# A capillary blood-based self-collection method for monitoring HIV viral load during ART interruption

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## Abstract

**Background:** Multiple barriers limit participation of people with HIV (PWH) in studies in which frequent viral load (VL) monitoring is required such as cure studies involving a treatment interruption (ATI). Convenient, home-based VL testing may increase equitable participation. Here we report a novel VL test based on capillary blood collection, comparing its specificity and sensitivity to conventional clinic-based plasma-based VL (pVL)

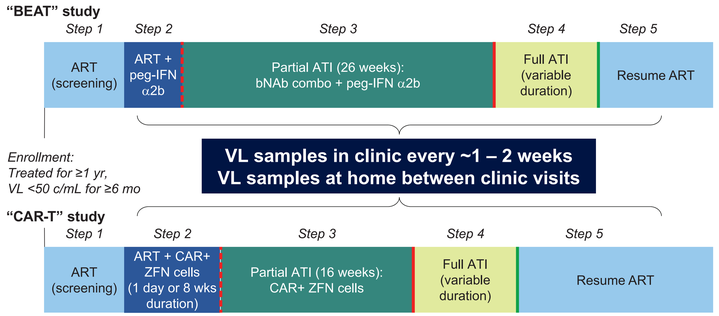
**Method:** We enrolled 21 PWH (5% female, 67% African American, mean age of 51 years) undergoing planned ATIs as part of the BEAT-HIV trial (NCT03588715). At contiguous visits (mean 20.5), we collected a) capillary blood using two 4-well Tasso-M50 devices, and b) matched plasma samples. Between visits, participants self-collected capillary blood using 2 devices that were mailed back (home collection). We employed automated RNA extraction and duplicate RT-qPCR readouts with dual LTR/GAG FAM-labeled primers. All M50 samples underwent qPCR in duplicate. We present the sensitivity and specificity of Tasso-M50 monitoring for detecting viral rebound

**Results:** The devices were well accepted, with a collection failure rate <10%. We analyzed a total of 5392 M50 PCR reads (3058 clinic, 2334 home collection). Among the 14 participants where M50 background levels could be determined from ≥4 weeks' suppressive therapy, M50 VL 2x above background were predictive of matched pVL ≥200 c/mL. Thirteen of 14 (93%) participants experienced an increase in M50 VL at the collection immediately following pVL rebound ≥200 c/mL (median increase 9-fold, range 1.8- to >1000-fold); the remaining participant experienced an increased M50 VL at the subsequent collection (to 1.6-fold above background). An M50 VL ≥2x background was always followed by pVL rebound ≥200 c/mL within 4 weeks

### Conclusions

- Our dried blood assay showed good negative predictive value for pVL ≥200 c/mL and ≥1000 c/mL in a cohort of PWH undergoing treatment interruption. This suggests that, upon clinical validation, the assay could be used for home viral load monitoring during ATIs
- This approach could enhance equitable participation in HIV research by minimizing participants' visit burden. The study of other potential applications, such as monitoring new infections in prophylaxis studies or assessing changes in residual cell-associated HIV in cure studies, is warranted

## Figure 1. Clinic + home dried blood collection to monitor viral rebound in 2 ART interruption studies



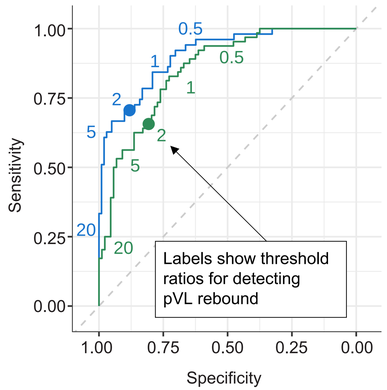

- Fully enclosed capillary blood collection
- Two devices used per timepoint (~400 µL collection)
- N = 21 participants, mean of 20.5 clinic visits each (every 1 - 2 weeks); devices distributed for home collection between visits
- Background dried blood signal (during suppressive therapy) could be established for 14 participants
  - Ability to detect viral rebound (comparing to reference plasma VL) evaluated for these 14 participants
- Total analyzable dried blood VL reads: 5392 (3058 clinic, 2334 home, avg of 6 reads obtained per device)
- Tasso-M50 is a prototype device investigated in this study; Tasso-M20 and Tasso+ devices pictured here

## Table 1. Tasso-M50 device distribution, collection, and troubleshooting

| | | Total | | Clinic collection | | Home collection | |
|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % |
| Distributed | | 1862 | 100% | 907 | 100% | 955 | 100% |
| Received in lab | | 1750 | 94.0% | 887 | 97.8% | 863 | 90.4% |
| Unusable devices: | No wells filled | 191 | 10.3% | 82 | 9.0% | 109 | 11.4% |
| | Film on | 108 | 5.8% | 15 | 1.7% | 93 | 9.7% |
| Usable devices | | 1451 | 77.9% | 790 | 87.1% | 661 | 69.2% |

## Figure 2. Evaluation of background-corrected dried blood VL to detect plasma viral rebound

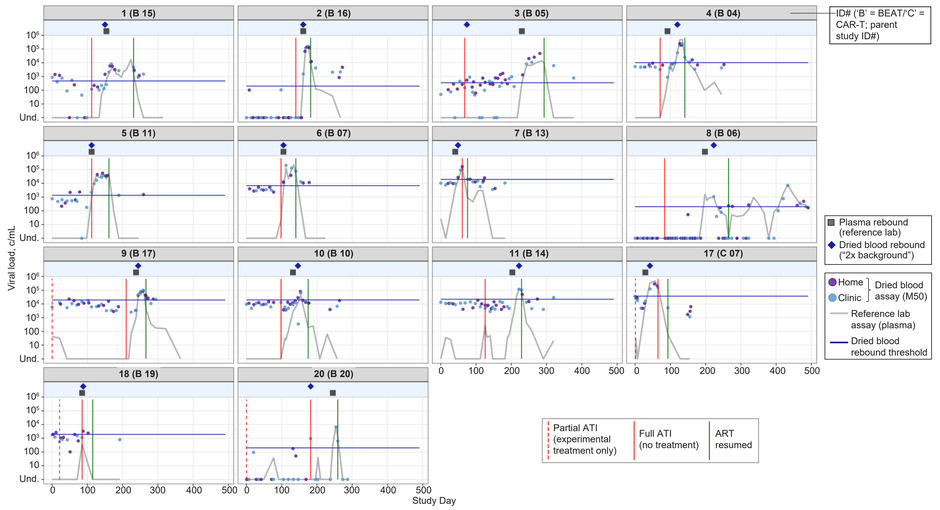
ROC curves using ratio (dried blood VL/background[a]) to detect plasma rebound
≥200 c/mL (green) or
≥1000 c/mL (light blue)




| | | Plasma rebound defined at: | |
|---|---|---|---|
| | | ≥200 c/mL | ≥1000 c/mL |
| AUC (0.5 = random guess; 1 = perfect detection) | | 0.85 | 0.91 |
| Proposed rule: Call rebound if dried blood VL ≥2x background[a] | Sensitivity | 66% | 71% |
| | Specificity | 81% | 88% |
| | PPV | 71% | 75% |
| | NPV | 76% | 86% |

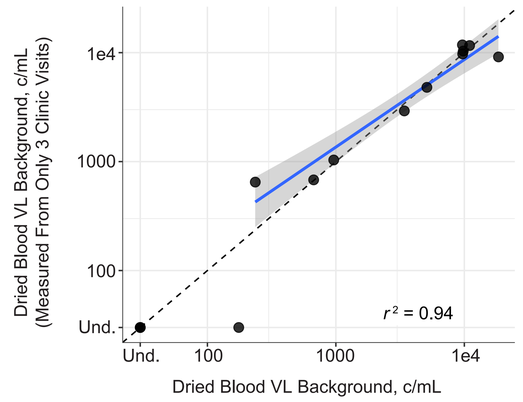
[a]If background value is less than half of plasma rebound threshold (200 or 1000 c/mL), it is set to half the rebound threshold for purpose of this calculation.

## Figure 3. Dried blood VL generally increases ≥2x above background upon plasma rebound (≥200 c/mL)




- 13 of 14 participants (all except ID #4): Dried blood VL exceeds ≥1x background levels no later than 1 sampling time after plasma rebound
- Performance of "≥2x background" dried blood threshold to detect rebound:
  - **On time** in 10 of 14: Dried blood VL first exceeds 2x background within ±1 sampling time of plasma rebound (≥200 c/mL)
  - **Early** in 2 of 14 (ID #3, #20): Earlier dried blood "2x" rebound signal, followed by another increase when plasma rebound occurred
  - **Delayed** in 2 of 14 (ID #4, #10): Delayed dried blood "2x" rebound signal (3 to 5 times after plasma rebound = 14 to 28 days)

## Figure 4. Individual participants' dried blood background VL is stable (reflecting viral reservoir size) and can be measured from just 3 visits (see poster #1091)




- Dried blood background VL is stable: similar whether measured from entire virally suppressed period (x-axis) or just 3 clinic visits (y-axis)
  - Total virally suppressed period used as background = 5 to 24 sampling timepoints in this cohort (median 12.5)

**Acknowledgements**

QC of code & dataset: Alejandra Herrera Reyes

Presented at CROI 2024; Denver, CO, USA; March 3-6, 2024.