An Efficient Non-invasive Sample Collection Technology for Various Population Segments

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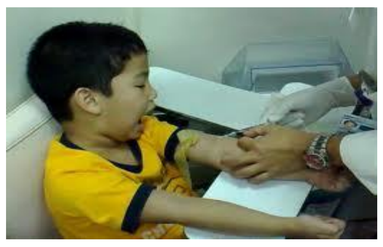
1. Introduction

Deciphering genomes/proteomes will not only help in researching hereditary predisposing factors but also contribute to designing drugs with higher efficacies. However, to arrive at this level of understanding we need to collect data in communities locally and globally. One of the major problems we face to achieve these objectives is volunteer recruitment for sample collection. Non-invasive sample collection represents the best option over blood in many ways:

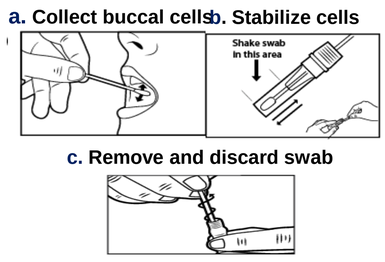
- Better volunteer compliance
- No cold chain involvement for transport and storage
- Allows self –collection and does not require expertise

However, current non-invasive collection methods suffer from insufficient DNA yields, low quality, and impractical usability for the different segments of the population.

Invasive vs. Non Invasive Sampling



Invasive Sample Collection (Blood)
- Painful
- Requires expertise
- Expensive handling infrastructure (cold chain transport and storage)
- Low compliance



iSWAB-DNA Non-invasive Sampling
- Painless
- Enables self or assisted collection
- Room temperature storage and transport
- No cold chain involvement

2. Objective

- Provide a non-invasive sample collection technology alternative to blood that is compatible with simple and complex genomics downstream applications

The iSWAB Sample Collection Technology

- The squeezing insert allows the full release and concentration of cells from multiple swabs per patient
- Unique design eliminates the need for swab transport
- Immediate stabilization of collected sample at the point of collection

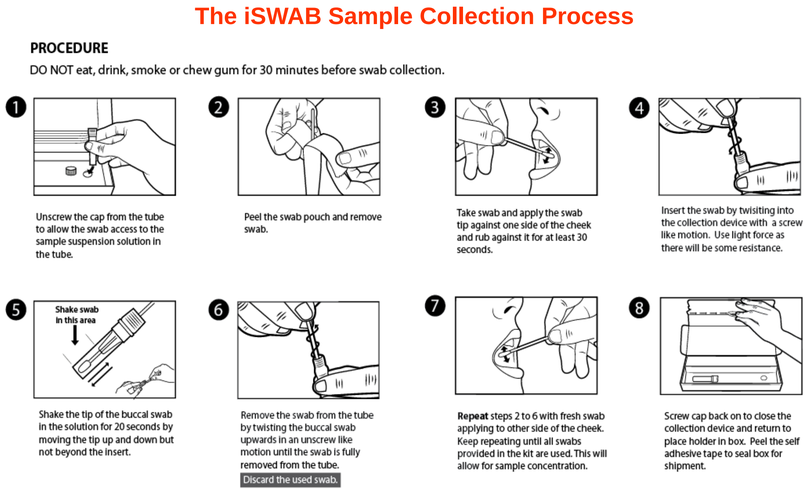
3. Methods

❖ **Sample collection**:

(i) Invasive: Drawing blood by a trained phlebotomist

(ii) Non-invasive: Self collection of **buccal cells** using the iSWAB sample collection device.

The iSWAB Sample Collection Process



❖ **DNA Extraction**:

- Genomic DNA extraction was performed using QIAamp blood extraction kit.

❖ **DNA quantification**:

- DNA yields where confirmed with 3 different methods: Nanodrop, picogreen assay and primers specific for the human beta actin gene were used to relatively quantitative the levels of human genomic DNA.

❖ **Bacterial DNA quantification**:

- Bacterial DNA content was determined by using primers specific for the 6S ribosomal RNA gene.

❖ **PCR and Next Generation Sequencing (NGS)**

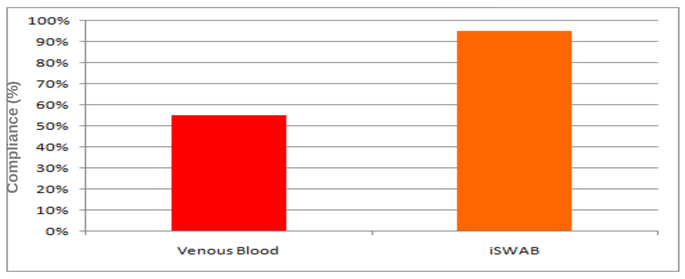
- Direct PCR: 0.5 µL from iSWAB collected sample was directly added, without extraction, to a standard PCR master mixture. The samples where amplified using an MJ Research Thermal cycler.

❖ **NGS**:

- Purified gDNA from both blood and iSWAB was used for the library generation and processing on MiSeq from Illumina.

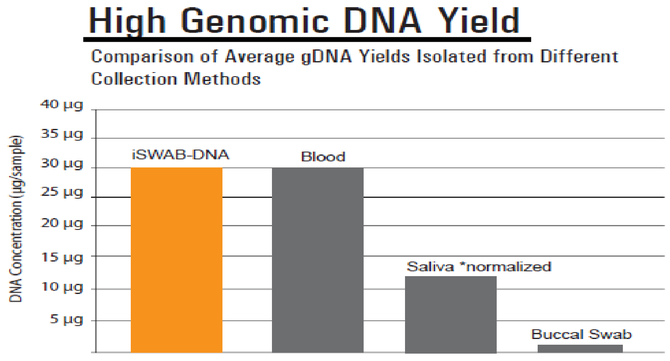
4. Results

High Collection Compliance

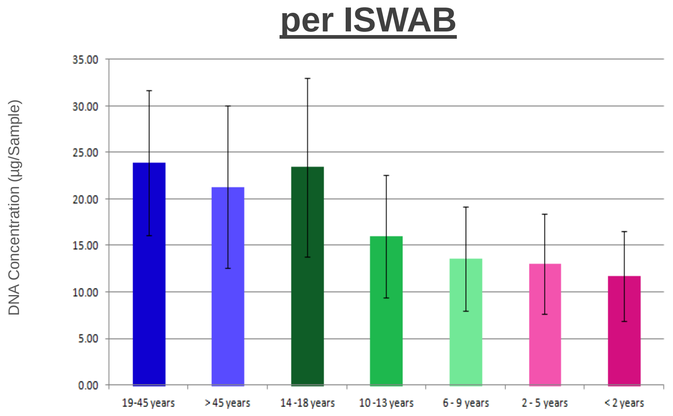


These numbers were generated based on the response of 100 volunteers in reporting to designated locations to submit invasive and non-invasive samples.

High Genomic DNA Yield

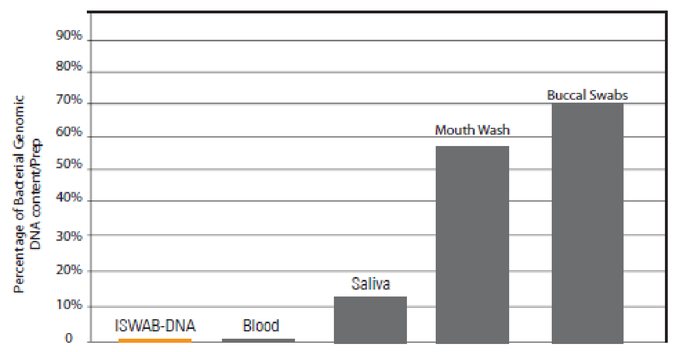


DNA Yield from Various Age Groups per ISWAB



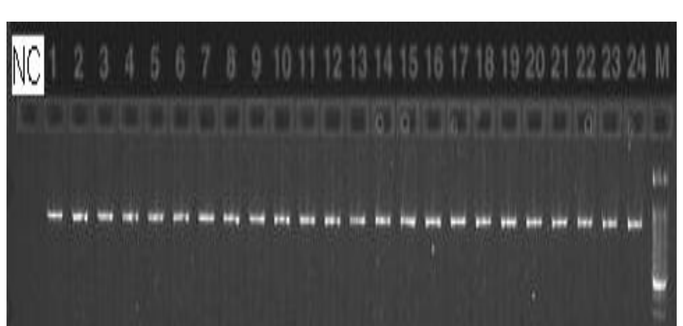
Age groups over 14 years old performed self collection. Samples from children under 14 were collected by a parent. Sample collection was performed at various times throughout the day.

Low Bacterial Contamination (< 1%)



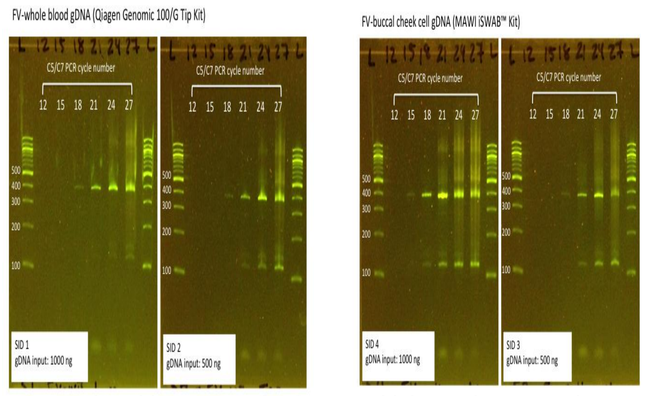
Primers specific for the 16S ribosomal RNA gene were used as a simple method to obtain relative quantiification of bacterial DNA.

No PCR Inhibition



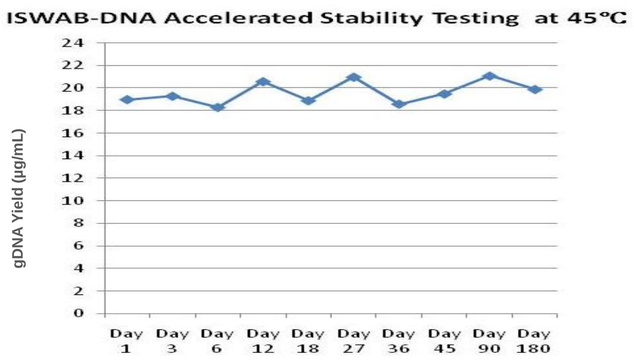
Genomic DNA isolated from iSWAB-DNA was used as template to amplify a 300bp region of human genomic DNA (beta actin). 4% Agarose gel. 5 µl loaded. M: 25bp DNA marker, NC: Non-template control, lanes 1-24 replicates of the iSWAB sample.

Equivalent Performance to Blood gDNA in Illumina's Targeted NGS Libraries



The proportional increase of PCR sensitivity to the gDNA input from iSWAB-DNA device is an indication of very limited PCR inhibitor carryover.

iSWAB-DNA Collected Samples are Stable Over 5 Years at Room Temperature Storage

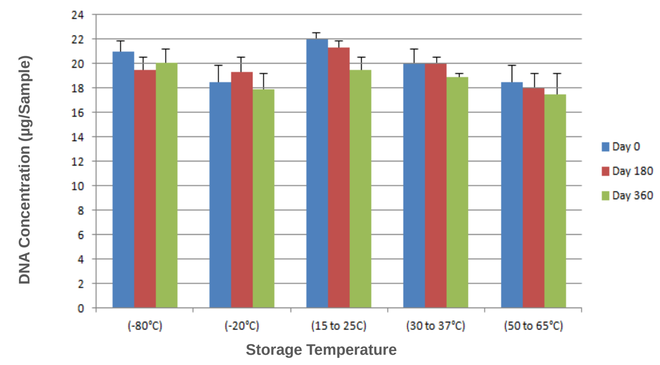


Accelerated Stability Testing Time Conversion Table

45°C*	Day 1	Day 3	Day 6	Day 12	Day 18	Day 27	Day 36	Day 45	Day 90	Day 180
RT	10 Days	1 Month	2 Months	4 Months	6 Months	9 Months	12 Months	15 Months	2.5 Years	5 Years

*45°C 3 days is equivalent to 1 month stability at RT

iSWAB Preservation Capability Maintains the Integrity of gDNA at a Wide Range of Temperatures (-80°C to 65°C)



5. Summary and Conclusions

- The high compliance and ease of use of iSWAB for all population segments including infants, toddlers, and elderly allows for achieving a better research outcome towards the understanding of genetic risk factors across various generations within families .
- iSWAB gDNA quality is comparable to blood allowing for field based collection and reducing energy costs from cold chain involvement.
- Proprietary tube insert design and lysing buffer yields up to 30µg of double-stranded, long fragment DNA ideal for simple and complex downstream genomic applications.
- Less than 1% bacterial genomic DNA contamination results in pure sample DNA leading for achieving more usable data.
- Swab-free sample transport reduces sample processing time without compromising sample integrity, resulting in faster turn around time.
- Long-term room temperature stability reduces sample storage and transport costs by eliminating cold chain requirements.

iSWAB implementation reduces operational cost significantly ($100Ks to $1000Ks)

Storage space - Energy savings
Sample collection and processing time