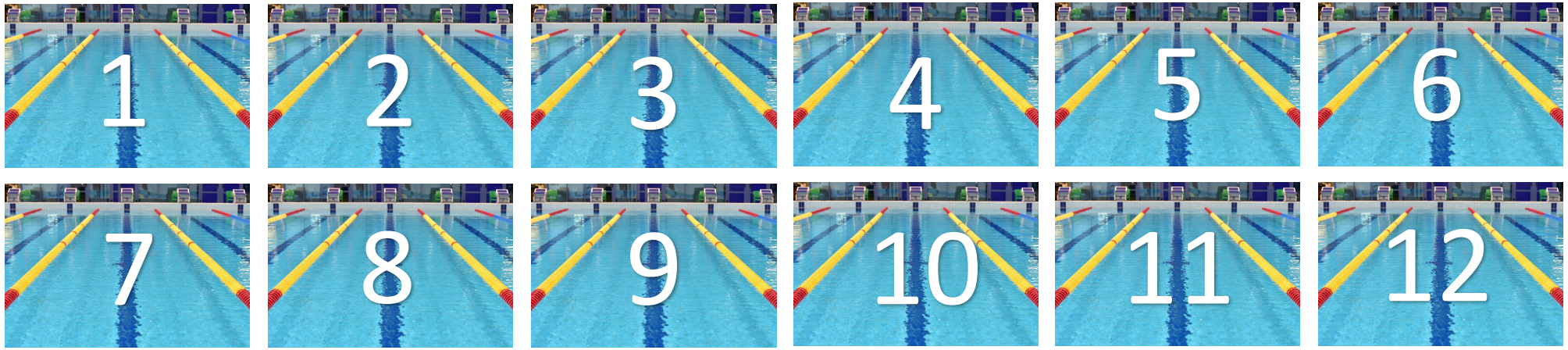
*Wickremsinhe E, Short M, Talkington B, West L. **2020**. DIY Blood Sampling for Pediatric Clinical Trials – The Patients Perspective. Applied Clinical Trials 29(3):20-24.
Wickremsinhe ER. **2022.** Perspectives on adopting patient-centric sampling for pediatric trials. In: Patient centric Blood Sampling and Quantitative Analysis 2023 .

Can this be the future?



Graphic is an example – not an endorsement.

Trivia: How much is 30 million liters of blood

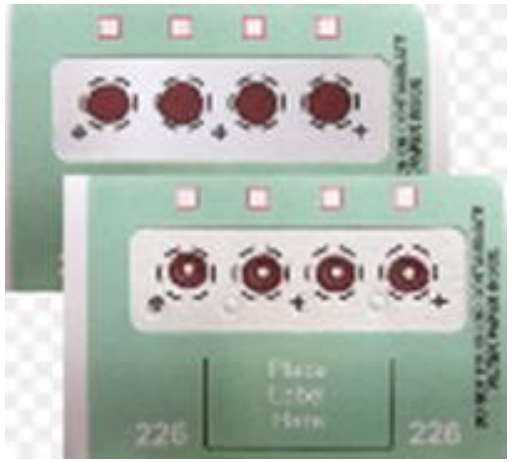


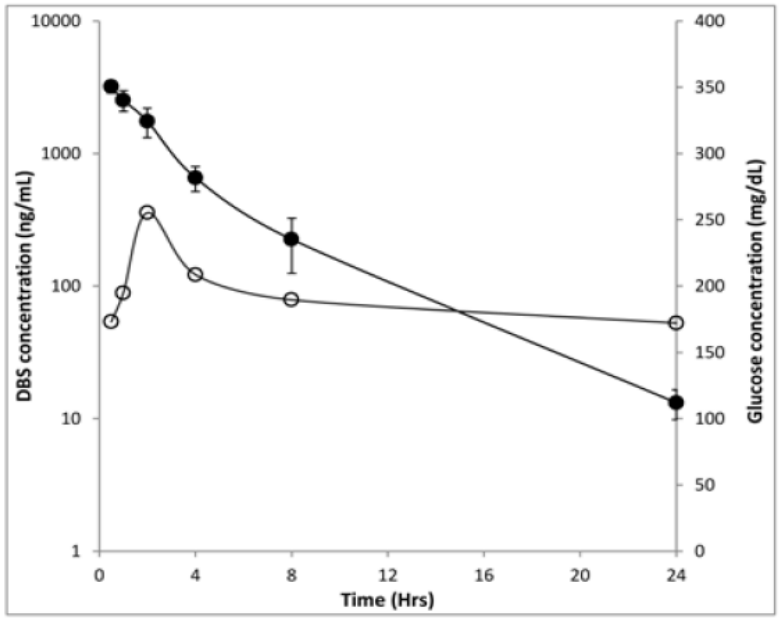
How much of this do we use/need?

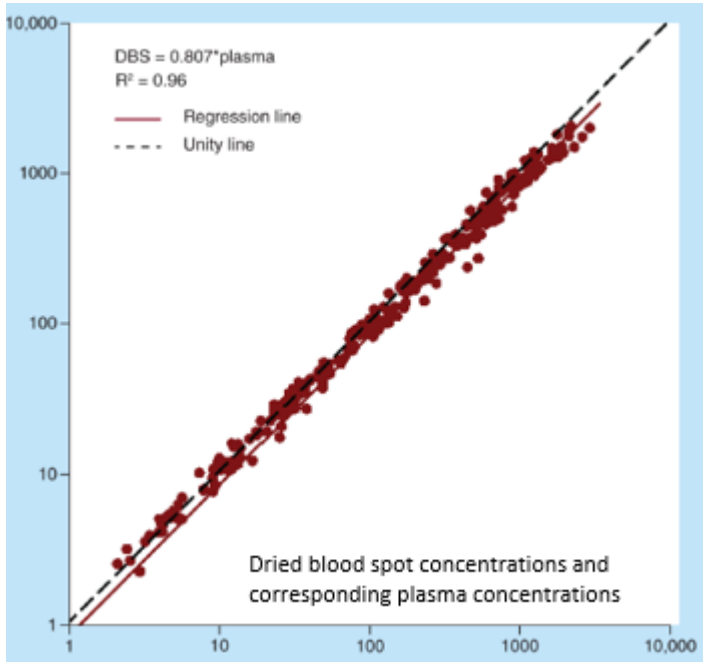

Time for Change

Dried Blood Spot (DBS)

- Technique introduced in 1960's by Dr. Guthrie for neonatal screening
- Subsequently adopted to quantify drug concentrations – non-clinical (especially rodents) and human clinical trials







DBS study n = 4
Traditional n = 24

Adoption of microsampling - Pharma

- Survey conducted in 2017 (AAPS Microsampling)
- Multiple techniques used (liquid and dried)
- Dried blood used in clinical development
- Broader implementation across drug development

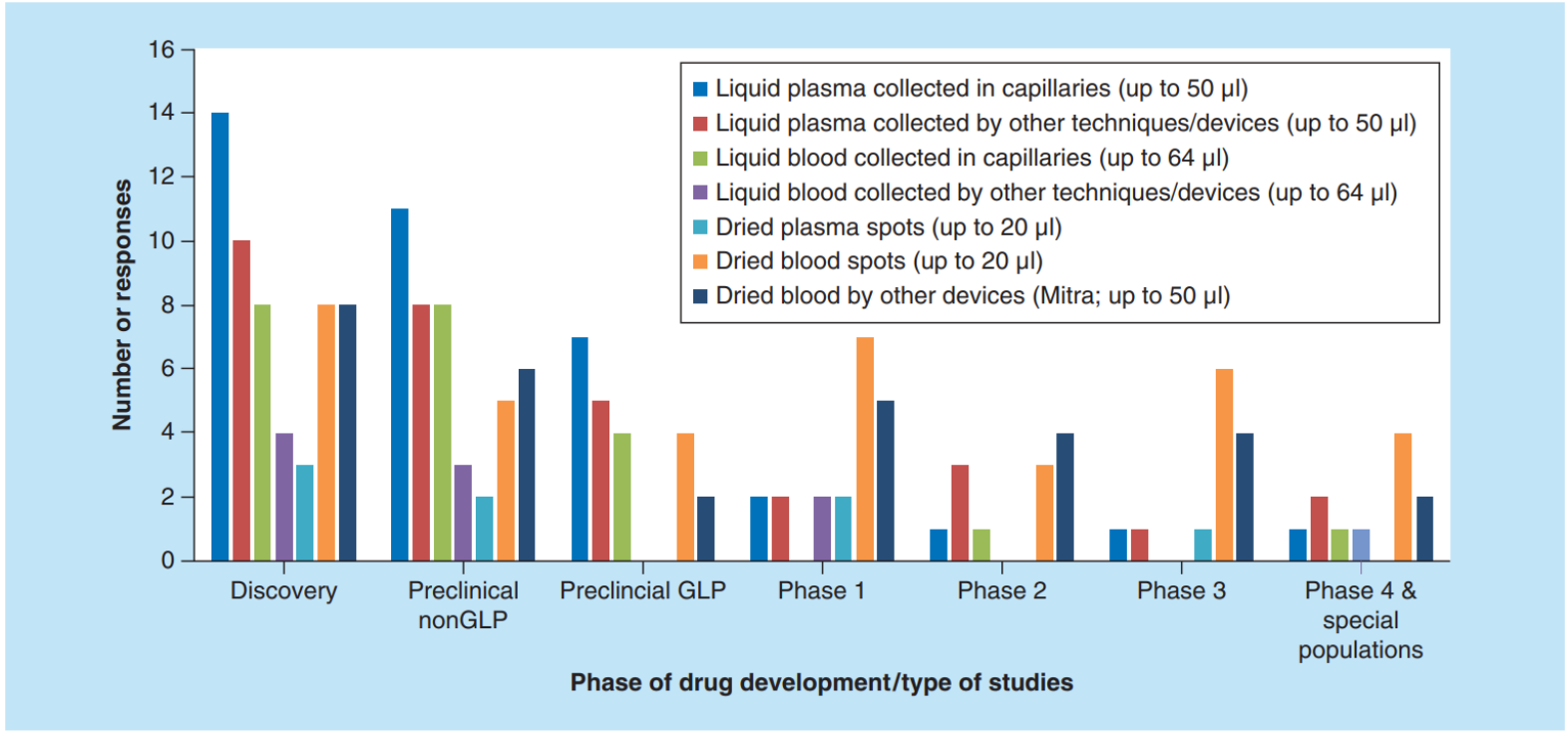


Figure 1. Utilization of different microsampling approaches for studies at various stages of drug development. The data represents responses from 39 different pharmaceutical companies and contract research organizations.

Patel *et al*. (2019) Microsampling for quantitative bioanalysis, an industry update: output from an AAPS/EBF survey. *Bioanalysis* **11(07)** 619-628

Microsampling in clinical trials

Numerous publications on validating methods

Fewer publications with clinical data

Merck: Publications and presentations

Eli Lilly: Publications and presentations

Pfizer: Publications & presentations

Wed RapidFire
VAMs for mAb and NAB assay

1. Xu Y, Woolf EJ, Agrawal NGB, Kothare P, Pucci V, Bateman KP. Merck's perspective on the implementation of dried blood spot technology in clinical drug development – why, when and how. *Bioanalysis* 5(3), 341–350 (2013).
2. Kothare AP, Bateman KP, Dockendorf M *et al*. An integrated strategy for implementation of dried blood spots in clinical development programs. *AAPS J.* 18(2), 519–527 (2016).
3. Dockendorf MF, Murthy G, Bateman KP *et al.* Leveraging digital health and outpatient sampling technologies in clinical drug development: a Phase I exploratory study. *Clin. Pharmacol. Ther.* 105(1), 168–76 (2019).
4. Wickremsinhe ER, Lee LB. 2021. Quantification of abemaciclib and metabolites: evolution of bioanalytical methods supporting a novel oncolytic agent. Bioanalysis. 13(9):711-724
5. Wickremsinhe ER, Decker RL, Lee LB, Lelle E, Carlton LA, Keller SY, Prakash A. 2023. Microsampling in pediatric studies: pharmacokinetic sampling for baricitinib(Olumiant™) in global pediatric studies. Bioanalysis 15:621-636
6. Wang KX, Potts D, Gonzales P, Smith I, Shi H, and Kavetska O. 2022 Bioanalytical method validation and sample analysis for nirmatrelvir in dried blood collected using Tasso-M20 device, Bioanalysis 20:1305-1315

Microsampling in clinical trials

Studies on ClinicalTrials.gov that has the words “dried blood” in the Study Title

Showing: 1-48 of **48** studies 100 studies per page

Row	Saved	Status	Study Title
1	☐	Recruiting	**Dried Blood** Spot Testing for At Home Health
2	☐	Completed	**Dried Blood** Spots for SARS-CoV-2 Serology (COVID-19)
3	☐	Completed	**Dried Blood** SPOT Analysis of Everolimus in Cancer Patients (SPOT-study)
4	☐	Completed	CD71 in **Dried Blood** Spots in Healthy Males
5	☐	Completed	Saliva and **Dried Blood** Spot Therapeutic Drug Monitoring for MDR-TB in Tanzania
6	☐	Recruiting	**Dried Blood** Spot Testing of CMV Detection in HCT Recipients
7	☐	Completed	Evaluation of **Dried Blood** Spot for HCV RNA Testing
8	☐	Recruiting	The Clinical Validation of a **Dried Blood** Spot Method for Vancomycin and Creatinine
9	☐	Recruiting	Screening for Hypercholesterolemia in Children Using **Dried Blood** Spot
10	☐	Completed	A Study to Assess the Feasibility of Non-invasive **Dried Blood** Sampling
11	☐	Recruiting	HIV Outpatient Monitoring Evaluation Through Self-collection of **Dried Blood** Spots
12	☐	Completed Has Results	The Cellular Pharmacology of F-TAF in **Dried Blood** Spots
13	☐	Completed	Assessment of **Dried Blood** Spot Thyroglobulin and Urinary Iodine Concentration in Pregnant Women
14	☐	Completed Has Results	Pre-Exposure Prophylaxis (PrEP) Adherence Monitoring Using **Dried Blood** Spots
15	☐	Completed	Clinical Validation of the Fluispotter System for Serial Sampling of Venous **Dried Blood** Spots
16	☐	Recruiting	The Mitopure Challenge to Detect Levels of Urolithin A in **Dried Blood** Spots
17	☐	Completed Has Results	Use of Antiretroviral (ARV) Drug Levels in **Dried Blood** Spots (DBS) to Assess and Manage ART Adherence in South Africa
18	☐	Recruiting	Impact of Acute and Chronic Inflammation on Cytochromes P450 Activity Measured With **Dried Blood** Spot
19	☐	Completed	Dexamphetamine Sustained Release Pharmacokinetics and Clinical Validation of **Dried Blood** Spots
20	☐	Completed	Clinical Validation of a **Dried Blood** Spot Method for Analysis of Immunosuppressives and Antifungals in Pediatrics
21	☐	Completed	Therapeutic Drug Monitoring (TDM) of Cyclosporine in Kidney Transplant Patients by **Dried Blood** Spot Assay. Interest and Feasibility.
22	☐	Completed	Integrating Hepatitis C Screening With **Dried Blood** Spot Testing Into Colorectal Cancer Screening
23	☐	Completed	Cocktail Approach for Cytochrome P450 and P-glycoprotein Activity Assessment Using **Dried Blood** Spot

Trials using microsampling:

- Dried blood spot (DBS)
- VAMS (Mitra®)
- Tasso M20 : dried capillary blood
- Tasso+ : capillary blood

Row	Saved	Status	Study Title
1	☐	Unknown †	**Mitra** v Fingerprick Tacrolimus Creatinine
2	☐	Completed	A Study to Compare the Finger Prick Whole Blood **MITRA** Assay Method With the Established Venepuncture Whole Blood Method for Quantitative Determination of Tacrolimus Blood Concentrations in Transplant Patients

1	☐	Not yet recruiting	**Microsampling** Assays for Immunosuppressive Drugs in Children
2	☐	Not yet recruiting	**Microsampling** Approach for Monitoring of Kinase Inhibitor Targeted Therapies
3	☐	Completed	Tacrolimus **Microsampling**
4	☐	Unknown †	Mitra v Fingerprick Tacrolimus Creatinine

Row	Saved	Status	Study Title
1	☐	Completed Has Results	**Tasso**-SST OnDemand Comparator Pilot Study
2	☐	Recruiting	ALT Routinely Recorded Remotely: A Comparator Study of Liver Function Tests Using the **Tasso**+ to Venipuncture.

Note: this list may not be current

Microsampling Liquid Blood

Dried blood suitable for most PK assays

But … can we collect <u>liquid blood</u> (serum, plasma)

The new “vacutainers”

Evaluate Vantage March 04, 2020

Becton Dickinson out for blood with new partnership

The BD device will be able to harvest a useable quantity of blood without requiring the finger to be squeezed, Mr Allen says, guarding against haemolysis. He was unable to give details of the design of the

Is Blood = Blood ?

- **Is IV blood = finger stick blood?**
- **How do you establish concordance?**
- **Does the sampling site matter?**
- **What would the FDA say?**

- *Land O'Lakes Workshop on Microsampling: Enabling Broader Adoption. 2020. AAPSJ 22:135*
- *ICH M10 Guidelines on Bioanalytical Method Validations*
- *CLSI guideline EP09c*

What else can you do with microsampling

PK ☑

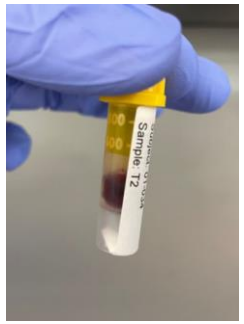
Routinely used clinical tests:

- Chemistry (Chem 14)
- Hematology (CBC)
- Other panels – liver, lipids
- Inflammation markers (CRP)
- Cardiac markers (NTproBNP)
- A1C
- Thyroid function
- Immunosuppressant drugs

Using a small volume (microsample)

Can we conduct routine blood tests with a microsample using the same analytical method/technique/instrument?

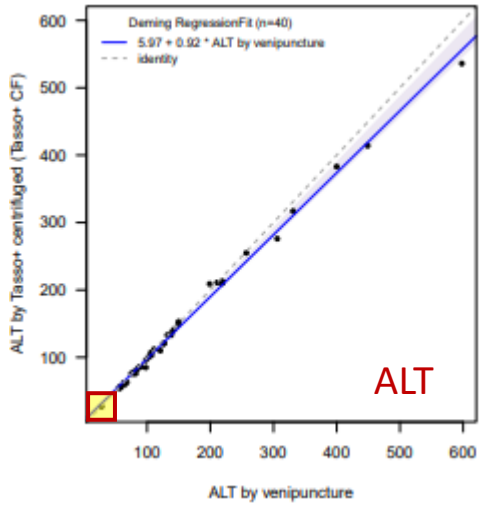
300 µL blood

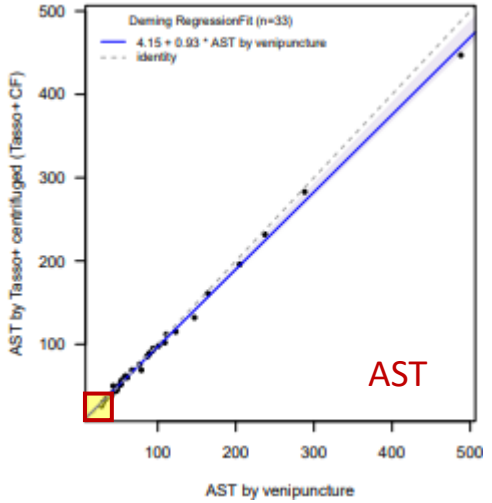


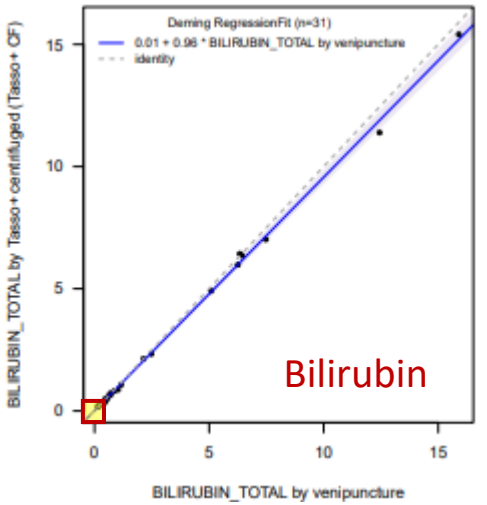
3 mL blood

Monitoring patients with abnormal liver chemistry

Serum







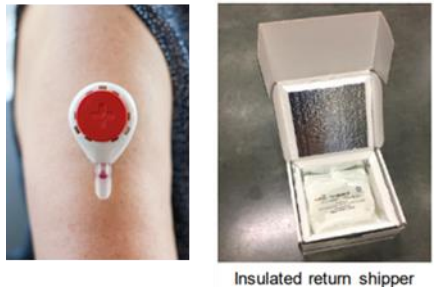
Approx upper limit of normal

15 analyte panel

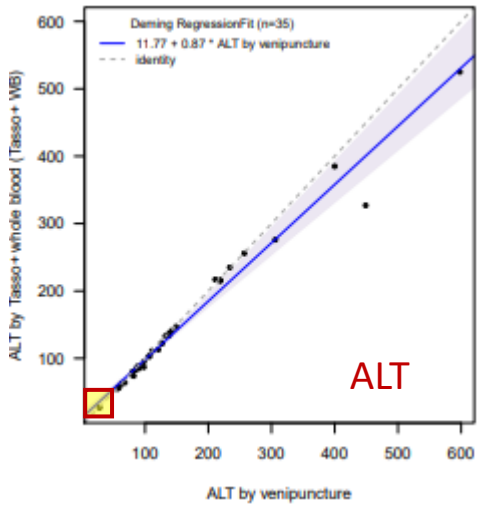
Wickremsinhe et al 2022. Standard Venipuncture vs a Capillary Blood Collection Device for the Prospective Determination of Abnormal Liver Chemistry. J Appl Lab Med. DOI:10.1093/jalm/jfac127

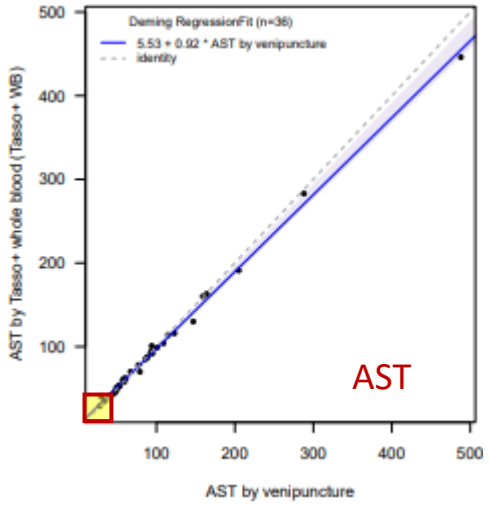
Monitoring patients with abnormal liver chemistry

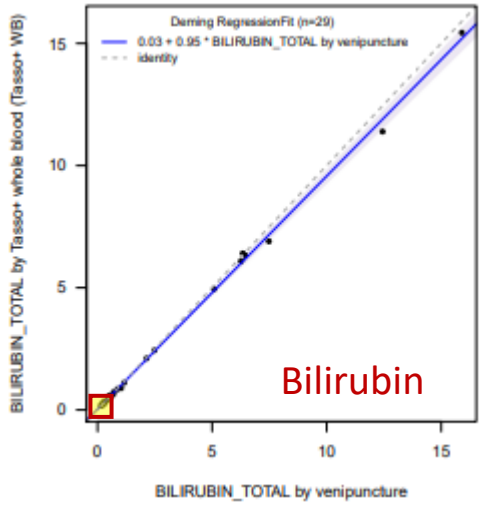
Refrigerated Blood



Insulated return shipper







Approx upper limit of normal

15 analyte panel

Wickremsinhe et al 2022. Standard Venipuncture vs a Capillary Blood Collection Device for the Prospective Determination of Abnormal Liver Chemistry. J Appl Lab Med. DOI:10.1093/jalm/jfac127

Monitoring patients conveniently (and frequently)

One blood draw at a time ….blood drawn at home

Vendors / Manufacturer / Service Providers

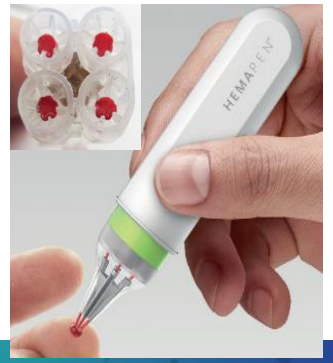
- Approval of devices (FDA, CE mark, etc.) – available/approved globally?
- Approval of specific tests/panels – FDA, CAP/CLIA labs
- Provide Kits and Training info
- Seamless integration with established workflows
- Sample ordering & tracking: collection time/date











Devices and uses

Vendor	Brand Names	Matrix	Volume	Precise Volume Collection	Sampling Type	Available for Purchase	Websi
Ahlstrom	BioSample/TFN	dried blood	70 uL	N	lancet finger stick	Y	htt ://www.ahlstrom.c
Ahlstrom	Gensaver 2.0	dried blood	125 uL	N	lancet finger stick	Y	htt s://www.ahlstrom
Ahlstrom	HemaSep	dried plasma	100/50 uL (punch/trip	N	lancet finger stick	Y	://www.ahlstrom.c a-sciences-and-la
BD	Microtainer Blood Collection Tubes	liquid blood (Hep, EDTA, serum)	250-500 µL	N	lancet finger stick	Y	https://ww
Capitainer	Capitainer®B	dried blood	2 x 10 µL, or 2 x 50 µL	Y	lancet finger stick	Y	https://cap
Drawbridge Health	OneDraw	dried blood	2 x 75 µL	Y	lancet upper arm	Y	https://www.draw
Greiner Bio-One	MiniCollect® Blood Collection Tubes	liquid blood (Coagulation,	0.25 – 1.0 ml	N	lancet finger stick	Y	https://ww
Health ID	Health ID PSD	dried plasma	4-5 drops of blood	N	lancet finger stick	Y	https://www.cl
HemaXis	HemaXis DB10	dried blood	4 x 10 µL	Y	lancet finger stick	Y	https://her
HemaXis	HemaXis DX	dried plasma	2 x 5 µL	Y	lancet finger stick	N	https://her
Loop Medical	Onflow	liquid blood (Hep, EDTA, serum)	up to 1.4 mL	N	lancet upper arm	N	https://www.loo
Neoteryx, brand of Trajan Scientific	Mitra VAMS	dried blood	2 or 4 x 10, 20 & 30 µL	Y	lancet finger stick	Y	https://www.r
Neoteryx, brand of Trajan Scientific	hemaPEN	dried blood	3 x 2.74 µL	Y	lancet finger stick	Y	https://www.r
Preci Health*	PBS-1000	liquid blood	150 µL - 2 mL	N	lancet upper arm	Y	https://prec
Qiagen	QIAcard Bloodstain	dried blood	1-4 x 20-125 µL	N	lancet finger stick	Y	https://www.q de/products/f
Qiagen	QIAcard FTA DMPK-C	dried blood	1-4 x 20-125 µL	N	lancet finger stick	Y	https://www.q de/products/f
RedDrop Dx	RedDrop Dx	liquid blood and plasma	600 µL	N	microneedle upper arm	N	https://www.re

Qiagen	QIAcard FTA DMPK-C	dried blood	1-4 x 20-125 µL	N	lancet finger stick	Y	https://www.q de/products/f
RedDrop Dx	RedDrop Dx	liquid blood and plasma	600 µL	N	microneedle upper arm	N	https://www.re
Revvity (nee PerkinElmer)*	226	dried blood	4 x	N	lancet finger stick	Y	://www.perkinelm analysis-card-pa
Rhinostics	VERIstic	dried blood	10 & 50 µL	Y	lancet finger stick	Y	https://rhin
Roche	Cobas Plasma Separation Card	dried plasma	140 µL	N	lancet finger stick	Y	tics.roche.com/gl plasma-separ
Spot On Me	Spotonme	liquid plasma	up to 600 µL	N	lancet finger stick	N	https://spoto
Spot On Sciences*	HemaSpot HD	dried blood	5 drops	N	lancet finger stick	Y	https://www.spot
Spot On Sciences*	HemaSpot HF	dried blood	2 drops in 8 wedges	N	lancet finger stick	Y	https://www.spot
Spot On Sciences*	HemaSpot SE	dried plasma	5 drops	N	lancet finger stick	Y	https://www.spot
Tasso	Tasso+	liquid blood (Hep, EDTA, serum)	200-600 µL	N	lancet upper arm	Y	https://www.t
Tasso	Tasso-M20	dried blood	4 x 17.5 µL	Y	lancet upper arm	Y	https://www.t
Tasso	TassoOne Plus	liquid blood (Hep, EDTA, serum)	200-600 µL	N	lancet upper arm	Y	https://www.t
Telimmune (nee Noviplex)*	Telimmune Plasma Separation Cards	dried plasma	25-60 µL	N	lancet finger stick	?	https://www.te
Whatman*	FTA DMPK A, B & C	dried blood	4 x 10-20 µL	N	lancet finger stick	Y	saaldrich.com/GE
Winnoz	Haiim	liquid blood	500 µL - 1 mL	N	lancet finger stick	Y	https://wi
YourBio	TAP Micro / TAP II	liquid blood (Hep, serum)	up to 700 µL	N	microneedle upper arm	Y	https://yourb
YourBio	TAP Micro Select	liquid blood (Hep, EDTA, serum,	up to 700 µL	N	microneedle upper arm	Y	https://yourb

[Blood Samplers | PCSIG]

Technologies “needed” for Home Sampling

Collection, processing and shipping

- Refrigerated shipping (savENRG COOL Pack)
- Home centrifuge
- Centrifuge shipper

Electronic data capture (on device)

- Patient ID
- Time & Date
- Sample tracking (chain of custody)
- Shipping temp & humidity
- “smart technologies”

Pics provided by Tasso

Bioanalytical challenges (for PK)

Preparation of Std curves and QCs

- Fresh blood (refrigerated?)
- Anticoagulant
- Manual effort
- Select/validate appropriate Hct range
- Addition of stabilizers (enzyme inhibitors, pH)

Addition of IS – in extraction solvent, pretreated

Interferences – due to device/collection matrix

More time and effort needed in BioA lab

- Not in 96-well format

Overall BioA cost higher ?

Issues with small volumes

Assay sensitivity

Losses due to “device/capillary”

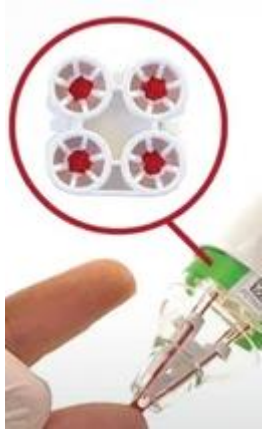
- Adsorption, evaporation

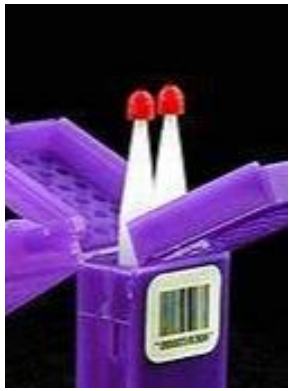
Accuracy of sample volume

- Lot-to-lot variability

Contamination

- Cross-contamination

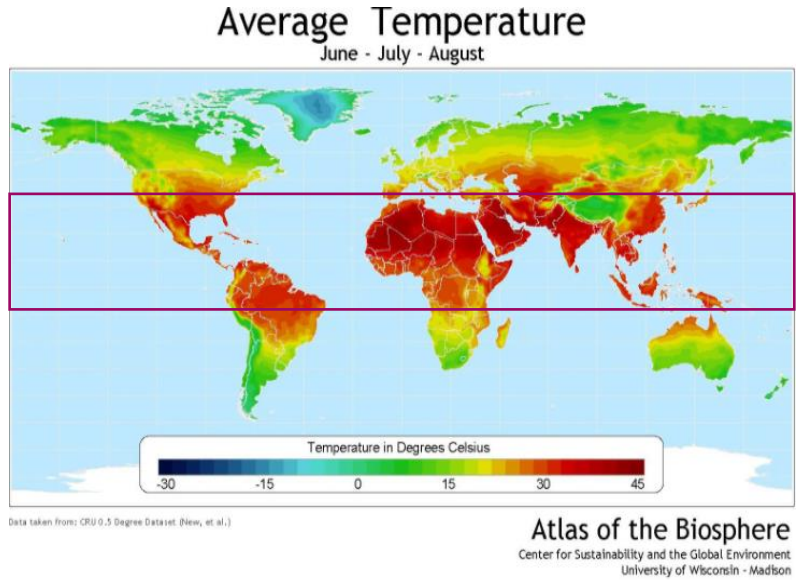


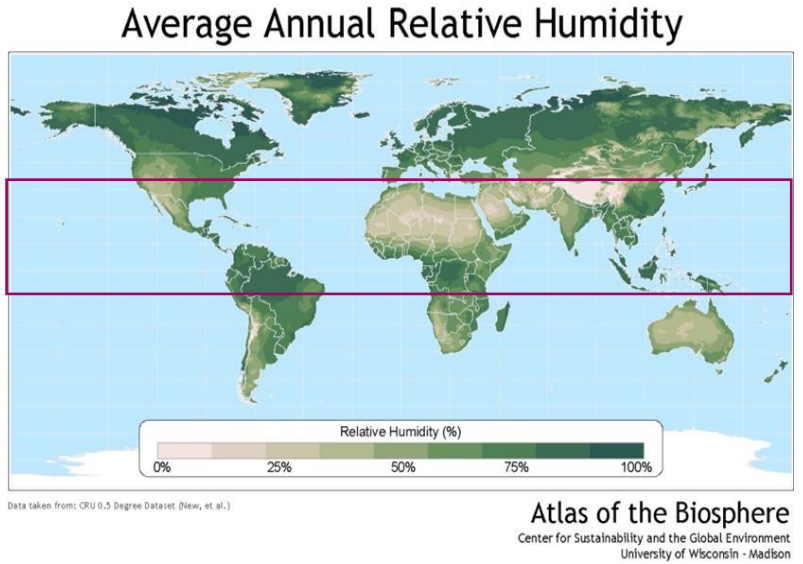


Stability Experiments

<u>Additional stability experiments</u>

- Drying time/conditions
- Storage at home
- Storage at clinic
- Shipping – local, international





Patient centricity – why has it taken so long

- Acceptance by stakeholders
  - **health authorities**, healthcare providers, **laboratories**, etc.
- Acceptance by **patients** – testing by self and/or at home
- Logistics – available commercially, globally
- Integration with established workflows
- Skepticism
- Resistance to change
- Cost
- Privacy concerns
- First followers?

Disruptive innovation

Clinical site | Central Lab | Kits | **Sampling** | Analysis | Reporting

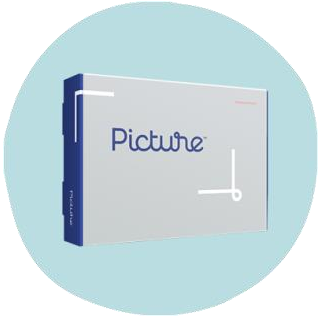
Its going to take a village…..

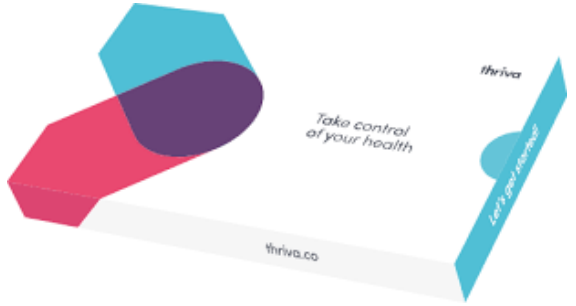
…and one BLOOD draw at a time

- Multiple stakeholders
- Patient Centric Sampling Interest Group (not-for-profit organization that brings together a variety of interested parties who wish to develop and promote the use of patient centric sampling technologies for blood, plasma and other human matrices to better facilitate the advancement of human healthcare and well-being)
  Home Sampling | Patient Centric Sampling Interest Group (pcsig.org)
- AAPS microsampling and patient centric sampling working group
- IHI (EC): Patient-centric blood sample collection to enable decentralised clinical trials and improve access to healthcare
  Funding & tenders (europa.eu)

What COVID did (for home sampling)

- Remote health monitoring became a necessity during the COVID-19 pandemic
- Increased patient demand for “remote applications”





Home blood testing (its already here)

Patient centricity….

Point-of-care devices

Home diagnostics

Non-invasive (bloodless)

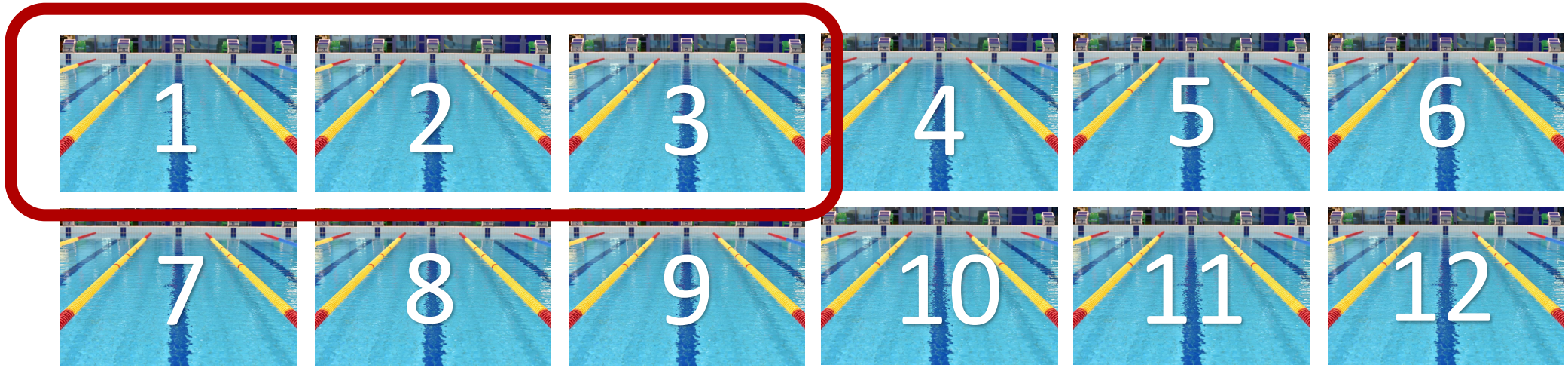
- Video based AI (vital signs, Hb, A1C, cholesterol, etc.)
- Imaging for WBC
- Etc.

Abaxis | Better at Point of Care
HemoScreen - Complete Blood Count (CBC) Diagnostic Analyzer (pixcell-medical.com)
Sight OLO | Sight Diagnostics (sightdx.com)
Video-based Vital Signs Monitoring – Binah
Leuko

Make patient centricity a reality….

…. because we are all patients at some point in time

Trivia: How much blood is collected by the Red Cross



Red Cross collects annually = 13.6 million units = 7.1 million Liters

Source: American Red Cross web site

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Questions

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