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University Hospitals of Leicester NHS
NHS Trust

Face mask sampling (FMS) and TB transmission

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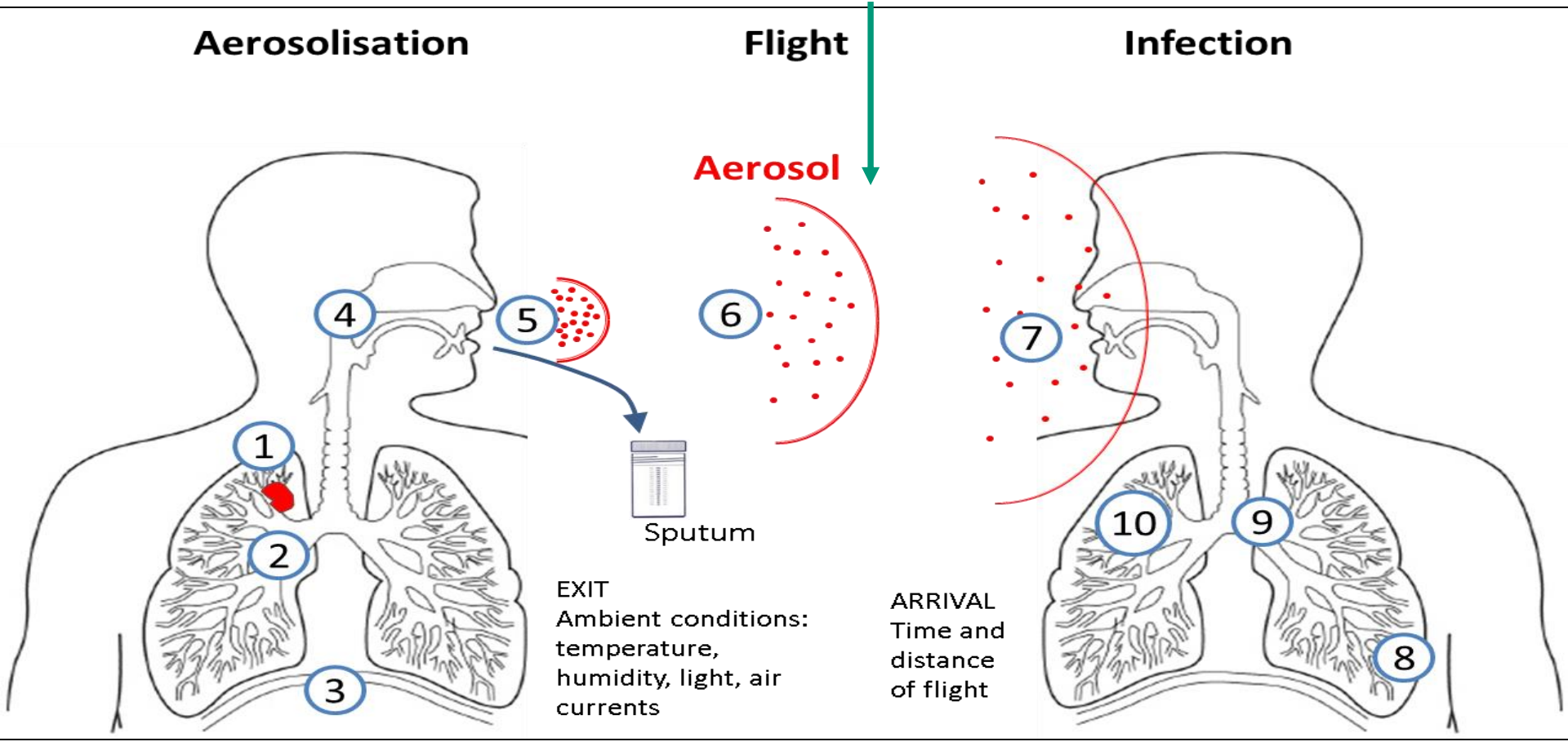
LTBRG
LEICESTER TB RESEARCH GROUP

https://www2.le.ac.uk/projects/tb-research

TB Transmission

Aerosol Sampling?

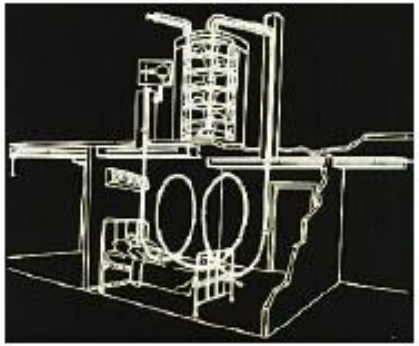


Aerosol Sampling systems

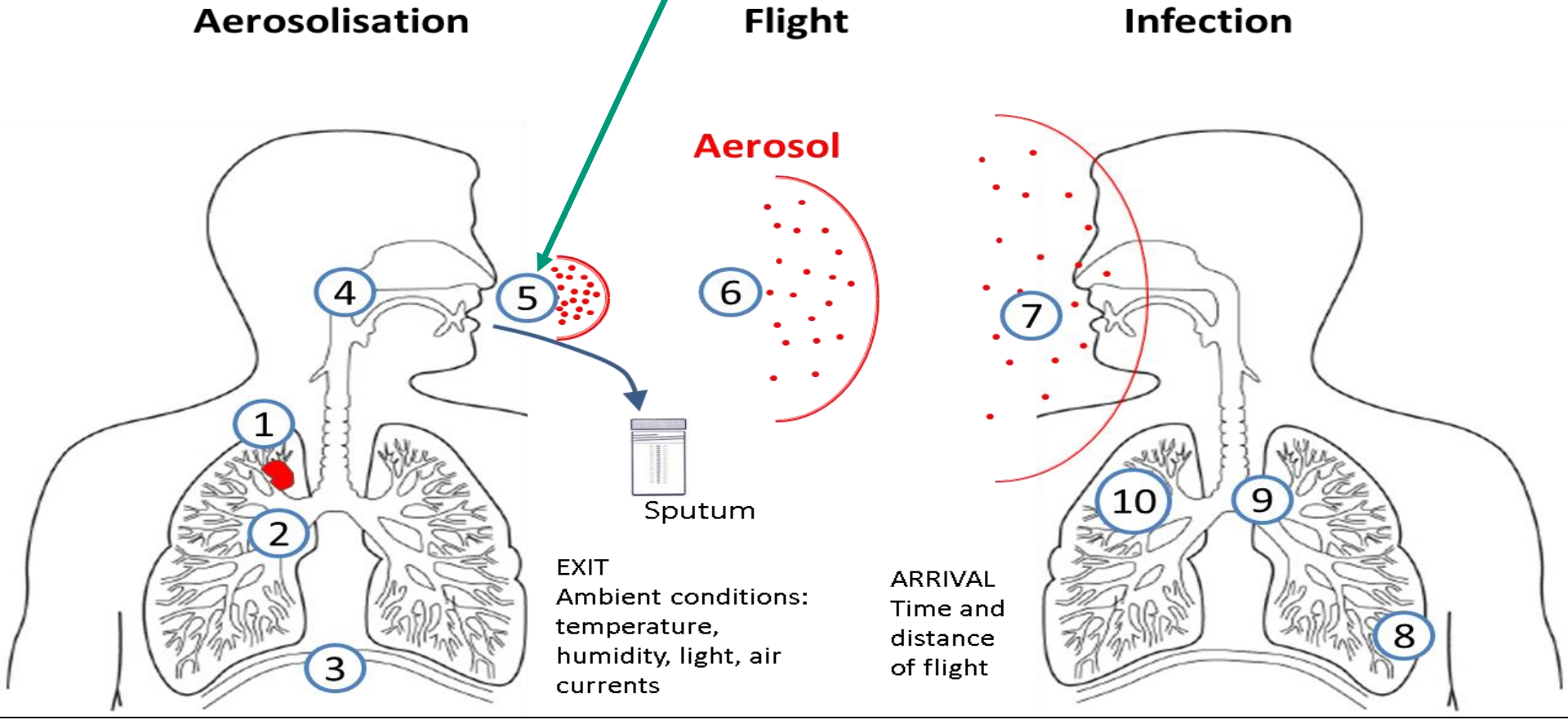
Eddie Jones-Lopez

Kevin Fennelly

Ed Nardell



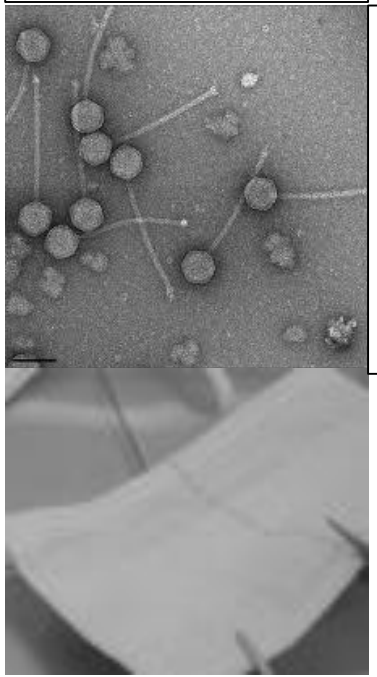
Face Mask Sampling?



EARLY STEPS
Bacteriophage Assay

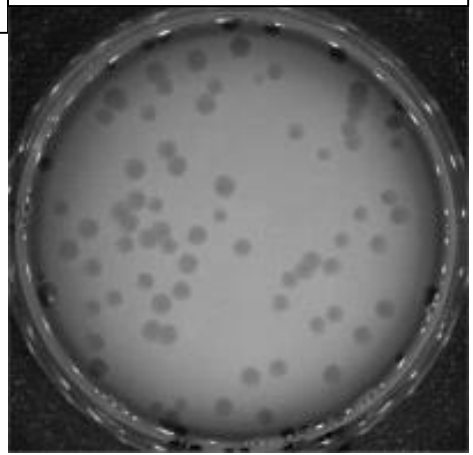
Support from Cath Rees
Univ Nottingham

Add bacteriophage directly to mask in suitable medium



1 hr at 37°C then Kill extracellular Phage and add released cells to rapid growing *M. smegmatis* culture for plaque assay

Count plaques at 48h. 1 plaque ~= 1 Mtb CFU



Eddy Cheah

OPEN ACCESS Freely available online

PLOS | ONE

Face Mask Sampling for the Detection of *Mycobacterium tuberculosis* in Expelled Aerosols

Caroline M. L. Williams[1☯], Eddy S. G. Cheah[1☯¤], Joanne Malkin[1,2], Hemu Patel[2], Jacob Otu[3], Kodjovi Mlaga[3], Jayne S. Sutherland[3], Martin Antonio[3], Nelun Perera[2], Gerrit Woltmann[4], Pranabashis Haldar[1,4,5], Natalie J. Garton[1], Michael R. Barer[1,2*]

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FFP30 Masks with DIY sterile gelatine filter sampling matrix

(c) Caroline Williams used with permission

65% of sputum AFB positives
Also mask positive by phage or Xpert
3 of 6 BAL positives were mask positive

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What is the pattern of Mtb output over 24 hours? - Pretoria

25 pts with diagnosed pulmonary TB (sputum Xpert/AFB+)

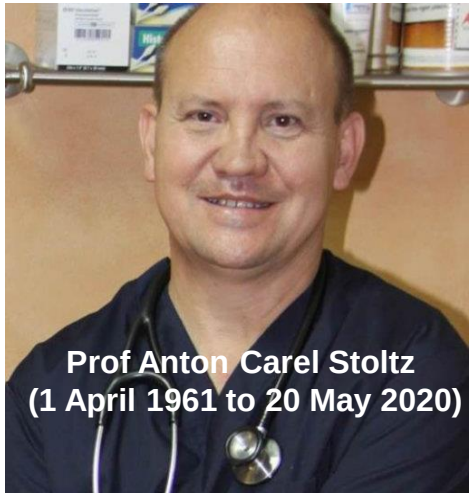
Pre-treatment or within 24 hours of starting

Exhaled sample taken via mask for 60 mins every 3 hours for 24 hours

Total sputum output collected for 24 hour period

Cough frequency determined MP3 recorder (Leicester cough monitor) worn for the 24 hours

TB detected by quantitative real time PCR



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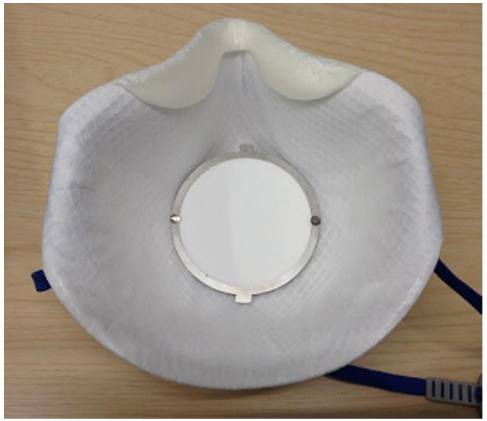

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Exhaled *Mycobacterium tuberculosis* output and detection of subclinical disease by face-mask sampling: prospective observational studies

Caroline M Williams, Mohamad Abdulwhhab, Surinder S Birring, Elsabe De Kock, Natalie J Garton, Eleanor Townsend, Manish Pareek, Alaa Al-Taie, Jingzhe Pan, Rakesh Ganatra, Anton C Stoltz, Pranabashis Haldar, Michael R Barer

Summary

Background Tuberculosis remains a global health challenge, with early diagnosis key to its reduction. Face-mask sampling detects exhaled *Mycobacterium tuberculosis*. We aimed to investigate bacillary output from patients with pulmonary tuberculosis and to assess the potential of face-mask sampling as a diagnostic method in active case-finding.

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24h Cough, Sputum and Mask assay

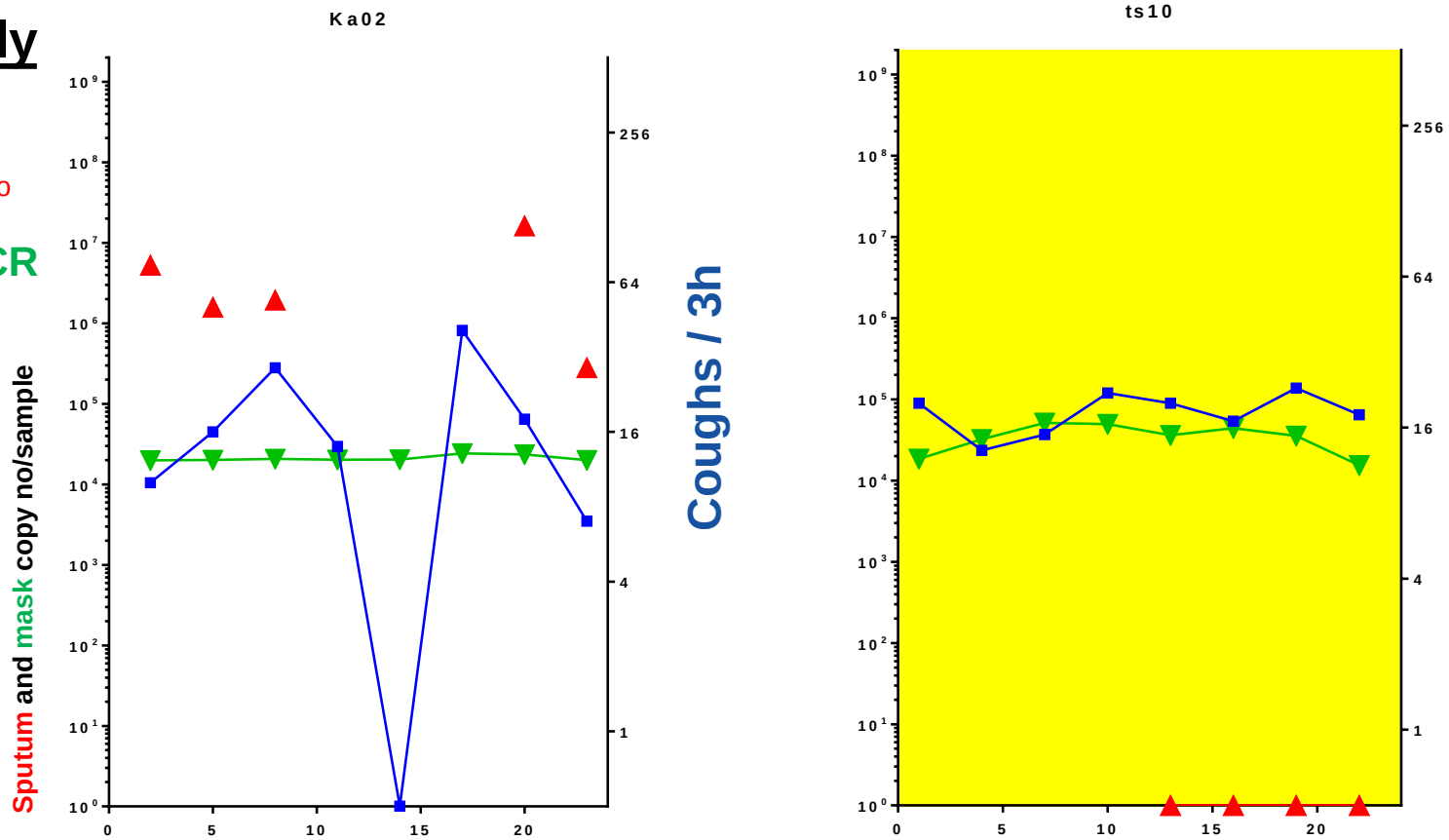
3 hourly

Sputum PCR

No symbol=no sample

Mask PCR

Cough count



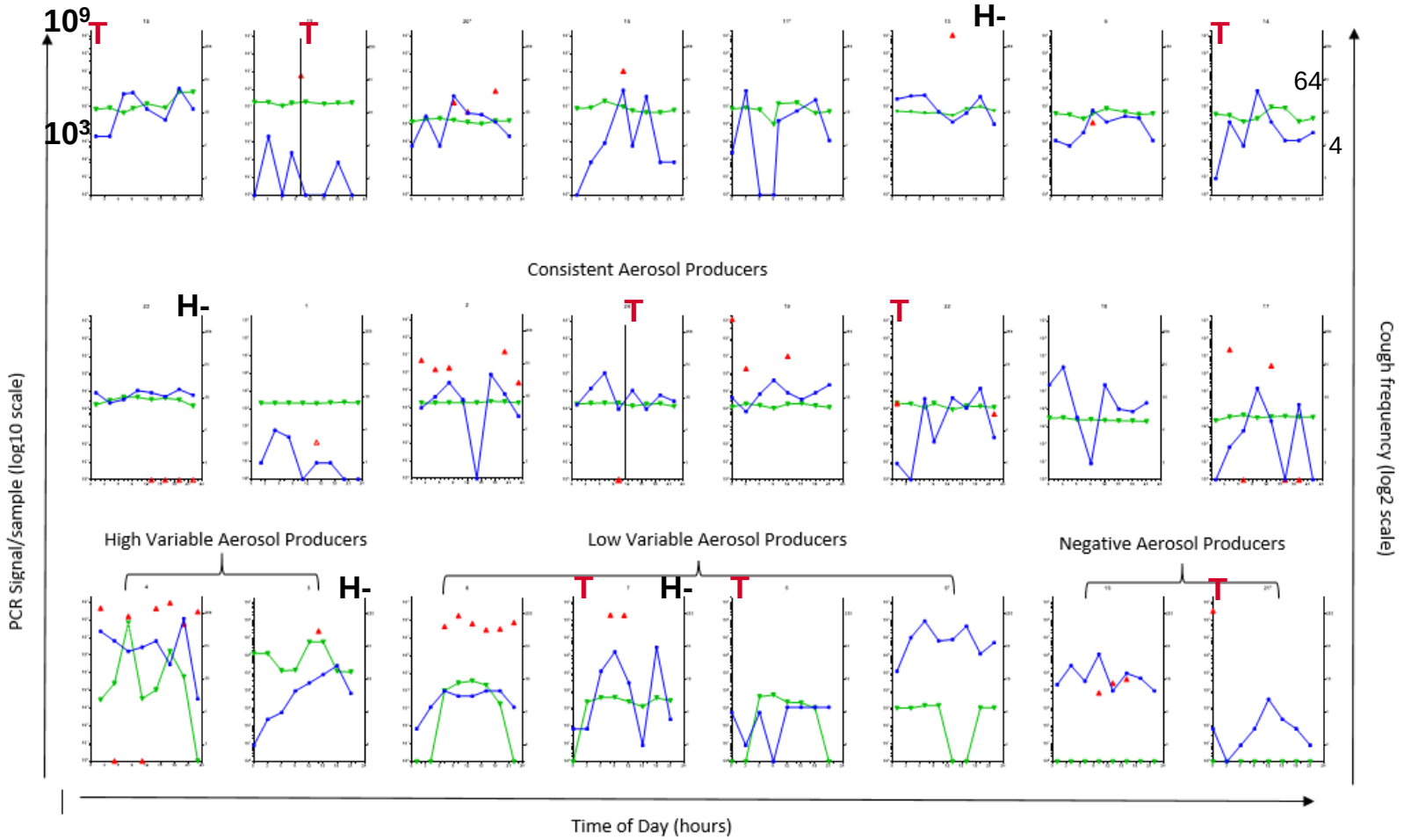
PATTERNS

3 hourly
Sputum PCR
No symbol=no sample
Mask PCR
Cough count

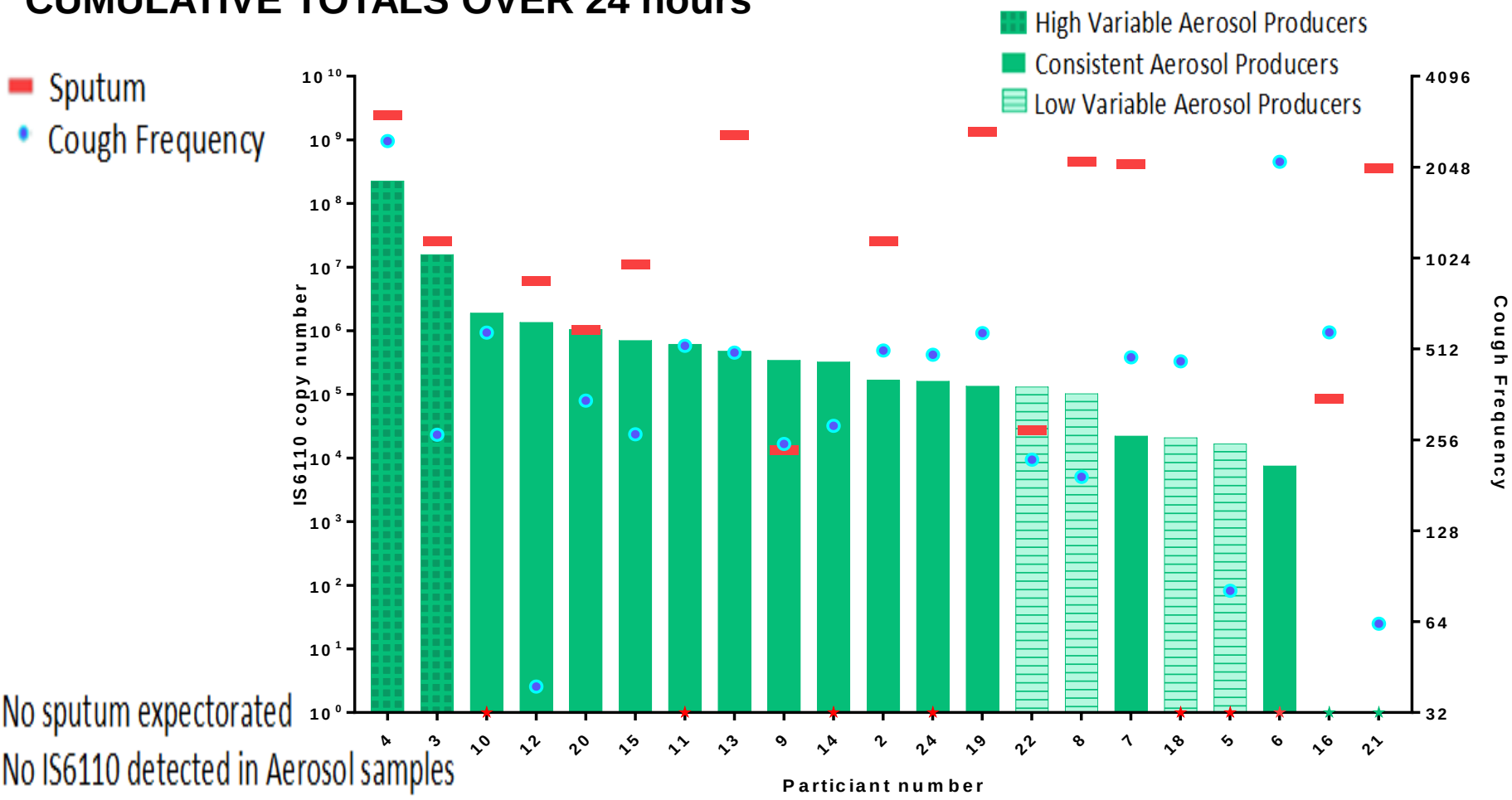
Some Questions:
- Does sputum content predict aerosol?
- Does cough frequency predict aerosol?
- Effect of treatment?
- Influence of HIV

Treatment T

HIV-ve H-



CUMULATIVE TOTALS OVER 24 hours



Conclusions: From 24 severely diseased predominantly HIV positive patients

- No clear diurnal pattern
- Patterns: High variable, Consistent, Low variable & Negative
- Mask+ve/Sputum-ve and vice versa are common
- Active case finding using the mask?
- Cough not needed for output (output detected during sleep)
- 24h Sputum output does not predict 24h Mask output.

- Can the mask signal be linked to transmission?

Household Transmission study

MRC Unit, The Gambia, TB case contact platform

Dr Jayne Sutherland

(c) Jayne Sutherland- used with permission

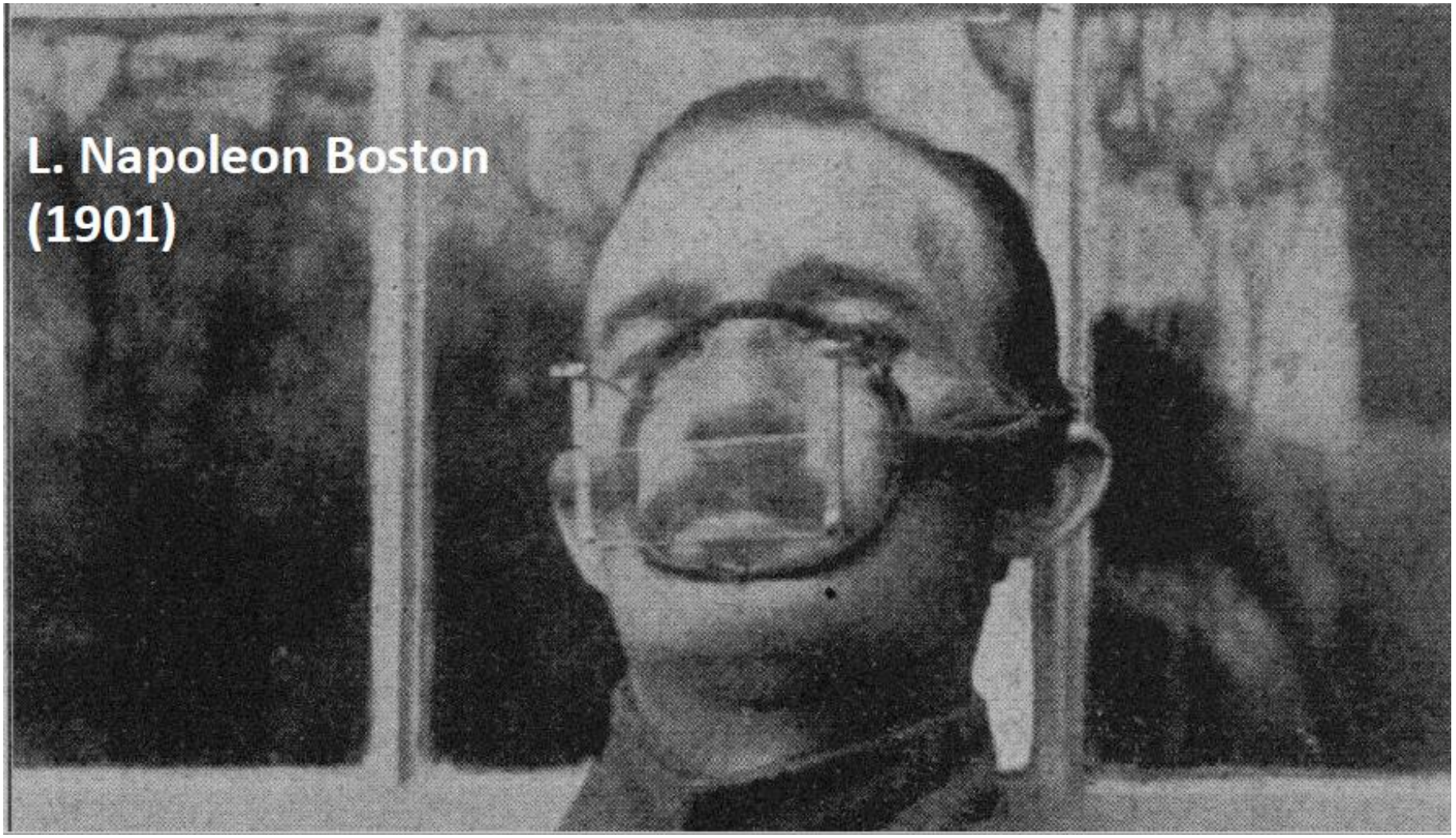
Aim

Determine the relationship between Mask captured Mtb from pulmonary TB patients and Mtb infections in household contacts

Compare this with other more traditional markers of infectivity such as sputum bacillary load, cough, sleeping proximity.

CONCLUSIONS

- Mask IS6110 signals collected over 1h are significantly associated with >3-fold increase in household transmission risk
- Numerous features in these assessments of ‘Source Strength’ open to improvement / investigation.
  (Need lower baseline IGRA+; Mask device development, assay targets, viability of Mtb, aerosol vs droplets; respiratory efforts)
- Additional value of cough assessment?
- Application in treatment monitoring – Efficacy, Loss of infectivity, Trials?


L. Napoleon Boston
(1901)

Prof Jingzhe Pan

Dr Alaa Al-Taie

Acknowledgements

Home team
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Kevin Fennelly

wellcome

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NHS National Institute for Health Research

MRC Medical Research Council

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