The Challenge

- Infections from before the first UK lockdown on 23rd March 2020, led to a statistically significant, two-fold excess mortality for London bus drivers between March to May 2020
- Even after taking account of contributing risk factors such as "in particular a higher proportion of BAME staff than in the general population and living in disadvantaged urban settings"

Goldblatt P, Morrison J. London Bus Drivers Review. https://www.instituteofhealthequity.org/resources-reports/london-bus-drivers-review March 2021

Coronavirus: London bus driver deaths to be reviewed

21 May 2020

Part of the review will examine the measures introduced to protect bus drivers

An independent review is to look at coronavirus infections and deaths among the capital's bus workers, Transport for London (TfL) has announced.

Thirty-three London bus workers have died after contracting Covid-19, including 29 drivers.

Part of the study will examine the measures introduced to shield drivers such as how the vehicles are cleaned.

THE 100 MOST INFLUENTIAL PEOPLE OF 2021

← BACK TO HOME

Lidia Morawska

"She assembled a team of more than 200 scientists and public-health authorities to recognize the role of aerosols in spreading SARS-CoV-2 and change how we measure and lessen our risk of contracting the virus." - TIME Magazine

UCL Dept of Civil Engineering

Dr Liora Malki-Epshtein

Prof Thorsten Stoesser

Dr Alex Stubbs

Prof Nick Tyler

Dr Lena Ciric

Dr Arthur Hajaali

Dr Filipa Adzic

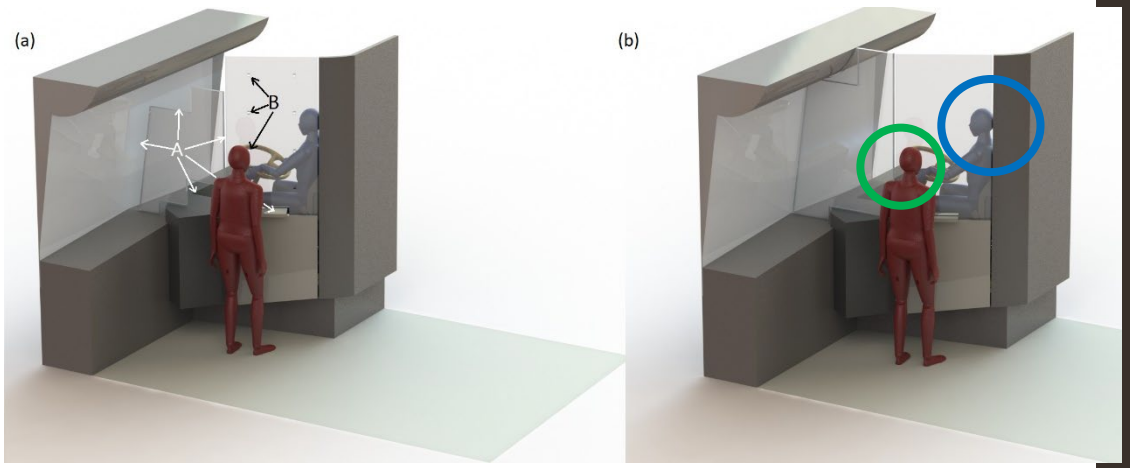
- In April 2020 we suspected a large number of infections in the community, packed public transport with numerous passengers and limited ventilation
- Bus drivers often belong to more vulnerable population groups
- Based on the precautionary principle of public health, we assumed Covid is airborne, a hierarchy of interventions was needed
- The Method: CFD simulations , experiments on UCL's PAMELA double-decker bus

Stubbs A, Malki-Epshtein L, Hajaali A, Adzic F, Stoesser T, Tyler N. [Mitigations for COVID-19 transmission on buses: reducing exposure of bus drivers to passenger's exhaled breath] submitted to Sustainable Cities and Society

CFD - Large Eddy Simulations

Simulations of air flow and concentrations of exhaled breath using Stoesser's Hydro3D model, run on the UK Met office supercomputer as an urgency measure

Case #	Description	Front Door	Middle Door	Cab Window	Screen Gaps	Speech holes
1	Pre-COVID19	Open	Closed	Closed	Large	Open
2	Initial Intervention: Seal speech holes	Open	Closed	Closed	Large	Sealed
3	Middle door boarding	Closed	Open	Closed	Large	Sealed
4	Middle door boarding and physical distancing (passenger standing 2m back)	Closed	Open	Closed	Large	Sealed
5	Middle door boarding and cab window open	Closed	Open	Open	Large	Sealed
6	Modified Screen Design – front door boarding	Open	Closed	Closed	Small	Sealed
7	Modified Screen Design – middle door boarding	Closed	Open	Closed	Small	Sealed
8	Modified Screen Design – both doors open for boarding and alighting	Open	Open	Closed	Small	Sealed
9	**Modified Screen Design – both doors open for boarding and alighting and cab window open**	Open	Open	Open	Small	Sealed



9 case studies simulated to test interventions

CFD - Large Eddy Simulations

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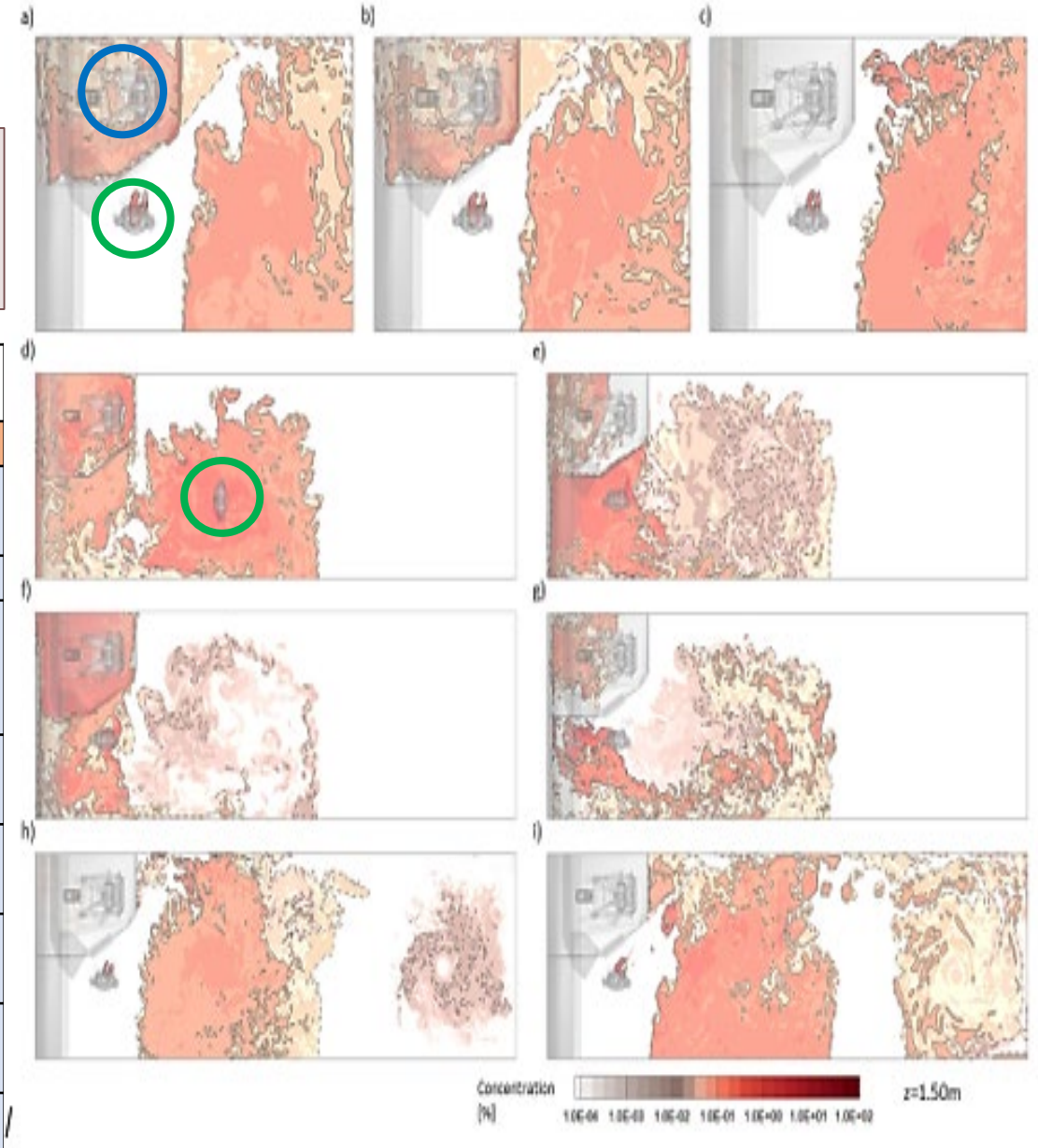

Figure 14: Scalar Comparison Panel: Scalar concentration plots at z=1.50m for all cases, in a clockwise direction starting

Decision Support tool for different interventions:

Based on a single simple parameter: relative exposure to Exhaled Breath

Intervention	Case	Exposure per minute: fraction of EB the driver is exposed to	Exposure per minute: compared to Reference Case 1	Recommendations
Modifications of Assault screens such that the gaps around them to be no more than 5 mm	**6** **7** **8** **9**	0.25% 0.8% 0.3% 0	3% 10% 4% 0	• The best passive protection measure • Does not require behaviour changes by either drivers or passengers. • The modifications are effective for all operational scenarios re: windows and doors. • Recommend this becomes a permanent change in driver's cab design at the vehicle manufacturing stage
Opening the window in the driver's cab	**5** **9**	0.02% 0	0.3% 0	• Highly effective and practical, implement as soon as possible on all buses. • Actual airflows through windows depend on outside wind and temperature.
Sealing the assault screen speech holes	**2** **3** **4**	7.4% 17.9% 18%	94% 226% 227%	• Effective against direct spray from droplets. • Only marginally effective for protection against aerosol concentrations. • In some scenarios this intervention had no impact.

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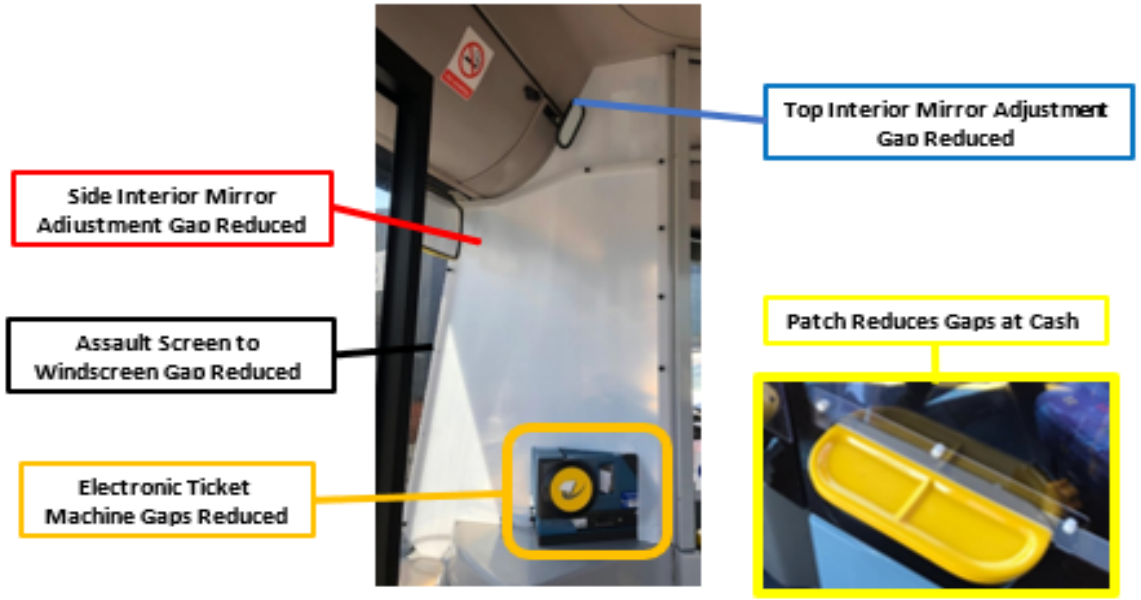
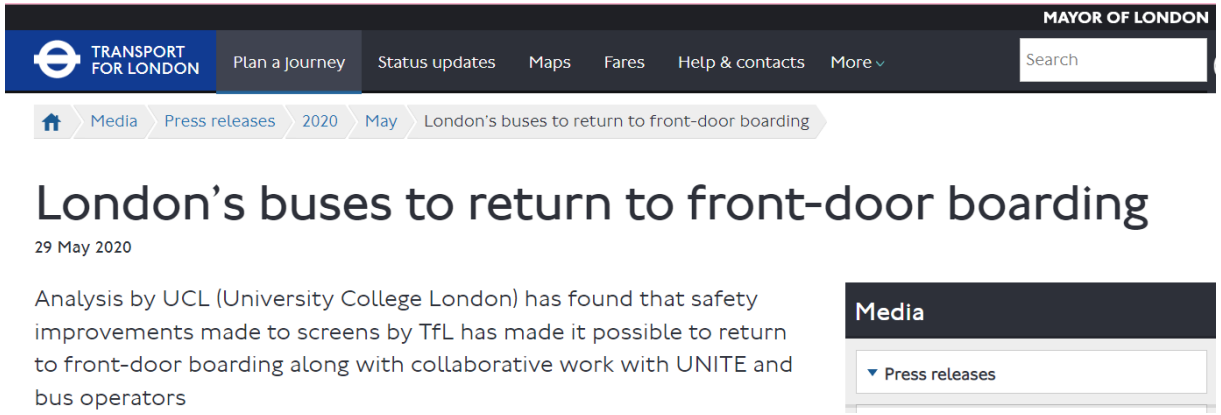
First implementations by TfL on 9000 buses, in May 2020:

- Buses returned to front door boarding and both doors opened at every stop
- Started to retrofit screens on all 9000 London buses
- Opened the windows in the driver's cab until ventilation systems were adapted



Modified assault screen on a bus



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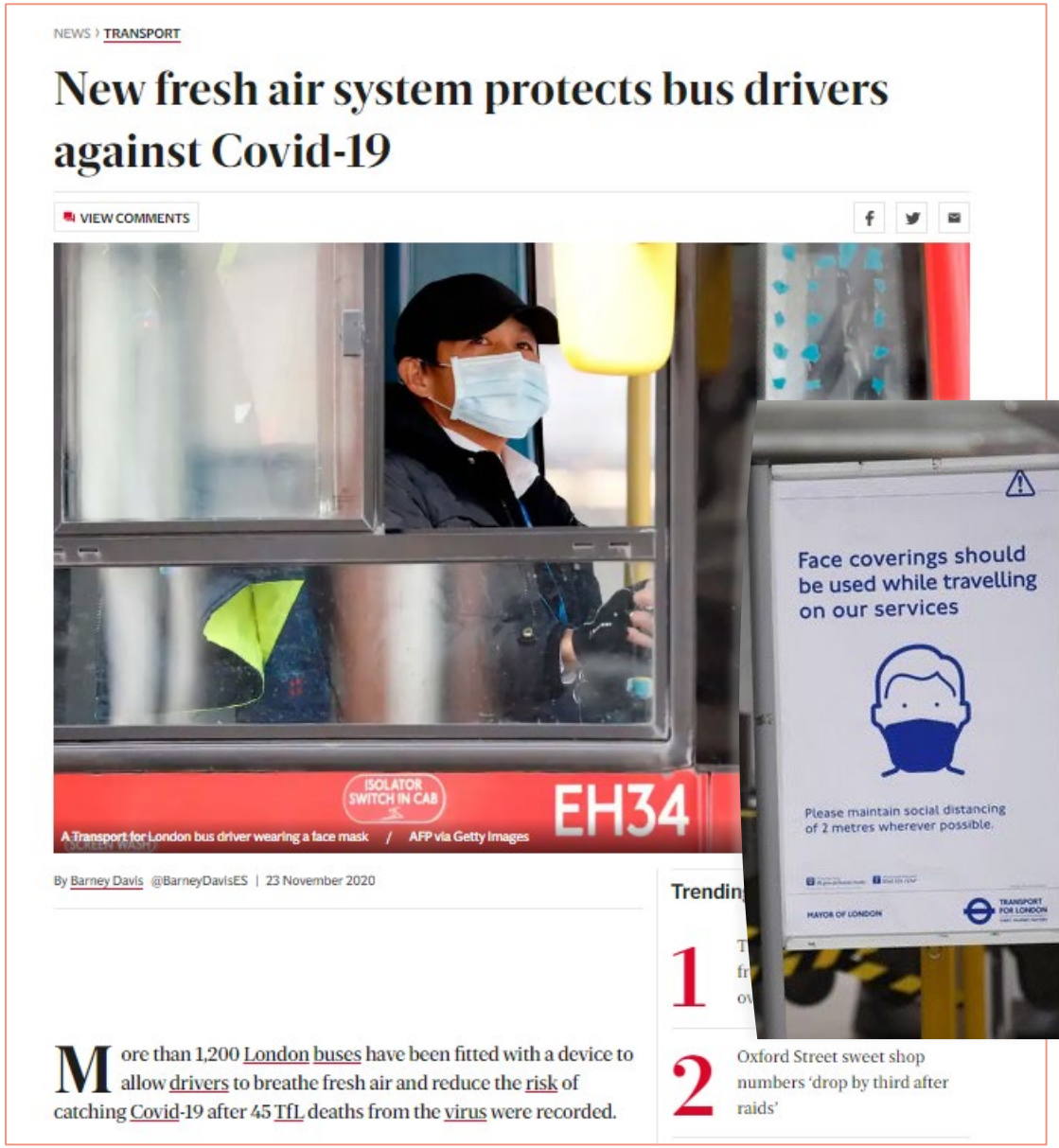
Second implementations by TfL, by November 2020:

- 1200 buses* were fitted with additional separate ventilation systems for the bus drivers to avoid recirculation
- All bus ventilation systems checked and maintained
- Passengers and drivers encouraged to open passenger windows
- Face coverings were mandatory on the entire network



NEWS › TRANSPORT

New fresh air system protects bus drivers against Covid-19

VIEW COMMENTS

A Transport for London bus driver wearing a face mask / AFP via Getty Images

By Barney Davis @BarneyDavisES | 23 November 2020

More than 1,200 London buses have been fitted with a device to allow drivers to breathe fresh air and reduce the risk of catching Covid-19 after 45 TfL deaths from the virus were recorded.

Trendin

1

2 Oxford Street sweet shop numbers 'drop by third after raids'