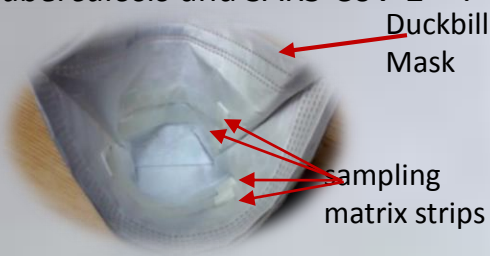
Bacterial signals captured from aerosols vary between different sampling matrices and different identities inform development of face mask sampling

Mohamad Abdulwhhab, Baber Saleem, Natalie Garton & Mike Barer *

Introduction

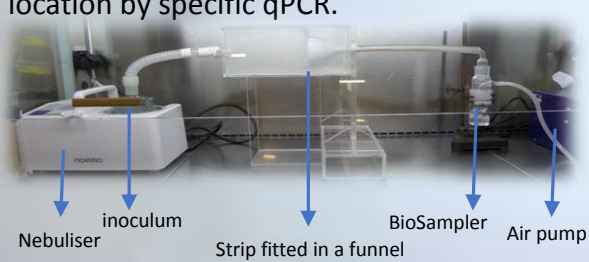
We have been using facemasks carrying 3D printed Polyvinyl alcohol (PVA) sampling matrix strips to study exhaled microbes including *M tuberculosis* and SARS-CoV-2[1–4].



Little is known about the factors influencing microbial capture in this system. Our aim here was to investigate the influences of microbial identity and sampling matrix composition in a microbial nebulization and capture system.

Methods

Inocula of bacteria associated with the human respiratory system were prepared from mid-exponential broth cultures and mixed at approximately equal densities in the **inoculum** reservoir of an OMRON NE-U780 nebulizer. Triplicate samples were run for 15 min at level-II. Test sampling matrix **strips** covering ~10% of the inlet funnel were placed in the rig as indicated below and flow through was collected in a liquid impactor (SKC **BioSampler**). Bacterial DNA was extracted and quantified at each location by specific qPCR.



Results

The influence of microbial identitity was first tested (**Figure 1.**) with 8 different bacteria and Leicester PVA sampling matrix . Although inocula were at similar densities major differences emerged at the two downstream sampling stages

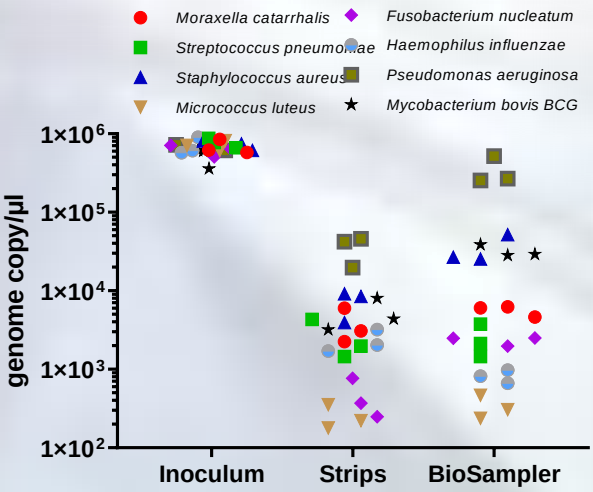


Figure 1. Bacterial abundance at 3 stages

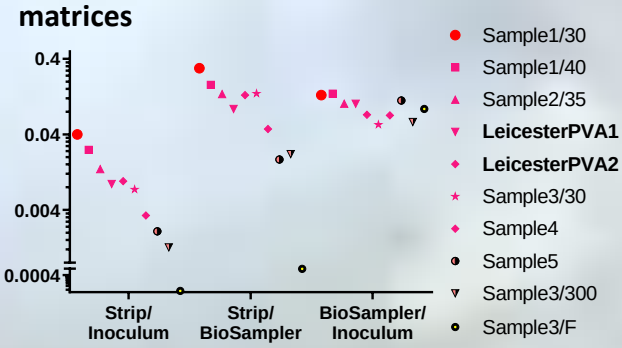
To investigate the differences further we examined the ratios between the signals obtained.

Table 1

	Strip/ Inoculum		Strip/ BioSampler		BioSampler/ Inoculum	
	Mean	SD	Mean	SD	Mean	SD
Ps. aeruginosa	528.0	184.7	1096.2	525.6	5114.3	1827.9
M. bovis BCG	102.2	42.4	1570.8	475.3	638.4	171.0
S. aureus	97.0	28.5	2192.4	1051.1	482.6	193.5
M catarrhalis	57.3	34.2	6674.9	2959.0	86.6	28.1
S. pneumoniae	35.8	25.9	11851.4	7719.9	32.5	16.1
H. influenzae	32.9	2.8	28168.1	6376.2	12.0	2.0
F. nucleatum	8.1	6.1	1929.1	975.3	38.5	9.8
M. luteus	3.6	1.4	7449.3	180.7	4.8	1.8

We suggest that the Strip/BioSampler ratio reflects efficiency of capture for the organism sampling matrix combination. On this basis, although *Ps. aeruginosa* travels best *H, influenzae* is the most efficiently captured.

Building on this we tested the capture efficiencies of 10 different sampling matrices and show below ratio results in **Figure 2 *M. luteus* captured by different matrices**



Sample 1/30 appears the most efficient capture material. The numbers after/ indicate thickness of the matrix. It appears that this adversely affects capture efficiency.

Conclusion

Both sampling matrix and microbial identity appear to be significant factors affecting capture of nebulized microbes. Differences in the facility with which different species enter and are stable in aerosol also need to be considered.

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References

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