PROTECT
A COVID-19 National Core Study

Public Transport and COVID-19:
Preliminary findings of the PROTECT study (Theme 3)

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Theme 3 – Sector specific studies

- Mixed method studies (literature reviews, surveys, qualitative studies) of certain sectors
  - Public transport
  - Food processing
  - Construction
- Analyses of existing datasets
  - To improve understanding of the role of work and other activities on risk of infection, ill-health and mortality
  - ONS data (CIS, Public Health Data asset, mortality data)
  - Virus Watch
  - Biobank
  - Longitudinal Linkage Collaboration

Public Transport Sector

- Literature review on transmission in ground based public transport
- Evidence from studies on infection, disease and mortality in Transport workers
- Qualitative Deep dive (with experts, organisational leaders, workers and passengers)

Public Transport Lit Review

Identified 28 papers for inclusion in the review (up to May 2021)

- 11 modelling studies / 17 empirical studies
- 17 peer reviewed / 11 pre-prints, reports, conference publications
- 7 contamination studies / 10 transmission studies / 11 control studies
- 2 studies conducted in the UK

Research Questions:

1. What is the evidence for the presence of the COVID-19 virus in air and on surfaces in ground public transport?
2. What do empirical studies of COVID-19 virus transmission on public transport show?
3. What evidence is there for the effectiveness of control measures in public transport?
4. What does risk modelling for COVID-19 virus transmission rates on ground public transport show?

Public Transport Lit Review

- Published literature was **sparse**.
- Studies which measured **surface and air contamination** reported mixed findings.
- **Empirical studies** provided some evidence for the transmission of SARS-CoV-2 transmission, and highlighted some important factors that moderate transmission (e.g **proximity and duration)**.
- Impact of RMMs:
  - effects of ventilation systems in a bus demonstrated that the **benefits of ventilation are not uniform across the vehicle space and can be dependent of the location of the infected passenger.**
  - **Window configurations in private car ventilation appeared to influence driver to passenger transmission.**
- **Modelling** studies suggested that transmission could be reduced by wearing face masks and by increasing ventilation.

Gartland et al (2021) https://doi.org/10.48420/16622974

Covid-19 Mortality in Transport Workers

- Public transport workers at increased risk of COVID-19 mortality (based on data from March – December 2020)
- Other transport workers similar risk of COVID-19 death as all working age men

Occupation	COVID-19 deaths	Rate	All cause mortality	Rate
Large goods vehicle drivers	118	39.7	1006	332.4
Van drivers	97	39.7	769	332.2
Bus and coach drivers	83	70.3	367	333.6
Taxi and cab drivers and chauffeurs	209	101.4	739	357.1
All men aged 20-64 years	5,128	31.4	42,082	256.0

https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/bulletins/coronaviruscovid19relateddeathsbyoccupationenglandandwales/deathsregisteredbetween9marchand28december2020#related-links

Covid-19 Mortality Transport – Linked census study

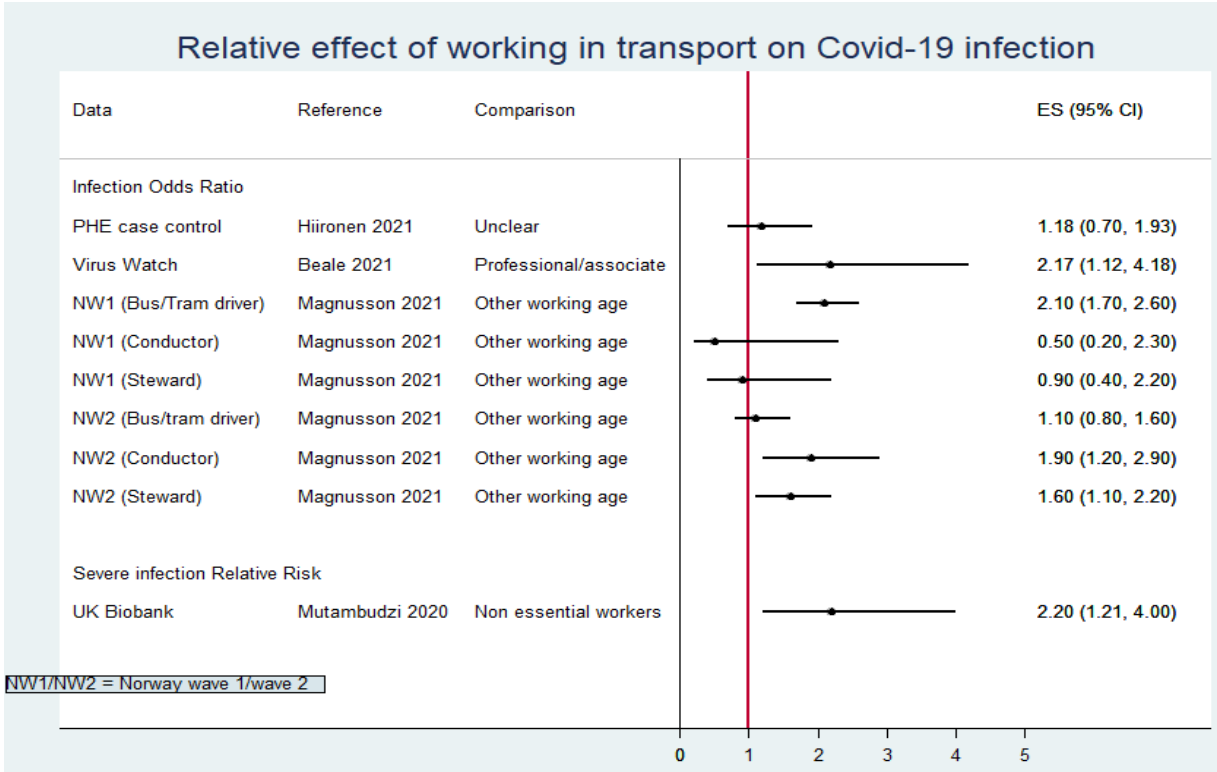
	Men		Women	
Occupation	Age-adjusted	Fully adjusted	Age-adjusted	Fully adjusted
Essential workers	1.45 [1.34 - 1.56]	1.22 [1.13 - 1.32]	1.16 [1.05 – 1.28]	1.06 [0.96 – 1.17]
Taxi and cab drivers and chauffeurs	3.08 [2.56 - 3.70]	1.39 [1.14 - 1.70]	3.94 [1.634 - 9.48]	2.45 [1.014 - 5.92]
Support staff	2.39 [1.68 - 3.41]	1.74 [1.22 - 2.49]	0.95 [0.673 - 1.34]	0.78 [0.550 - 1.10]
Bus and coach drivers	2.33 [1.81 - 3.00]	1.11 [0.85 - 1.45]	2.95 [1.226 - 7.12]	1.73 [0.716 - 4.18]
Sanitary workers	1.84 [1.46 - 2.32]	1.18 [0.93 - 1.50]	1.78 [1.473 - 2.16]	1.09 [0.892 - 1.33]
Social care	1.83 [1.51 - 2.20]	1.27 [1.04 - 1.53]	1.62 [1.390 - 1.89]	1.18 [1.010 - 1.39]
Van drivers	1.81 [1.48 - 2.22]	1.26 [1.03 - 1.55]	1.59 [0.661 - 3.84]	1.27 [0.526 - 3.06]
Health associate professionals	1.65 [1.26 - 2.16]	1.86 [1.41 - 2.46]	0.92 [0.746 - 1.15]	1.22 [0.969 - 1.54]
Food retail & distribution	1.41 [1.22 - 1.63]	1.14 [0.98 - 1.32]	1.39 [1.187 - 1.63]	1.02 [0.867 - 1.20]
Other transport workers	1.21 [1.02 - 1.43]	1.10 [0.93 - 1.30]	0.36 [0.115 - 1.11]	0.31 [0.098 - 0.95]
Health professionals	1.21 [0.82 - 1.78]	1.45 [0.97 - 2.15]	0.25 [0.079 - 0.76]	0.45 [0.145 - 1.42]
Food production	1.12 [0.86 - 1.45]	1.15 [0.89 - 1.50]	1.48 [0.968 - 2.26]	1.15 [0.750 - 1.77]
Education	0.63 [0.47 - 0.84]	0.91 [0.68 - 1.23]	0.56 [0.446 - 0.70]	0.83 [0.653 - 1.05]
Police & Protective Services	0.45 [0.31 - 0.67]	0.60 [0.40 - 0.88]	0.38 [0.123 - 1.19]	0.50 [0.160 - 1.54]

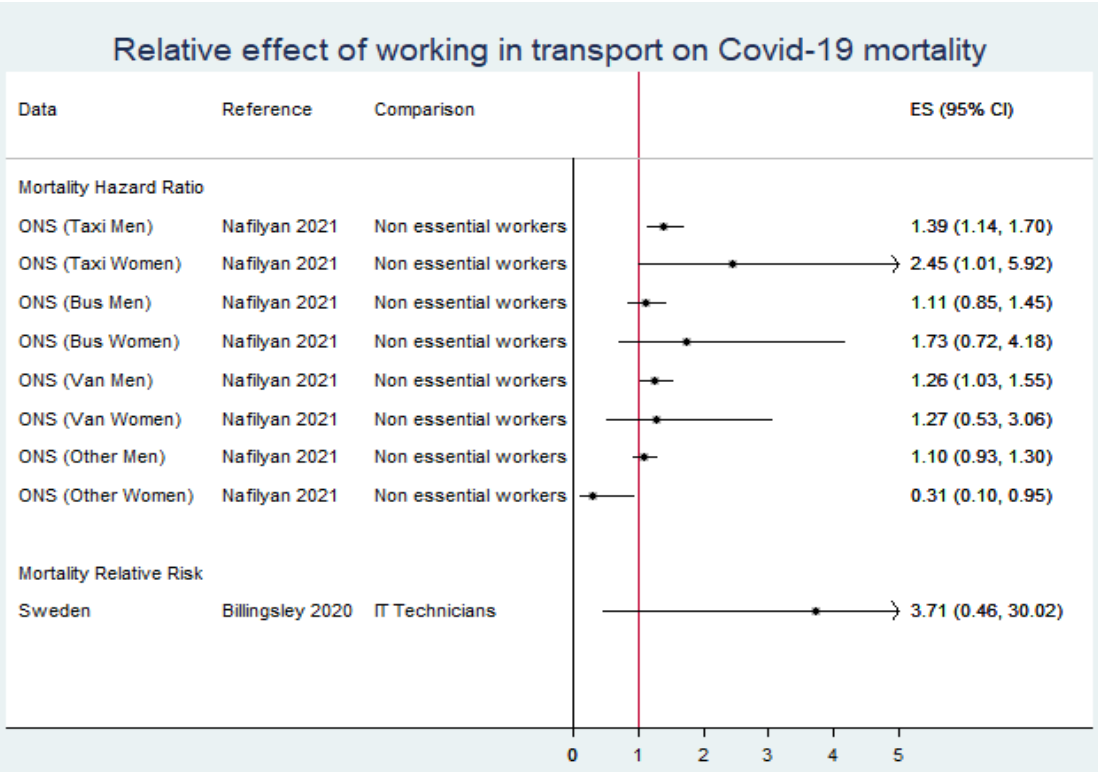
Note: Fully adjusted Cox regression models include geographical factors (region, population density, urban/rural classification), ethnicity, socio-economic characteristics (Index of Multiple Deprivation decile group, household deprivation, educational attainment, social grade, household tenancy, type of accommodation, household size, multigenerational household, household with children), health (body mass index, chronic kidney disease (CKD), learning disability, cancer or immunosuppression, other conditions). See Supplementary Tables S1 for more details.

Nafilyan et al (2021) Occupation and COVID-19 mortality in England: a national linked data study of 14.3 million adults. https://doi.org/10.1101/2021.05.12.21257123

Transport workers

Infection, Covid19, mortality





- Suggestive of increased risk of infection, COVID-19 morbidity and mortality in Transport workers
- However, results vary between and within studies

Public Transport use

Risk factors for acquiring COVID-19 infection outside the household amongst adults during pandemic second wave

n=10,475 , 874 infections (defined by antibody, PCR and lat flow)

Activities	Weekly frequency	Univariate OR (95% CI) p	Multivariate OR (95% CI) p
Leaving home for work or education	No	1.00	1.00
	Yes	1.72 (1.49 – 1.98)	1.20 (1.02-1.42)
		P<0.0001 (PAF=17%)	P=0.031 * (PAF=7%)
Weekly frequency of using public transport	0	1.00	1.00
	>0 -1	1.38 (1.15 – 1.66)	1.24 (1.03 – 1.49)
	>1	2.35 (1.95 – 2.83)	1.82 (1.49 – 2.23)
		P<0.0001 (PAF=15%)	P= <0.0001 (PAF=14%)
Weekly frequency of any retail	0	1.00	1.00
	>0 -1	1.59 (1.22 – 2.07)	1.45 (1.09 – 1.92)
	>1	2.01 (1.57 – 2.56)	1.69 (1.29 – 2.21)
		P<0.0001 (PAF=39%)	P= 0.0003 (PAF=34%)
Weekly frequency of other activities (excluding retail, work, education, public transport and healthcare use)	0	1.00	1.00
	0.5 – 1.5	1.23 (0.89 – 1.69)	0.99 (0.71 – 1.39)
	2 – 3	1.31 (0.95 – 1.81)	0.88 (0.63 – 1.23)
	3.5 – 5	1.58 (1.16 – 2.16)	0.97 (0.69 – 1.36)
	> 5	1.53 (1.11 – 2.10)	0.87 (0.61 – 1.23)
		P=0.0066 (PAF=23%)	p= 0.6188

Activities	Weekly frequency	Univariate OR (95% CI) p	Multivariate OR (95% CI) p
Ethnic group	White	1.00	1.00
	White Other	1.13 (0.85 – 1.52)	0.67 (0.49 – 0.92)
	Asian	1.67 (1.14 – 2.45)	0.97 (0.65 – 1.47)
	Black	1.12 (0.45 – 2.83)	0.65 (0.25 – 1.66)
	Mixed	1.27 (0.55 – 2.97)	0.69 (0.29 – 1.66)
	Other	0.99 (0.36 – 2.79)	0.56 (0.19 – 1.61)
		P= 0.230	P=0.1153
Deprivation score (IMD quintile) 1= most deprived	1	1.27 (0.97 – 1.68)	0.93 (0.69 – 1.25)
	2	1.52 (1.24 – 1.88)	1.14 (0.91 – 1.42)
	3	1.17 (0.95 – 1.43)	1.02 (0.83 – 1.26)
	4	1.10 (0.91 – 1.33)	1.02 (0.84 – 1.24)
	5	1.00	1.00
		P=0.0026	p=0.698

With permission from Prof Andrew Hayward

Qualitative Deep Dive

What do we know about the risk of SARS-CoV-2 transmission in this sector?

- Strategically important essential service.
- Early evidence suggested an increased risk of contracting COVID-19 for public transport workers.

Research questions

1. What are **the perceptions of risk** of transmission by the various stakeholders (experts (research / policy), organisational leaders, unions, middle management, employees, passengers)?
2. What are the **mitigations** being put in place and the **perceived effectiveness** of these risk mitigation strategies?
3. What are the **major knowledge gaps** that will need to be addressed in the short and longer term?

Deep Dive Methods:

- Significant informal **engagement exercise** with people working in and with the public transport sector Nov – Dec 2020.
- Lit review and engagement took place concurrently to **inform the design** of the study.
- **Focus** on rail (including light rail / tram), bus and taxi.
- **Semi-structured interviews** with
  - **Experts** (policy / research / regulators) & **organisational leaders** (including unions) between Jan – Mch 2021.
  - **Workers & passengers** (April – May 2021).
- Interview data analysed **thematically** using NViVo.

Qualitative study in Public Transport

February – May 2021

Type of respondent	Number
Expert - Research	5
Expert - Government / policy	7
Expert - Industry / regulator	5
Org leader / union	13
Workers – rail / bus	5
Passengers	12 Mix of current and lapsed users for all modes PT (rail, bus, taxi, tube, tram)
Total	47

Perception of risk of viral transmission

- Perceived risk of transmission was generally **low** but **risk not constant**
- Feelings of safety reliant on observations of **compliance** with mitigation measures by the transport operators, transport staff, and other passengers, alongside policing of these measures.
  - Including compliance with: **cleaning**, **social distancing**, **face coverings**
  - **Contraventions of mitigation** measures undermined perceptions of safety.
- Vaccination programme increased confidence in public transport for passengers but new variants of COVID-19 counterbalanced this view.
  - Experts raised concerns that **vaccines** may lead to over-confidence and reduced compliance with mitigation measures.
- Confidence to use public transport was seen as a **balance** between transmission rates, vaccines, mitigations, new variants, and compliance with behaviour.

Perceived risk affected by :

- **time of day**
- **where** you are travelling to and from
- journey **duration**
- **rural vs urban** settings
- **type of vehicle**
- **co-passengers**

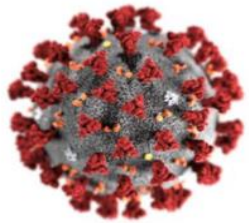
Risk Mitigations and effectiveness

- Most perceived mitigations to be **appropriate and effective**
- **Difficult to determine which mitigations were working** – introduced at pace at same time.
- Effectiveness perceived as dependent on the relative importance of **transmission routes**
- Effectiveness of **behavioural** mitigations was seen as being dependent on the compliance of individuals with these measures.
    - Responsibility at the individual level caused some issues
- Clear **messaging** about the effectiveness of the mitigations on public transport was seen to be essential for the return of many passengers

- Cleaning
- Face masks/coverings
- Social Distancing
- Ventilation
- Reducing contact
- Prioritising employee health

Knowledge gaps

- Initially, organisational leaders and experts found it difficult to source consistent and timely information to help facilitate their decision-making.
- Lack of clear scientific evidence / objective data for the public transport sector
- When **outbreaks** have occurred difficult to tell (in many cases) if it was work related, travel to and from work related or community related
- Calls for an evaluation of mitigation measures, to determine **effectiveness** and **sustainability**
- Understanding and predicting **passangers' behaviour** in varying circumstances
- Uncertainty over what the demand for public transport would look like in the future:
  - Public confidence in using public transport and how to encourage use of PT
  - Shifting travel patterns



Conclusions

- **Increased risk** for infection and mortality for employees (at least initially). This may have reduced over the course of the pandemic due to low passenger numbers.
- Drastic **interventions** resulted in reduced PT usage, which is still not recovered
- Suggestion that **use of PT** is also associated with increased risk of infection.
- **Perception of risk** generally low in the UK and generally satisfaction that risk mitigation measures were implemented rapidly
- However, **context** of low passenger numbers and relatively good adherence to guidance –
  - Passenger numbers have increased, although still lower than expected
  - Adherence to mask wearing, social distancing etc seems to have collapsed in England. Different rules in place in devolved nations.
- **Lacking objective data** about the effectiveness of different mitigations, in isolation and together.
- **Need further knowledge** of behavioural issues and impact of messaging / communication.
- **Link to wider agendas / longer term planning** e.g. Green / carbon neutral, accessibility of PT, subsidies / funding models, future passenger demand prediction.

Acknowledgements

UK COVID-19 National CORE Studies Consortium

UoM
Anna Coleman
Nicola Gartland
Sarah Rhodes
Matt Gittins
Katie Stocking
+ many others

LSHTM
Neil Pearce
+ others

UCL
Andrew Hayward
Sarah Beale

ONS
Vahe Nafilyan
+ others

HSE
David Fishwick
+ others

This work was supported by
i) funding from the PROTECT COVID-19 National Core Study on transmission and environment, managed by the Health and Safety Executive on behalf of HM Government

ii) A grant from the COLT Foundation

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Thank you

Martie van Tongeren

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