COLLECTION OF NASAL SPECIMENS AND DRY TRANSPORT

METHODS AND RESULTS FROM BMGF GRANTEES AND COLLEAGUES

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NASAL SWAB AS AN ACCESSIBLE AND ACCEPTABLE SPECIMEN

The Everett Clinic
Part of Optum®

Nasopharyngeal

Nasal	Positive	Negative
Positive	47	1
Negative	3	447

94% positive percent agreement
99.8% negative percent agreement

Avg Ct ORF1 (NP) = 23.3
Avg Ct ORF1 (nasal) = 23.3

Avg Ct E gene (NP) = 24.97
Avg Ct E gene (nasal) = 24.01

The NEW ENGLAND JOURNAL of MEDICINE

Stanford MEDICINE

Oropharyngeal

Nasal	Positive	Negative
Positive	11	1
Negative	0	18

100% positive percent agreement
94.7% negative percent agreement

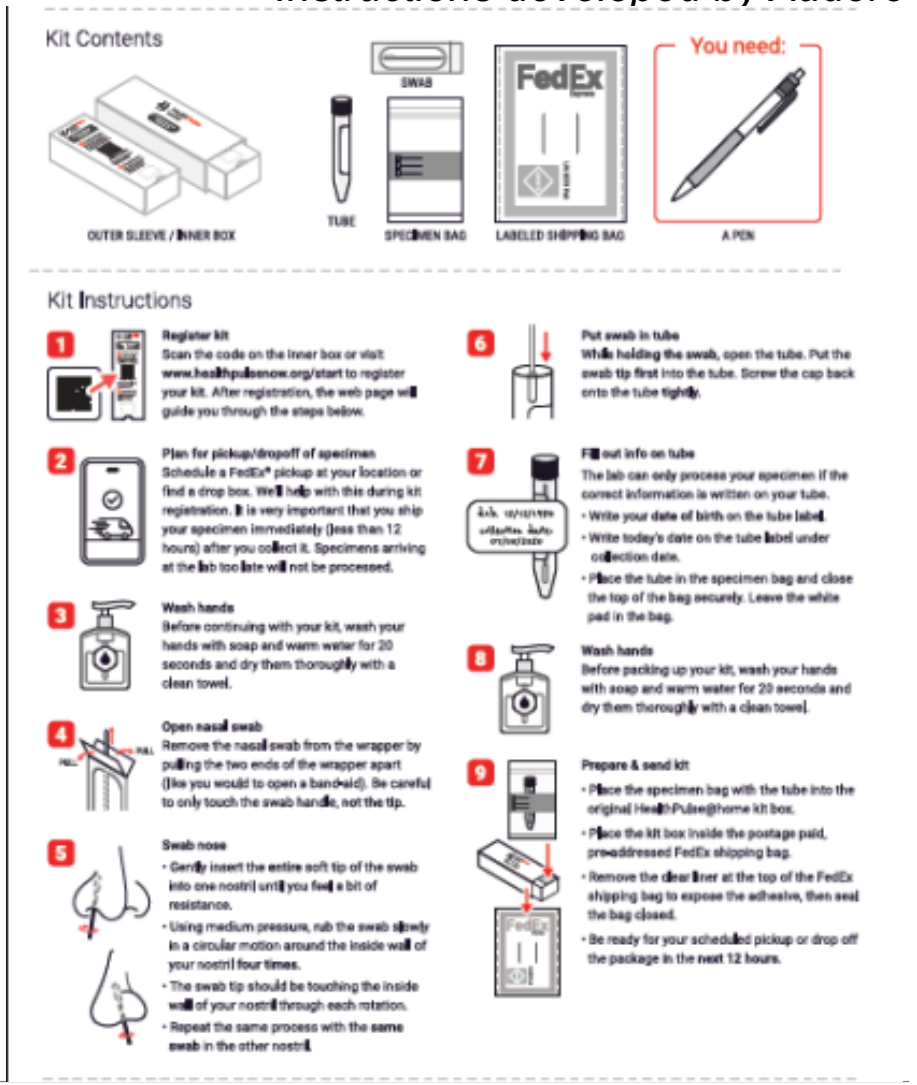
JAMA®
The Journal of the American Medical Association

NASAL SWAB COLLECTION INSTRUCTIONS

Important considerations:

- Both sides of the nose should be swabbed with the same swab
- Specimens should be collected purposefully
- Self-collection of the nasal swab may yield better results than if collected by a healthcare worker (Stanford study)

Instructions developed by Audere



SPUN POLYESTER SWABS – A MORE PLENTIFUL SUPPLY

- Original nasal swab studies were conducted with Puritan foam swabs.
- Due to supply shortages of the foam swabs, spun polyester swabs were tested.
- Polyester swabs were subsequently demonstrated to have equivalent performance to foam.
- Polyester swabs may be manufactured at a much higher capacity than foam swabs.

VTM, SALINE OR DRY?

- VTM (viral transport media) has been in short supply and is used largely for historical reasons
- Saline has been demonstrated to have equivalent or better performance than VTM when using the nasal swab (Everett Clinic)
- Foam and polyester nasal swabs demonstrate excellent performance, with specimen eluted in PBS in the laboratory (Quantigen)
- Dry foam and polyester swabs demonstrate superior stability over time and high temperature as compared to saline (Quantigen)

QUANTIGEN. BIOSCIENCES

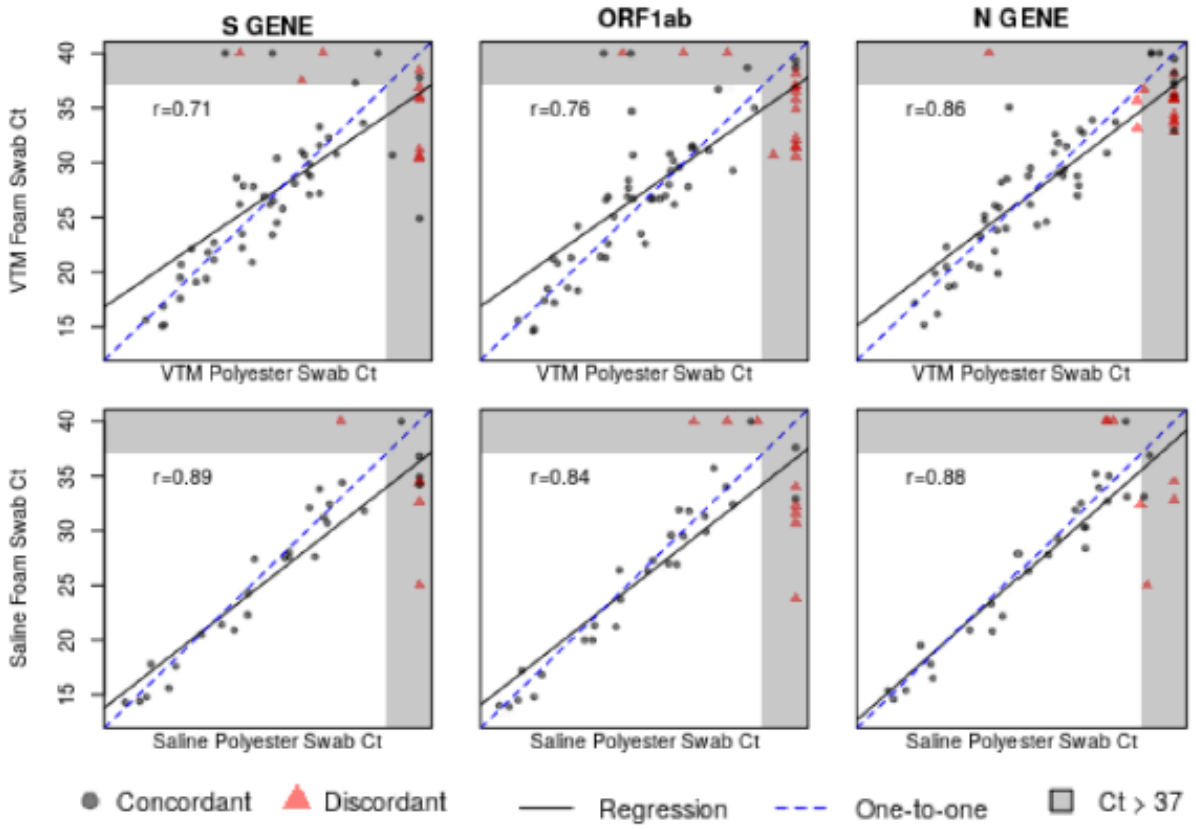
POLYESTER SWABS HAVE BETTER PERFORMANCE AND CONCORDANCE WITH FOAM SWABS WHEN TRANSPORTED IN SALINE VS VTM

- Spun polyester swabs have equivalent performance to foam swabs when stored in saline.
- Performance of both swabs appear to be better in saline than VTM.

What about storing and shipping swabs in a dry tube without transport media?

VTM

Saline



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DRY SWAB ELUTION PROTOCOL (IN THE LAB, PRIOR TO EXTRACTION)

Dry swab elution protocol validated by Quantigen:

1. **Add 1 mL PBS to the tube containing the dry swab**
2. **Vortex for 30 seconds with intermittent pulsing**
3. **Incubate in room temperature for at least 10 minutes prior to extraction**

The following elution methods have been tested and are **NOT** recommended:

1. Swirling the swab in 1 mL PBS (without vortexing)
2. Passive elution by adding 1 mL incubation (no vortexing or swirling)

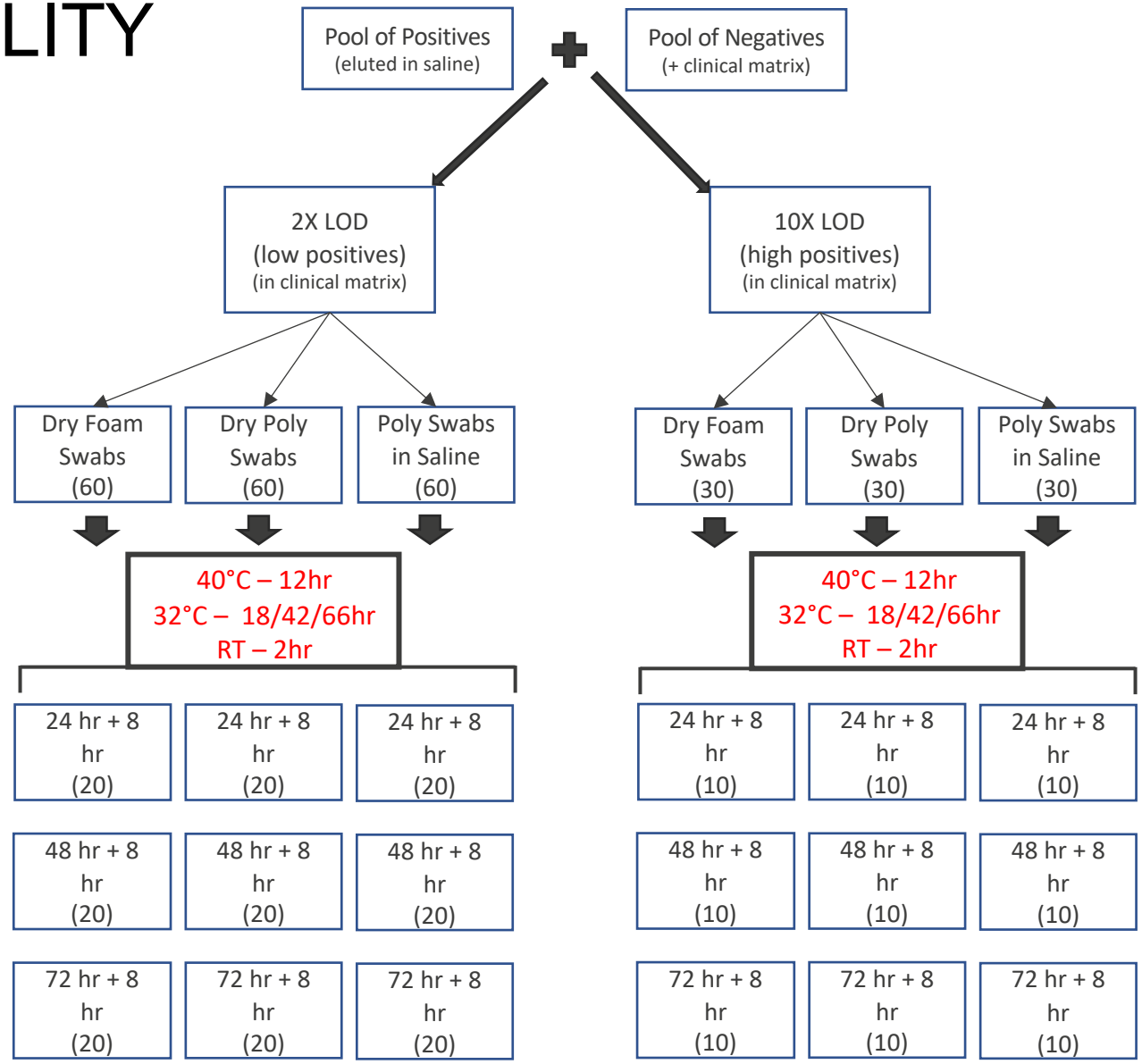
Modifications that have been tried:

1. Elution in smaller volumes of PBS (to concentrate the sample)
2. Elution into PCR buffer

QUANTIGEN. BIOSCIENCES

NASAL SWAB DRY STABILITY STUDY DESIGN

Limit of Detection (LOD) defined as 5% false-negative rate (95% positive)



SUMMARY OF NASAL SWAB STABILITY STUDY

	Time 0			
	Positive	Negative	% Positive	Pass?
2xLoD Foam Dry	5	0	100%	Y
10xLoD Foam Dry	5	0	100%	Y
2xLoD Poly Dry	5	0	100%	Y
10xLoD Poly Dry	5	0	100%	Y
2xLoD Poly Saline	5	0	100%	Y
10xLoD Poly Saline	5	0	100%	Y

	24 + 8 Hours			
	Positive	Negative	% Positive	Pass?
2xLoD Foam Dry	20	0	100%	Y
10xLoD Foam Dry	10	0	100%	Y
2xLoD Poly Dry	20	0	100%	Y
10xLoD Poly Dry	10	0	100%	Y
2xLoD Poly Saline	20	0	100%	Y
10xLoD Poly Saline	10	0	100%	Y

	48 + 8 Hours			
	Positive	Negative	% Positive	Pass?
2xLoD Foam Dry	20	0	100%	Y
10xLoD Foam Dry	10	0	100%	Y
2xLoD Poly Dry	20	0	100%	Y
10xLoD Poly Dry	10	0	100%	Y
2xLoD Poly Saline	20	0	100%	Y
10xLoD Poly Saline	10	0	100%	Y

	72 + 8 Hours				
	Positive	Negative	Inconcl.	% Positive	Pass?
2xLoD Foam Dry	19	1	0	95%	Y
10xLoD Foam Dry	10	0	0	100%	Y
2xLoD Poly Dry	19	1	0	95%	Y
10xLoD Poly Dry	10	0	0	100%	Y
2xLoD Poly Saline	13	7	0	65%	N
10xLoD Poly Saline	10	0	0	100%	Y

QUANTIGEN. BIOSCIENCES

OVERALL RESULTS OF NASAL SWAB STABILITY STUDY

Swab	MS2	N Gene	ORF1ab	S Gene	Time
2xLoD Foam Dry	23.26	32.29	29.91	31.98	0
	23.64	31.99	30.76	32.90	24 + 8 Hours
	23.40	32.24	29.97	35.05	48 + 8 Hours
	23.19	31.93	31.40	35.13	72 + 8 Hours
10xLoD Foam Dry	23.12	29.45	27.54	28.88	0
	23.72	29.25	28.17	28.47	24 + 8 Hours
	23.40	29.56	27.62	29.79	48 + 8 Hours
	23.10	29.02	27.76	27.12	72 + 8 Hours

Swab	MS2	N Gene	ORF1ab	S Gene	Time
2xLoD Poly Dry	23.21	31.98	30.05	31.65	0
	23.47	31.26	29.50	32.32	24 + 8 Hours
	23.69	31.58	28.98	33.55	48 + 8 Hours
	23.55	31.63	30.82	35.82	72 + 8 Hours
10xLoD Poly Dry	23.24	29.21	26.32	27.69	0
	23.60	28.78	27.58	29.50	24 + 8 Hours
	23.79	28.79	27.75	29.34	48 + 8 Hours
	23.32	28.43	29.96	27.97	72 + 8 Hours

Swab	MS2	N Gene	ORF1ab	S Gene	Time
2xLoD Poly Saline	23.52	32.06	30.26	31.80	0
	26.00	32.39	31.42	35.36	24 + 8 Hours
	25.70	32.09	30.96	32.11	48 + 8 Hours
	27.20	31.64	31.14	Undet.	72 + 8 Hours
10xLoD Poly Saline	23.22	29.44	27.20	28.60	0
	25.99	29.28	28.35	28.75	24 + 8 Hours
	26.14	28.76	27.40	25.79	48 + 8 Hours
	27.22	28.71	27.45	24.91	72 + 8 Hours

Mean Cts for patients from start of symptoms

N Gene	ORF1ab	S Gene	Time
24.3	23.6	25.1	Days 4-6
31.2	29.3	31.5	Days 7-10
34.6	32.4	34.6	Days 11-18

US COTTON #3 SPUN POLYESTER NASAL SWAB AS AN ALTERNATIVE TO COPAN SPUN POLYESTER SWAB

- US Cotton is an established non-medical swab manufacturer in the US
- US Cotton was engaged during the SARS-CoV-2 outbreak to enlist their support in manufacturing spun polyester swabs due to lack of sufficient capacity in the other major manufacturers (Copan and Puritan)
- The company does not have the capability to individually package and sterilize swabs
- BMGF has engaged SteriPack to provide these services and serve as the manufacturer of record with the FDA
- SteriPack has received a grant from BMGF to customize an existing packaging line, and to build a new one to increase capacity
- SteriPack has the potential to increase capacity to 1 billion swabs per year if the company can be supported in the development of an automated solution to avoid human handling of the swabs and boxing of product
- SteriPack has worked with BMGF grantee Audere to provide customized labeling with 2D barcode to connect the swab with electronic swab instructions and other functionality

UNIVERSAL, LOW COST (<$1), SWAB AND DRY TUBE KIT

Nasal swabs are now used and preferred in many US sites

- United Health Group uses them exclusively
- Many public health labs are using them (eg New York, Orange County, CA)
- Several universities use them for clinical research studies
- Broad, CATCH and SCAN have transitioned to them

Expanded Supply to Meet Global Demand

- Clinical poly swabs available July 23, 2020, to be distributed for evaluation
- Current capacity = 100 million per year (LMIC pricing < $0.20)
- Expanded capacity (8/2020) = 300 million per year

Low Cost

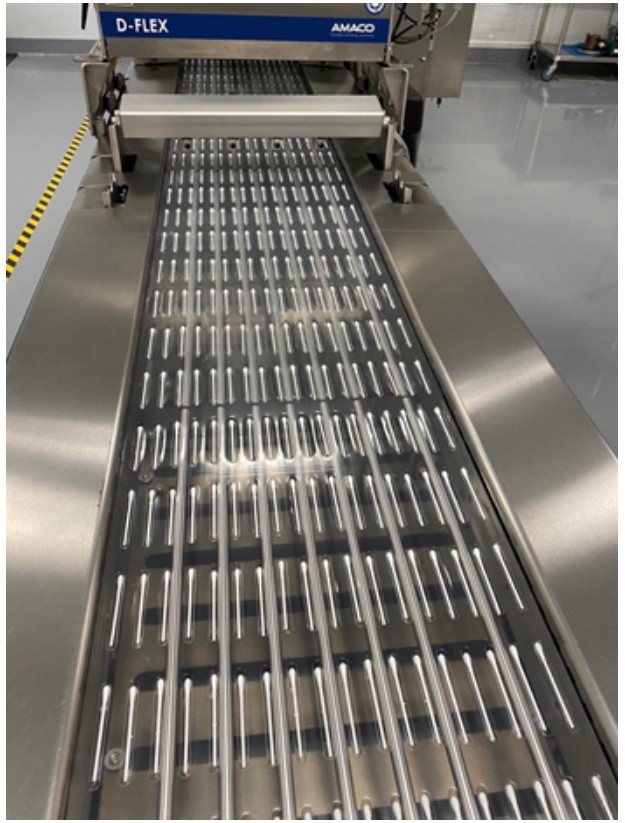
- Copan and Puritan swabs retail $1 - 2 (not including tube and media)
- US Cotton/SteriPack swabs could go as low as $0.10 at 1 billion/year

Multifunctional and Ubiquitous

- Nasal swabs may be self-collected and shipped to the lab without cold chain
- Swabs have been validated for PCR and LAMP testing
- May be used for point of care testing, including direct antigen (Lumira, LFA)
- May be used for multiple upper respiratory infections (flu, RSV, TB?)
- Swabs may be ***prepositioned***, so that collection and testing may be ***immediate***

U.S. COTTON

SteriPack™ CONTRACT MANUFACTURING



POLYESTER NASAL SWAB CONCLUSIONS

- Self-collected nasal swabs show equivalent performance to NP and OP swabs in the range of viral loads seen in COVID patients at least through 10 days from start of symptoms and during the infectious period
- Self-collected nasal swabs demonstrate adequate and reproducible amounts of material (RNase P)
- Spun polyester nasal swabs have similar performance to foam nasal swabs in VTM, with better performance and greater concordance with foam in saline
- Polyester nasal swabs may be stably/stored transported to the lab in a dry tube.
- Dry polyester swabs may be eluted with 1 mL PBS, with 30 sec vortexing
- The US Cotton #3 polyester nasal swab has equivalent performance to the Copan polyester swab:
  - Normal healthy volunteers – RNase P
  - Positive human surrogate specimens (human volunteers spiked with known positive specimens)
  - Dry swab stability: 48 hr + 8 hr with high temperature excursion (12 hr 40°C, 34 hr 32°C, 2 hr RT)
    72 hr + 8 hr refrigerated

SELF-COLLECTED SWAB SPECIMENS FOR COVID AND TB

- Self-collected nasal swabs are now used for SARS-CoV-2 specimen collection as an alternative to nasopharyngeal swabs collected by a healthcare worker
- Nasal swabs have been demonstrated to be a good specimen for influenza detection, and could be used to test for SARS-CoV-2, influenza A and influenza B from a single specimen in patients with upper respiratory symptoms
- Self-collected oral swabs (tongue scraping) are being evaluated by multiple groups for TB NAT testing as an alternative to sputum, which is difficult to obtain from HIV+ patients and children
- Self-collected oral swabs have demonstrated good sensitivity for detecting SARS-CoV-2
- Oral swabs have the potential to be used for combined SARS-CoV-2 and TB NAT testing

ORAL AND NASAL SWABS ARE BEING EVALUATED FOR TB AND SARS-COV-2 DETECTION BY MULTIPLE BMGF GRANTEES

- **NHLS / University of Witwatersrand** (Wendy Stevens and Lesley Scott) – evaluation of swabs for use with multiple existing platforms, such as Cepheid, Roche, Abbott, Thermo Fisher for TB and SARS-CoV-2 detection

- **LumiraDx** – SARS-CoV-2 direct antigen test using SteriPack nasal swab for point of care instrument and low-cost consumable that may be manufactured at very high scale and low cost; TB NAT test from oral swab under development

- **University of Washington / Jerry Cangelosi** – evaluation of alternative swab types and multiple different platforms for TB and SARS-CoV-2 detection from oral swab (tongue swab)