ViveST™: A REVOLUTIONARY AMBIENT TEMPERATURE STORAGE AND TRANSPORTATION DEVICE FOR UTILIZATION IN INFECTIOUS DISEASE TESTING

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Introduction

Infectious disease monitoring often requires collection sites to ship biological specimens to reference laboratories for molecular based testing. Standard specimen storage and transportation methods have several disadvantages including temperature control and low-volume requirements.

Studies discussed here-in evaluate the use of ViveST, a transformational dried ambient matrix, for storage and transport of infectious plasma samples used with downstream molecular based viral load assays.

Methods

- For all testing described, infectious plasma (HCV, HIV-1 or HBV) was loaded onto ViveST, dried, capped and stored at ambient temperature.
- After recovery from ViveST, specimens were analyzed using the following commercially available FDA approved viral load assays:
  - RealTi*m*e HCV Assay (Abbott Molecular, Des Plaines, IL)
  - COBAS® TaqMan® HCV Test, v2.0 for use with the High Pure System (Roche Diagnostics, Indianapolis, IN)
  - RealTi*m*e HIV-1 Assay (Abbott Molecular, Des Plaines, IL)
  - COBAS® TaqMan® HIV-1 Test, v2.0 for use with the High Pure System (Roche Diagnostics, Indianapolis, IN)
  - RealTi*m*e HBV Assay (Abbott Molecular, Des Plaines, IL)
- To assess precision (inter- and intra-assay) for each analyte/assay combination, multiple aliquots of infectious plasma specimens (3 or 5 depending on assay/analyte combination) with varying viral loads (3 levels) were analyzed on 3 separate runs after storage (RT) on ViveST for up to 10 days.
- To assess linearity for each analyte/assay combination, a high titer infectious plasma sample was diluted in normal human plasma (7 levels). Each level was loaded onto ViveST in triplicate, stored for 7 days (RT), recovered and tested on a single run (n = 21 each analyte/assay combination). For comparison purposes, identical aliquots of frozen plasma were tested simultaneously.

Results (HCV Viral Load)

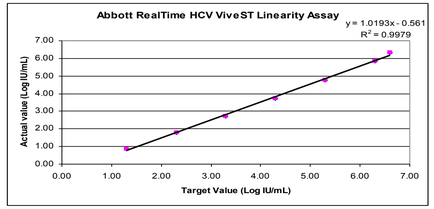
Abbott RealTi*m*e HCV

- Precision results are summarized in Table 1. HCV infectious samples processed through ViveST yielded reproducibility results with a standard deviation <0.10 LOG IU/mL (intra-assay) and <0.07 LOG IU/mL (inter-assay). The 95%CI were <±0.11 (intra-assay) and <±0.04 (inter-assay).
- Analysis of diluted samples from ~1 to ~6 LOG IU/mL demonstrated a direct proportional relationship between the dilution factor and the number of HCV copies reported with R^2>0.99 (see Figure1).

Table 1. ViveST_Abbott HCV Intra-assay and Inter-assay Precision

ViveST_Abbott HCV Intra-assay and Inter-assay Precision												
	Intra-assay precision									Inter-assay precision		
Concentration:	Low			Mid			High			Low	Mid	High
Timepoint (Day)	1	2	3	1	2	3	1	2	3			
Replicates (n)	3	3	3	3	3	3	3	3	3	9	9	9
Mean (LOG IU/mL)	2.21	2.18	2.22	3.71	3.63	3.63	5.16	5.03	5.10	2.20	3.66	5.10
Std Dev	0.08	0.03	0.10	0.04	0.05	0.02	0.01	0.05	0.02	0.07	0.05	0.06
95% CI	0.03	0.03	0.11	0.01	0.06	0.02	0.00	0.06	0.02	0.04	0.03	0.04

Figure 1. ViveST_Abbott HCV Analytical Measurement Range



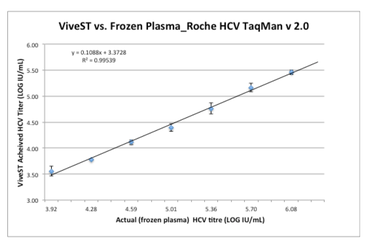
COBAS® TaqMan® HCV Test, v2.0

- Precision results are summarized in Table 2. HCV infectious samples processed through ViveST yielded reproducible results with a standard deviation of <0.15 LOG IU/mL (intra-assay) and <0.11 LOG IU/mL (inter-assay). The 95%CI were <±0.17 (intra-assay) and <±0.07 (inter-assay).
- Analysis of diluted samples from ~4 to ~6 LOG IU/mL demonstrated a direct proportional relationship between the dilution factor and the number of HCV copies reported with R^2>0.99 (see Figure 2).

Table 2. ViveST_Roche HCV Intra-assay and Inter-assay Precision

ViveST_Roche HCV Intra-assay and Inter-assay Precision												
	Intra-Assay Precision									Inter-Assay Precision		
Concentration	Low			Mid			High			Low	Mid	High
Run #	1	2	3	1	2	3	1	2	3			
Days Stored	1	3	7	1	3	7	1	3	7			
Replicates	3	3	3	3	3	3	3	3	3	9	9	9
Mean (LOG IU/mL)	3.65	3.59	3.48	4.17	4.22	4.06	4.48	4.49	4.38	3.57	4.15	4.45
Std Dev	0.15	0.04	0.07	0.13	0.04	0.07	0.01	0.03	0.09	0.11	0.11	0.07
95% CI	0.17	0.04	0.08	0.15	0.04	0.08	0.01	0.03	0.10	0.07	0.07	0.04

Figure 2. ViveST_Roche HCV Analytical Measurement Range



Results (HIV-1 Viral Load)

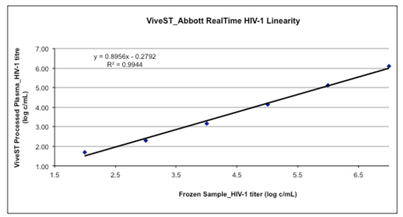
Abbott RealTi*m*e HIV-1

- Precision results are summarized in Table 3. HIV-1 infectious samples processed through ViveST yielded reproducibility results with a standard deviation <0.11 LOG c/mL (intra-assay) and <0.10 LOG c/mL (inter-assay). The 95%CI were <±0.10 (intra-assay) and <±0.05 (inter-assay).
- Analysis of diluted samples from ~1 to ~7 LOG c/mL demonstrated a direct proportional relationship between the dilution factor and the number of HIV-1 copies reported with R^2>0.99 (see Figure 3).

Table 3. ViveST_Abbott HIV-1 Intra-assay and Inter-assay Precision

ViveST_Abbott HIV-1 Intra-assay and Inter-assay Precision												
	Intra-assay precision									Inter-assay precision		
Concentration:	Low			Mid			High			Low	Mid	High
Run #	1	2	3	1	2	3	1	2	3			
Days Stored	3	7	10	3	7	10	3	7	10			
Replicates (n)	5	5	5	5	5	5	5	5	5	15	15	15
Mean (LOG c/mL)	2.71	2.56	2.66	3.64	3.58	3.60	4.72	4.61	4.62	2.65	3.61	4.65
Std Dev	0.06	0.08	0.11	0.06	0.03	0.06	0.03	0.09	0.05	0.10	0.06	0.07
95% CI	0.05	0.07	0.10	0.05	0.03	0.05	0.02	0.08	0.04	0.05	0.03	0.04

Figure 3. ViveST_Abbott HIV-1 Analytical Measurement Range



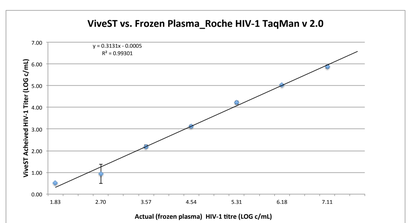
COBAS® TaqMan® HIV-1 Test, v2.0

- Precision results are summarized in Table 4. HCV infectious samples processed through ViveST yielded reproducible results with a standard deviation of <0.17 LOG c/mL (intra-assay) and <0.25 LOG c/mL (inter-assay). The 95%CI were <±0.19 (intra-assay) and <±0.16 (inter-assay).
- Analysis of diluted samples from ~1 to ~7 LOG c/mL demonstrated a direct proportional relationship between the dilution factor and the number of HCV copies reported with R^2>0.99 (see Figure 4).

Table 4. ViveST_Roche HIV-1 Intra-assay and Inter-assay Precision

ViveST_Roche HIV-1 Intra-assay and Inter-assay Precision												
	Intra-Assay Precision									Inter-Assay Precision		
Concentration	Low			Mid			High			Low	Mid	High
Run #	1	2	3	1	2	3	1	2	3			
Days Stored	1	4	7	1	4	7	1	4	7			
Replicates	3	3	3	3	3	3	3	3	3	9	9	9
Mean (LOG c/mL)	2.49	1.97	2.06	3.16	2.86	2.90	5.04	4.61	4.72	2.17	2.97	4.79
Std Dev	0.01	0.04	0.12	0.07	0.05	0.09	0.02	0.17	0.05	0.25	0.16	0.21
95% CI	0.01	0.04	0.14	0.08	0.07	0.10	0.02	0.19	0.06	0.16	0.10	0.14

Figure 4. ViveST_Roche HIV-1 Analytical Measurement Range



Results (HBV Viral Load)

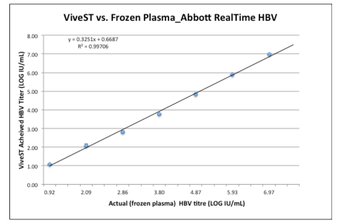
Abbott RealTi*m*e HBV

- Precision results are summarized in Table 5. HBV infectious samples processed through ViveST yielded reproducibility results with a standard deviation <0.13 LOG IU/mL (intra-assay) and <0.10 LOG IU/mL (inter-assay). The 95%CI were <±0.14 (intra-assay) and <±0.06 (inter-assay).
- Analysis of diluted samples from ~1 to ~7 LOG IU/mL demonstrated a direct proportional relationship between the dilution factor and the number of HBV copies reported with R^2>0.99 (see Figure 5).

Table 5. ViveST_Abbott HBV Intra-assay and Inter-assay Precision

ViveST_Abbott RealTime HBV_Intra-assay and Inter-assay Precision												
	Intra-Assay Precision									Inter-Assay Precision		
Concentration	Low			Mid			High			Low	Mid	High
Run #	1	2	3	1	2	3	1	2	3			
Days Stored	1	3	7	1	3	7	1	3	7			
Replicates	3	3	3	3	3	3	3	3	3	9	9	9
Mean (LOG IU/mL)	3.61	3.57	3.66	4.74	4.70	4.83	5.81	5.82	5.84	3.61	4.76	5.82
Std Dev	0.04	0.05	0.06	0.02	0.13	0.10	0.02	0.04	0.03	0.06	0.10	0.03
95% CI	0.04	0.05	0.07	0.02	0.14	0.11	0.03	0.04	0.03	0.04	0.06	0.02

Figure 5. ViveST_Abbott HBV Analytical Measurement Range



Conclusions

- These studies demonstrate ViveST's utility for storing and transporting infectious plasma for subsequent RNA and DNA viral target analysis using various commercially available molecular based assays.
- ViveST provides significant cost savings as compared to shipping samples on dry ice and can enhance access to healthcare globally while significantly reducing the burden associated with shipping frozen samples.
- ViveST provides superior reproducibility and accuracy for HCV, HBV and HIV-1 viral load testing.

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