INSTITUTE of HEALTH EQUITY

REDUCING HEALTH INEQUITIES THROUGH ACTION ON THE SOCIAL DETERMINANTS OF HEALTH

INITIAL ASSESSMENT OF LONDON BUS DRIVER MORTALITY FROM COVID-19

About this report:

This initial assessment report was produced by the UCL Institute of Health Equity and was commissioned by Transport for London.

Publication:

UCL Institute of Health Equity, 2020

www.instituteofhealthequity.org

Report authors: Professor Peter Goldblatt, Dr Joana Morrison, Institute of Health Equity, University College London, London, UK.

EXECUTIVE SUMMARY

Death rates from COVID-19 among bus drivers in London exceeded death rates for London as a whole in the majority of weeks from early April to early May.

Bus and coach drivers are among the occupations that ONS reported as having elevated mortality from COVID-19. Many of these occupations also have increased levels of exposure to the general public. It seems likely that this exposure has contributed to the increased risk. To the extent possible, it is important to separate occupational exposure from other influences on bus drivers. Additional risks of COVID-19 related mortality for bus drivers include: age, living in areas characterised by deprivation, having a high proportion of members of Black, Asian, and Minority Ethnic (BAME) groups; and the presence of underlying health conditions – hypertension, cardiovascular disease and diabetes – which are associated with increased likelihood that infection with COVID-19 becomes fatal.

It is impossible at this stage to establish which of these risks is greatest, but there is evidence that among bus drivers those aged 65 and over, those from BAME backgrounds and those with pre-existing hypertension are at higher risk of Covid-19 mortality and this should be taken into account in efforts by TfL and bus companies to reduce risks.

BACKGROUND

The COVID-19 pandemic spread to the United Kingdom in late January 2020 and the first confirmed case of COVID-19 in London was detected on 12 February 2020. The first reported COVID-19 death in England was on 6 March 2020. By mid-March, there were almost 500 confirmed cases and 43 deaths were recorded as being due to COVID-19, of which 23 were in London. By early May there had been 46,000 more deaths in England compared to what would be expected in the same period based on death rates in 2015-19, 9,000 of which were in London.

Following the tragic deaths of a number of colleagues among bus operators within London, Transport for London (TfL) requires a full understanding of the COVID-19 prevention and control measures required to protect the health, safety and wellbeing of bus workers in London. To do this, TfL have indicated their wish to understand the pattern of infection with, and deaths from, COVID-19 in the London bus worker population to inform recommendations on any additional occupational health measures that should be put in place to protect this key-worker population.

To this end, this report presents the results of part one of a two-stage review, commissioned by TfL of the potential risks for mortality from COVID-19 among bus drivers and related actions and measures that have been implemented to date. The aim is to consider what is working and whether any elements should be amended or further improved. Recommendations for any additional occupational health measures will be considered in stage two of the review.

MORTALITY AMONG BUS DRIVERS IN ENGLAND AND WALES – RISKS FROM COVID-19

For deaths in England and Wales, ONS have published occupational mortality from all causes and deaths involving COVID-19 between March and May 2020. The all cause death rate for bus and coach drivers of 128 per 100,000 was greater than that for all occupations (78 per 100,00) and almost double what would have been expected from the mortality of bus and coach drivers in the previous five years. There were 70 more deaths to bus and coach drivers in England and Wales than would have been expected, of which 53 deaths included COVID-19 on the death certificate and 17 did not.

PATTERNS IN LONDON BUS DRIVER MORTALITY

Among the 10 bus companies operating for TfL, 34 of the 30,000 employees are reported to have died of COVID-19. Of these deaths, 29 were to the 25,000 bus drivers. However, one occurred to a driver who went on sick leave for other reasons before February 2020 and another occurred in June 2020. To align with other data available at the time our analyses were performed, this report covers deaths in the three months March to May 2020 and focuses on the 27 deaths to bus drivers who were working since the start of the epidemic in London (February 2020).

For those aged under 65, we were able to estimate the age standardised COVID-19 rate for bus drivers in London. It was 68 per 100,000, compared to 44 for bus and coach drivers in England and Wales and 19 for all occupations in England and Wales.

Although every one of these deaths is sadly one too many, the numbers available are insufficient to draw firm conclusions about the respective role of occupational and other potential factors identified by ONS. We also did not, at this stage in the review, have access to the level of detail about London bus drivers who did not die to accurately quantify relative risks. This should be available in stage 2, from which we will be able to draw more conclusions about relative risks and about the measures required to reduce these risks.

To the extent that was possible with the available data, we identified several main patterns in the mortality data:

First, among drivers who died, most ceased work between mid-March and early April i.e. in the 10 days either side of lockdown on 23 March. This suggests that they became infected before lockdown. After lockdown, death rates came down among drivers as they did in London as a whole and nationally. The study reinforces the point that lockdown is the most effective measure for reducing

mortality among bus drivers; it significantly reduced passenger use of buses and hence reduced risk of infection for bus drivers as well as passengers. In addition to reducing exposure of drivers to infection in their line of work, lockdown reduced overall levels of transmission in London. Had lockdown come earlier it is likely that many fewer bus drivers would have died.

Second, among 13 deaths certificates provided to us by relatives of drivers who died, in seven cases, hypertension was identified by the certifying doctor as a contributory factor to the death. This may be indicative of both the sedentary nature of bus driving and work stress. The health risks to bus drivers in London has been known since Morris published successive research papers between 1953 and 1966 and studies in the United States have indicated similar risks associated with the occupation. The implications are twofold. It is especially important to protect drivers, firstly, from infection because of the high background risk to health related to their job, deprivation and demographic characteristics and, secondly, to focus on prevention of hypertension.

Third, among the deaths were a high proportion of people from BAME backgrounds. We do not have sufficient detail to quantify the level of increased risk, but we note the possibility that employment in front line occupations may contribute to the increased risk of COVID-19 mortality in BAME groups.

Fourth, deaths were unequally distributed by type of area in which drivers lived. A high proportion of deaths were to people living in areas of above average deprivation and three-quarters of those who died lived in the quarter of London Boroughs with the highest COVID-19 death rates in April 2020.

Fifth, while death rates varied between bus companies, without more detail of age structure and other characteristics, it is not possible to draw conclusions about whether the differences were at statistically significant levels and/or explained by other factors. This will be considered in the second stage of the Review.

ACTIONS TAKEN BY BUS COMPANIES

In terms of actions to prevent infection, we analysed 14 of the actions that were identified by bus operators and TfL as potentially reducing COVID-19 transmission and were initiated in the period March to early June by operators. These actions comprised those related to vehicles (daily antiviral cleaning, enhanced cleaning, closing holes on assault screens, restricted access to front seats and middle door boarding), to drivers (communications, HR policies and advice, hand sanitiser, wipes and masks) and to premises (access to toilets, enhanced cleaning, adapted premises/social distancing, health and safety/union reps stood down and cleaning inspections). On average, operators implemented 13.3 of these 14 actions.

However, there was variation in the timing of implementation by TfL and bus companies. On average, 5.3 actions were taken before lockdown took place on 23 March and a similar number after the peak of mortality was reached in the week ending 3rd April (with an average of 2.6 between 23rd March and 3rdApril). As indicated, above, this timing makes it unlikely that they affected the majority of infections leading to death – which mainly occurred before lockdown

The timing of actions by TfL and most bus companies was related to when advice was available from WHO, PHE and the science on what would be effective. Several bus operators were, however, slower in initiating some of the actions recommended and there was inconsistent action and advice. While

any delays in taking action are unlikely to have contributed to the death rates from COVID-19 among bus drivers, that does not mean that all the actions were ineffective – simply that they were not really tested.

RECOMMENDATIONS

- Many bus drivers are at high risk of COVID due to the occupation of bus driving and proximity to the public, their age, sex, pre-existing health conditions, BAME and area of residence. All bus drivers and particularly those with multiple risk factors need enhanced protection through early interventions on ill-health prevention and reducing exposure during epidemics. Companies have taken a wide range of actions, but not at the same pace. As passenger numbers increase again, it will be important to have confidence that the planned actions are likely to be effective, are led by the scientific evidence and are implemented simultaneously across bus companies with clear recommendations for early adoption of measures in the event of a second spike. There is scope for TfL to develop clear guidance on rapid and simultaneous implementation of measures in the event of spikes of infection in London or increased infection rates among staff.
- BAME staff, especially those living in poorer areas, are more at risk of becoming severely ill and dying from COVID-19. The recommendations in PHE's recently published report "Beyond the data: Understanding the impact of COVID-19 on BAME groups" should be implemented. In particular that employers should have strategies to create healthy and supportive workplaces (within and outside the health service) that have zero tolerance for discrimination and empower BAME staff to raise concerns about occupational risk and safety
- TfL's occupational risk assessment tool should be used by London bus companies to identify those most vulnerable - with the oversight of TfL- to reduce the risk of employee's exposure to and acquisition of COVID-19.
- The contribution of pre-existing health conditions, known to increase the severity of COVID-19, suggests a need to introduce criteria for staff by TfL and bus operators to be offered additional protection. This would enable TfL and bus companies to make arrangements to protect those now known to be more vulnerable, as understanding of the disease increases. Improved engagement with health promotion initiatives and uptake of preventive interventions is also essential, to reduce the risk of diseases such as hypertension, diabetes and cardiovascular disease.

TABLE OF CONTENTS

BACKGROUND

Following the tragic deaths of a number of colleagues among bus companies operating routes within London, TfL requires a full understanding of the COVID-19 prevention and control measures required to protect the health, safety and wellbeing of the bus community in London. As consideration turns to the changes in lock down restrictions and longer-term recovery, TfL needs to continue to work with bus operators to take appropriate, effective, evidence-based action to minimise the risk to bus workers from COVID-19

To do this, TfL wish to better understand the pattern of infection with and deaths from COVID-19 in the London bus worker population. This will inform recommendations on any additional occupational health measures that should be put in place to protect this key-worker population.

To this end, TfL have commissioned UCL Institute of Health Equity to:

- First undertake a rapid, short term review of the actions and measures that have been implemented to date, to consider what is working and whether any elements should be amended or further improved.

- Second, in parallel, to commission a more detailed study to understand the pattern of infection with deaths and sickness from COVID-19 in bus workers to inform recommendations on any additional occupational health measures that should be put in place to protect this key worker population.

This report concerns the first stage of the review.

As background to this first stage, we describe

- The COVID-19 situation nationally and in London, including the scale and timing of the pandemic

- Existing evidence of risk factors for adverse outcomes of COVID-19 relevant to London bus drivers, including COVID-19 death rates by ethnicity, deprivation, pre-existing health and age in London

- The evidence of the scale of risk of COVID-19 mortality represented by these factors.

Based on this analysis, we then look at the relationship between the timing of illness of those who died, the progress of the epidemic, those actions taken by TfL and bus companies, the consistency of these actions across companies and whether this provides evidence concerning their effectiveness. We focus on 14 actions considered most likely to have protected both drivers and their passengers from the spread of COVID-19 during bus journeys.

From this evidence we indicate:

- What conclusions can be drawn about the efficacy of the measures taken
- What further evidence and analysis is needed in the second stage of the study
- What short term actions are suggested by this analysis, in addition to those already in place.

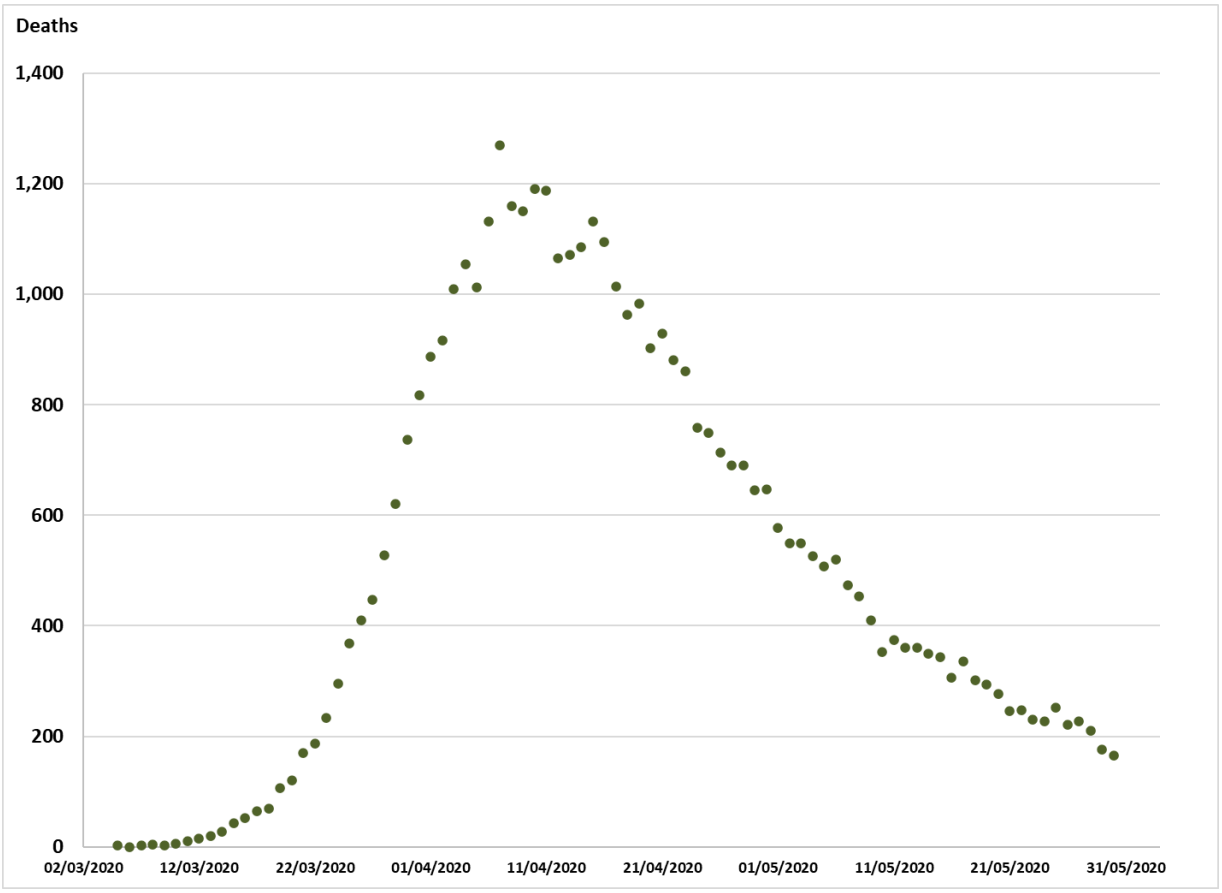
1. COVID-19 SITUATION NATIONALLY AND IN LONDON

The COVID-19 pandemic spread to the United Kingdom in late January 2020 and the first confirmed case of COVID-19 in London was detected on 12 February 2020. The first reported COVID-19 death in England was on 6 March 2020. By mid-March, there were almost 500 confirmed cases and 43 deaths were recorded as being due to COVID-19, of which 23 were in London.

TIMING OF COVID-19 DEATHS IN LONDON

In contextualising the pattern of deaths of bus drivers, it is useful to identify the timing of deaths in the community more generally. Figure 1.1 shows the daily occurrence of deaths where the death certificate indicated the involvement of COVID-19 in England as a whole. This shows that these deaths peaked over the Easter weekend and have been slowly declining since then, with numbers of deaths declining at a rate of five deaths per day at the end of May.

Figure 1.1 Number of deaths involving COVID-19 occurring up to 31 May 2020, England



Note: based on registrations to 13 June, adjusted for expected late registrations.
Source: ONS, 2020 (1).

EXCESS COVID-19 MORTALITY IN LONDON

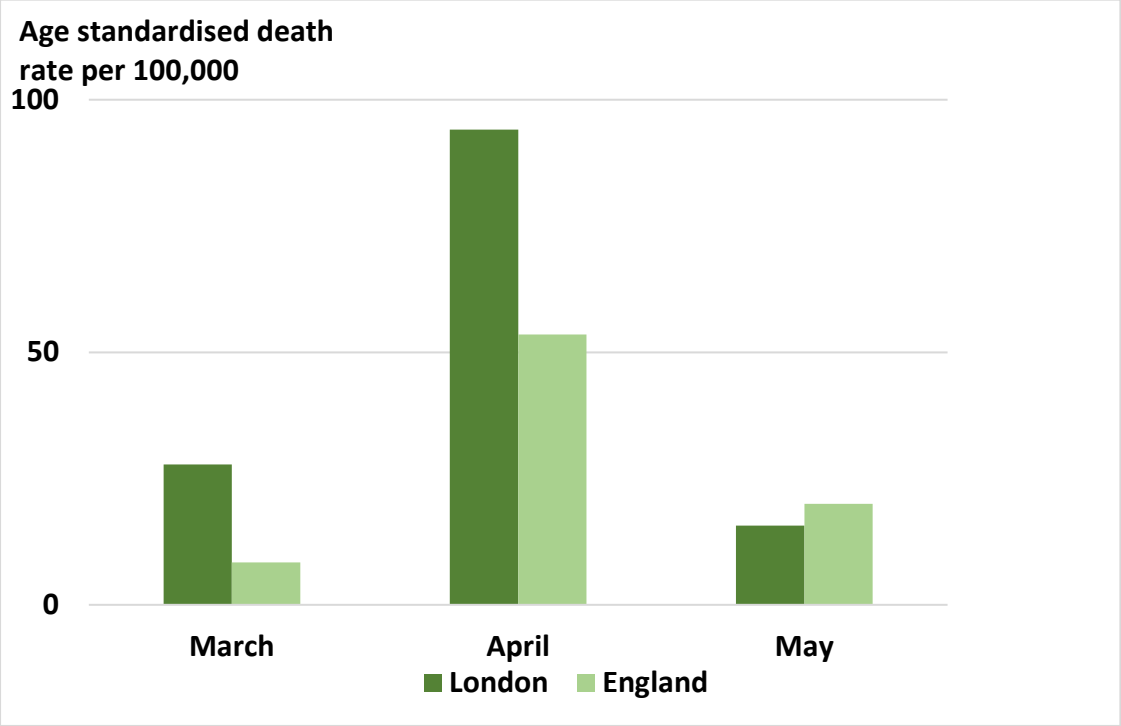
ONS analysis shows that between 1 March and 17 April 2020, local authorities in London had the highest mortality rates from COVID-19 in England, an age-standardised mortality rate involving COVID-19 of 137.6 deaths per 100,000 persons. This was statistically significantly higher than any other region in England and more than a third higher than the region with the next highest rate (1).

Figures 1.2 a) and b) show how the change in death rates in London for deaths mentioning COVID-19 and those not doing so (non-COVID mortality), respectively, compared with that for England as a whole over the period April to May after controlling for age. The majority of deaths in excess of what were expected, based on death rates in the same months in 2015-19, occurred in those aged 75 and over, with 20,841 (45%) in those aged 85 and over and 13,921 (30%) in those aged 75 to 84. While this illustrates the size of the epidemic in London in particular, it should be noted that numbers of deaths and deaths rates at ages more relevant to bus drivers were much smaller, as most drivers who died were aged under 75. London had higher COVID-19 mortality rates in April to May, compared with England, but lower non-COVID mortality rates, shown in Figure 1.2. The non-COVID rates include people who may have contracted COVID-19 but died without a diagnosis (e.g. deaths at home that were not tested). The overall impact of COVID-19 is therefore assessed through comparisons with deaths rates in a comparable period in earlier years. It is unclear whether any deaths of bus drivers with undiagnosed COVID-19 occurred and were consequently not reported. In this context of expected levels of mortality, we note that overall death rates in London were lower than for England in 2015-19 (1).

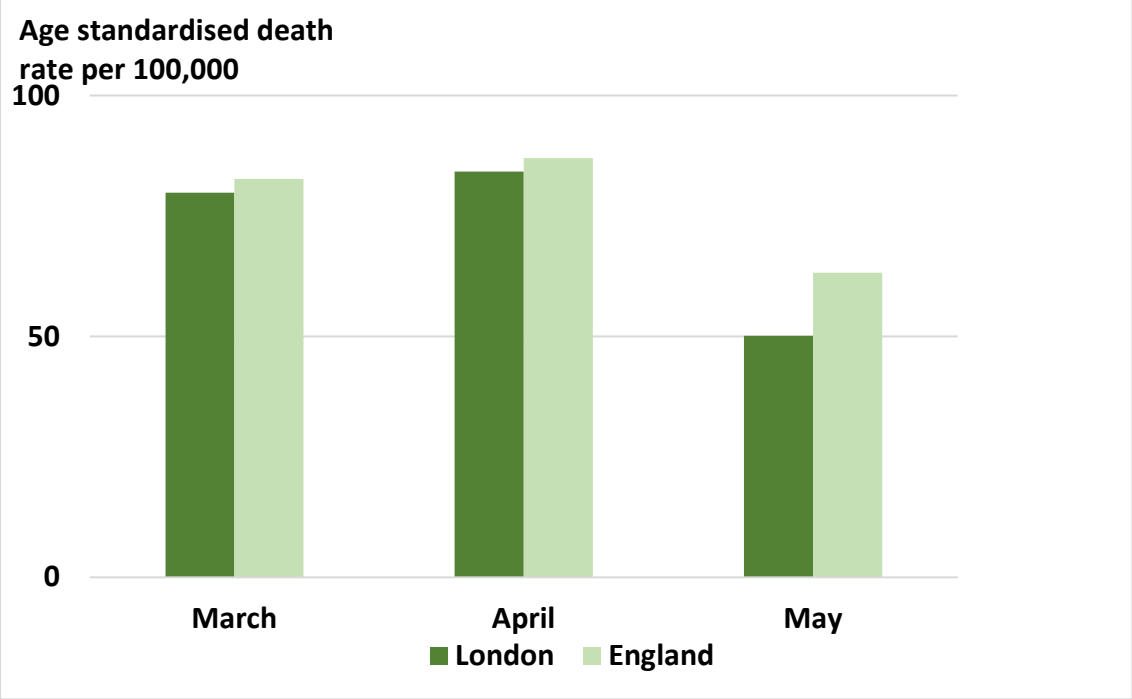
As an indication of the importance of the pandemic in London, we note that in April age-standardised death rates from COVID-19 exceeded those from non-COVID-19 causes. By sharp contrast, both in March and May non-COVID-19 death rates were higher than COVID-19 death rates.

Figure 1.2 Age standardised death rates in London and England: deaths with and without a mention of COVID-19, March to May 2020

a) COVID deaths



b) Non-COVID deaths



Source: ONS, 2020 (1).

As shown in In Table 1.1 from late March to early May, there were 2.3 times as many deaths in London as would be expected on the basis of mortality rates in the previous five years, compared to a figure of 1.7 for England as a whole (2). COVID-19 deaths comprised 81.7 percent of the excess deaths in London in that period.

Table 1.1 Cumulative all-cause deaths by date of registration and region, 20 March to 7 May 2020 England.

	Observed deaths	Expected deaths	Ratio observed/expected	Excess deaths	COVID-19 deaths	COVID-19 deaths as % excess
London	**16073**	**7038**	**2.3**	**9035**	**7383**	**81.7**
England	**116269**	**70213**	**1.7**	**46056**	**35439**	**76.9**

Source: Public Health England excess mortality model based on ONS death registration data (2).

For deaths in England and Wales, ONS have published occupational mortality from all causes and deaths involving COVID-19 between March and May 2020 (3). Table 1.2 shows the numbers and rates for the occupation group bus and coach drivers aged 20 to 64 years in this period. Based on their mortality in the five years 2015-19, 78 deaths would have been expected in this occupation group in this period. Thus, there were 70 more deaths to bus and coach drivers than would have been expected, of which 53 deaths included COVID-19 on the death certificate and 17 did not. The all cause death rate for bus and coach drivers of 128 per 100,000 was almost twice what would have been expected from mortality in the previous five years. By contrast, the difference in mortality for 'all occupations' was less (78 compared to 61 expected), than the difference among bus and coach drivers, from 128 compared to 65 expected.

Table 1.2 Deaths to male bus and coach drivers at ages 20-64 years involving COVID-19 and from all causes England and Wales. Deaths registered between 9th March and 25th May 2020.

	Bus and coach drivers		All occupations
	Numbers of deaths	Age-standardised rates per 100,000 population	Age-standardised rates per 100,000 population
All causes of death	148	128	78
Deaths expected based on rates in the same period in 2015-19	78	65	61
Deaths involving COVID-19	53	44	19
Excess deaths from other causes	17	19	-2

Note: A negative excess indicates fewer deaths than would have been expected on the basis of death rates in 2015-19

Source: ONS, 2020 (3)

In their analysis of COVID-19 related occupational mortality, ONS identified a number of characteristics of occupational groups that may have contributed to raised levels of COVID-19 mortality. These included proximity to others, exposure to disease, median hourly pay, and the percentages of the workforce that are female, aged 55 years and over and from a BAME background. At a national level, bus and coach drivers were identified has having arms-length proximity to others (a score of 75 on a scale of zero to 100), slightly below the national median hourly pay, a low percent of female workers (nine percent compared to an average of 49 percent) and a relatively high percent of BAME workers (19 percent compared to an average of 11 percent) and an older workforce (41 percent aged 55 and over compared to an average of 21 percent) (4).

Among all occupations ONS identified 17 larger occupation units that had elevated levels of COVID-19 mortality in men, including bus and coach drivers. These had proximity to others ranging from 48 (cleaners and domestics) to 90 (nursing auxiliaries and assistants). Among these 17 occupation units there were moderate statistical correlations between proximity score and mortality from COVID-19 and between percent BAME and COVID-19 mortality. There was a weaker relationship between percent BAME and proximity. This suggests that some part of higher BAME COVID-19 mortality is linked to a greater propensity to work in jobs with greater proximity to others.

1.1 COVID-19 DEATH RATES BY ETHNICITY, DEPRIVATION AND AGE IN LONDON

The demographic and social characteristics of bus drivers and those who died are discussed in Sections 2 and 3, respectively. To provide context to that discussion, we summarise here the most recent evidence from ONS and PHE on how these factors are related to the risk of dying from COVID-19.

ONS data show that the COVID-19 mortality rate increased consistently with age. In each age group where a rate was recorded, males had a higher age-specific mortality rate than females. This difference was significant in all age groups starting from those aged 40 to 44 years (5).

AREA DEPRIVATION AND COVID-19

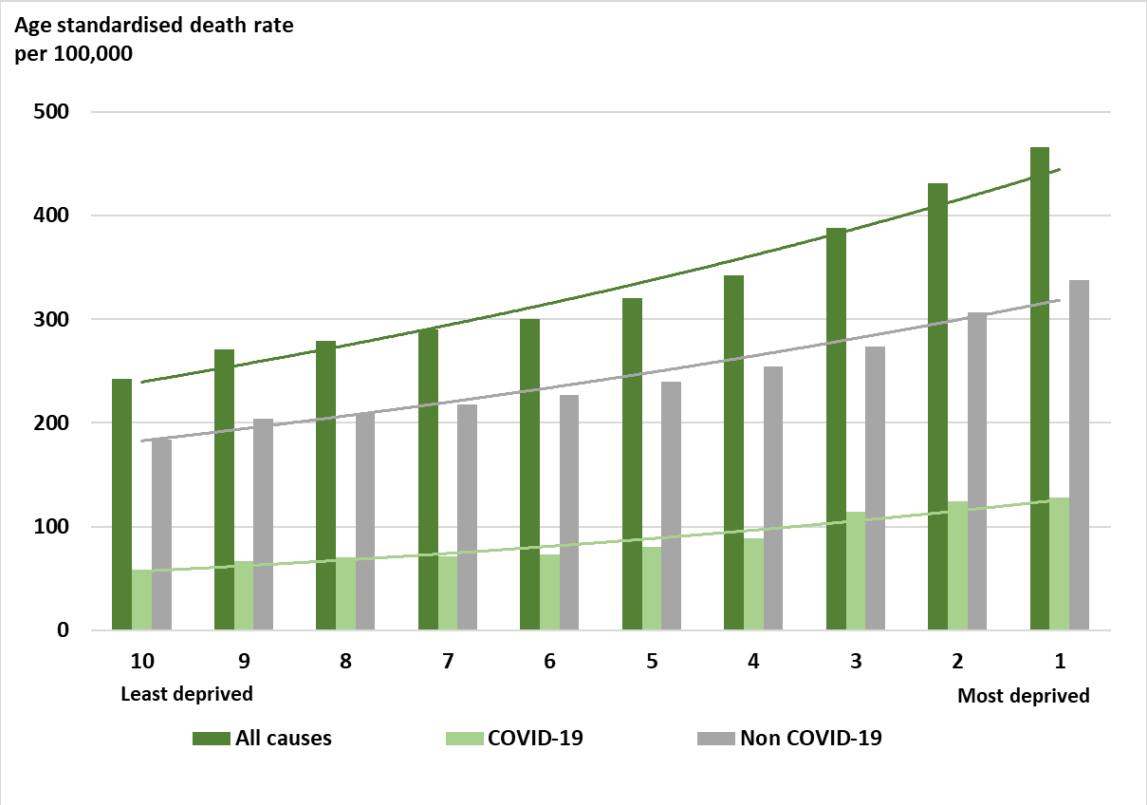
PHE have reported, people in deprived areas are more likely to be diagnosed and to have poor outcomes following diagnosis of COVID-19 than those in less deprived areas. High diagnosis rates may be due to geographic proximity to infections or a high proportion of workers in occupations that are more likely to be exposed, including bus drivers. They note that poor outcomes remain after adjusting for ethnicity, but the role of underlying health conditions in more deprived areas is not yet fully understood, although there is growing evidence on pre-existing conditions that increase the risk of death from COVID-19 (6) (2).

All-cause mortality rates from March to May 2020 in the most deprived areas in England were 1.9 times those in the least deprived areas (Figure 1.3). The comparable ratios for deaths mentioning COVID-19 and those that did not mention COVID-19 were 2.2 and 1.8, respectively (1). The deprivation inequality related to COVID-19 is therefore even higher than that of other causes of death. In the comparable period in 2014-18, the all-cause mortality ratio was the same as in 2020 i.e. 1.9 (2), suggesting that the larger deprivation ratio for COVID-19 mortality did not change overall inequalities. This may reflect the effect of COVID-19 as a contributory factor in the deaths of people with serious underlying health conditions.

As indicated earlier, not all those who died with COVID-19 would have had it diagnosed and mentioned on the death certificate. The majority of testing for COVID-19 in March to May was been offered to those in hospital with a medical need as well as NHS key workers, rather than the general population. Confirmed cases therefore represent the population of people with severe disease and those working in the NHS, rather than all of those who get infected (2). Survival among confirmed cases, after adjusting for sex, age group, ethnicity and region was lower in the most deprived areas, particularly among those of working age (2).

To overcome any undercounting of deaths associated with the COVID-19 epidemic, including those undiagnosed COVID-19 cases, PHE analysed overall excess mortality in the period between 20 March and 7 May 2020 by area deprivation. This suggests that there may have been a small effect of the epidemic on overall inequalities. They showed that there was excess mortality among all five deprivation quintiles. The crude number of excess deaths ranges from 10,678 in the most deprived quintile areas to 8,621 in the least deprived, a slightly larger relative increase in the most deprived quintile (2).

Figure 1.3 Age-standardised mortality rates, all deaths and deaths involving the coronavirus (COVID-19), Index of Multiple Deprivation, England, deaths occurring between 1 March and 31 May 2020



Source: ONS, 2020 (1).

Monthly analyses by ONS of death rates among men by deprivation deciles in England during March and April 2020 - the two months during which the majority of deaths among bus drivers took place - shows a clear pattern. All-cause mortality rates for men during March and April in London were lowest in the least deprived decile (mortality for men in decile 10 in March was 84.4 and in April: 127.6) and increased as deprivation levels increased (the age standardised mortality rate for men in decile 1 in March was 160.2 per 100,000 and in April it was 256.4 per 100,000) (1).

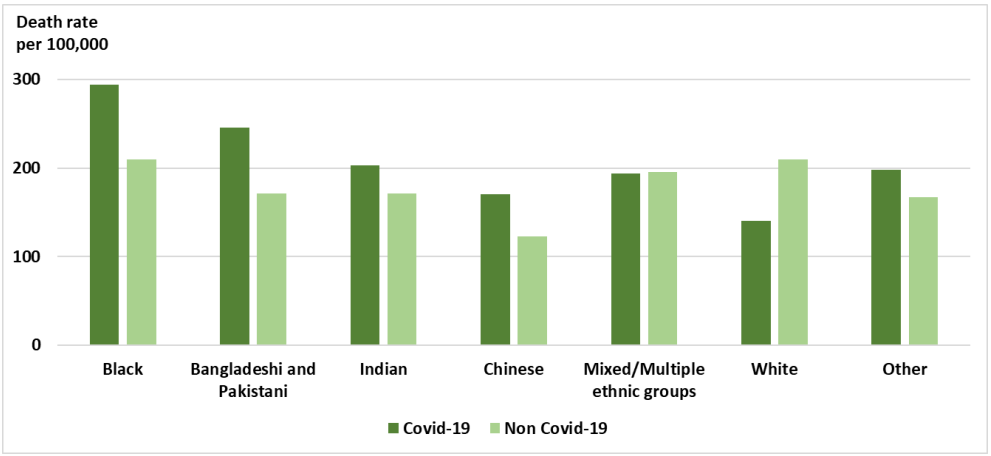
COVID-19 AND BAME MORTALITY

Individuals from BAME groups are more likely to work in occupations with a higher risk of COVID-19 exposure, including public transport workers (7) (6). In 2019, figures for the United Kingdom indicate that 19 percent of the bus driver workforce was drawn from BAME groups, compared to 11 percent of the workforce overall. The BAME figure for London bus drivers is much greater – 54 percent (see Section 2). In terms of COVID-19 risk in occupations with a high proportions of BAME workers, it is also worth noting that research suggests individuals in BAME groups are more likely to use public transportation to travel to their essential work, leading to additional routes of exposure (8) (7) (6). It is unclear whether this would apply to bus drivers travelling to work.

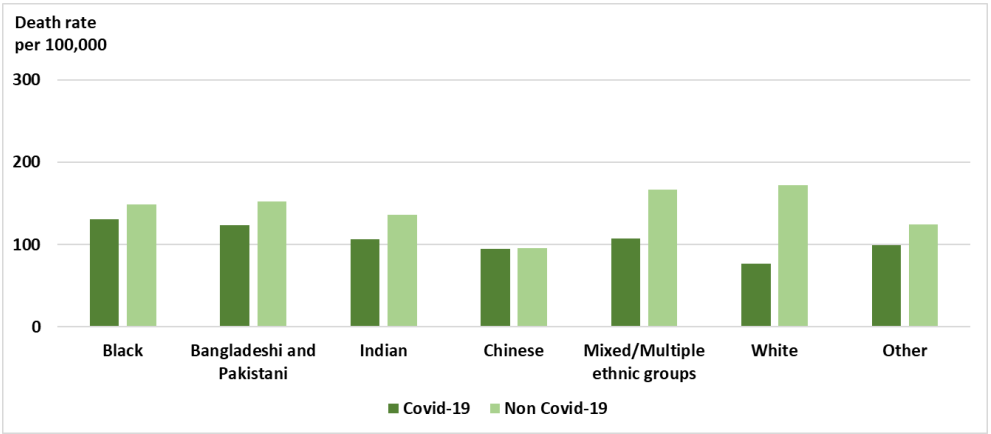
Figure 1.4 shows that in London, all BAME groups had higher mortality from COVID-19 than those from white backgrounds, but similar or lower levels of mortality from other causes between March and mid-May. This greater mortality impact of COVID-19 compared to other causes of death in BAME groups was most pronounced for men whose ethnicity was were Black, Bangladeshi or Pakistani. Excesses were all larger for men than women.

Figure 1.4 Age standardised death rates from COVID-19 and other causes by ethnicity at ages 9 to 110, London, 2 March 2020 to 15 May 2020

(a) Males



(b) Females

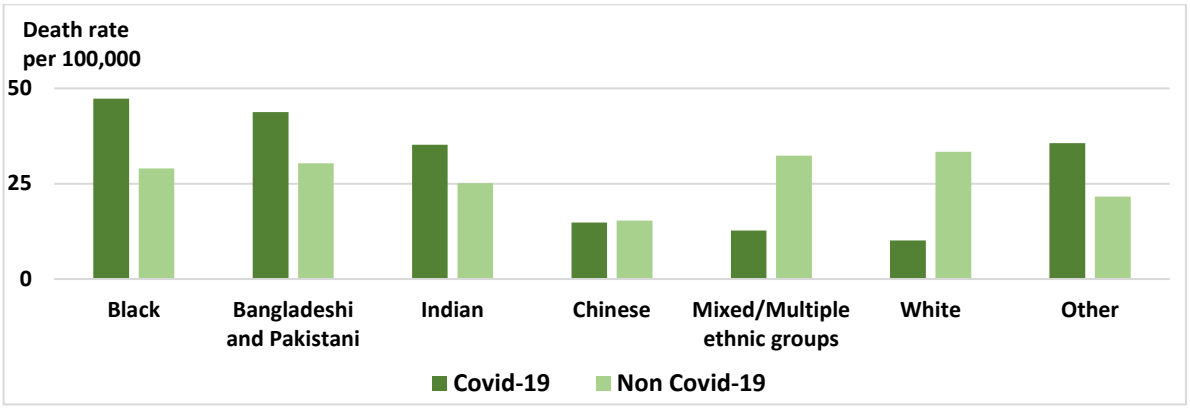


Source: ONS, 2020 (9).

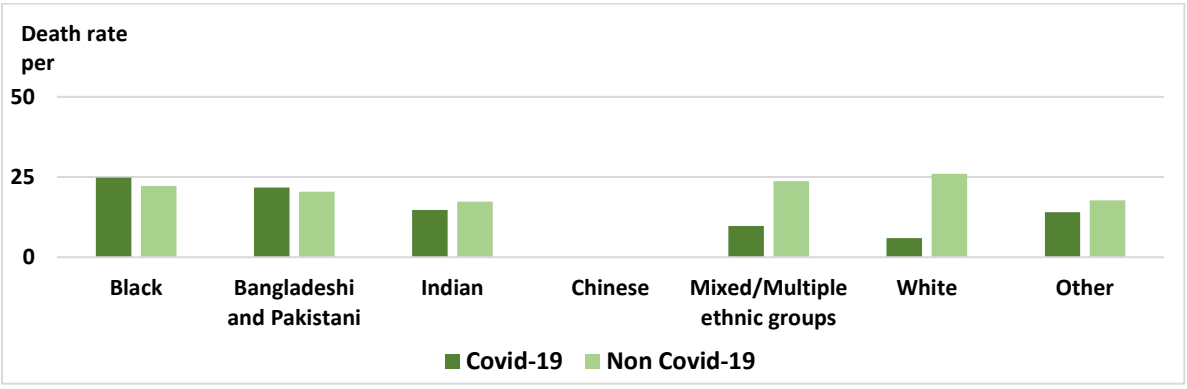
The proportion of BAME groups aged 65 and over in England is much smaller than for white groups (5 and 18 percent, respectively). Similarly, the overall proportion of bus workers aged 65 and over is small (4 percent – see Section 2). For this reason, it is important to consider the differences in COVID-19 impact by ethnic group at ages under 65, as well as at all ages. Mortality analysis at ages between nine and 64 is currently only available for England as a whole, rather than specifically for London - Figure 1.5. Although based on much lower death rates in all groups, the relative risk of COVID-19 mortality compared to white groups is greater for black, Bangladeshi/Pakistani and Indian men than that shown in Figure 1.4 which covered those aged 9 to 110. Taken together, these two figures provide a basis for comparing mortality of BAME bus drivers in London to that in the community in March to May 2020.

Figure 1.5 Age standardised death rates from COVID-19 and other causes by ethnicity at ages 9 to 64, England and Wales, 2 March 2020 to 15 May 2020

(a) Males



(b) Females

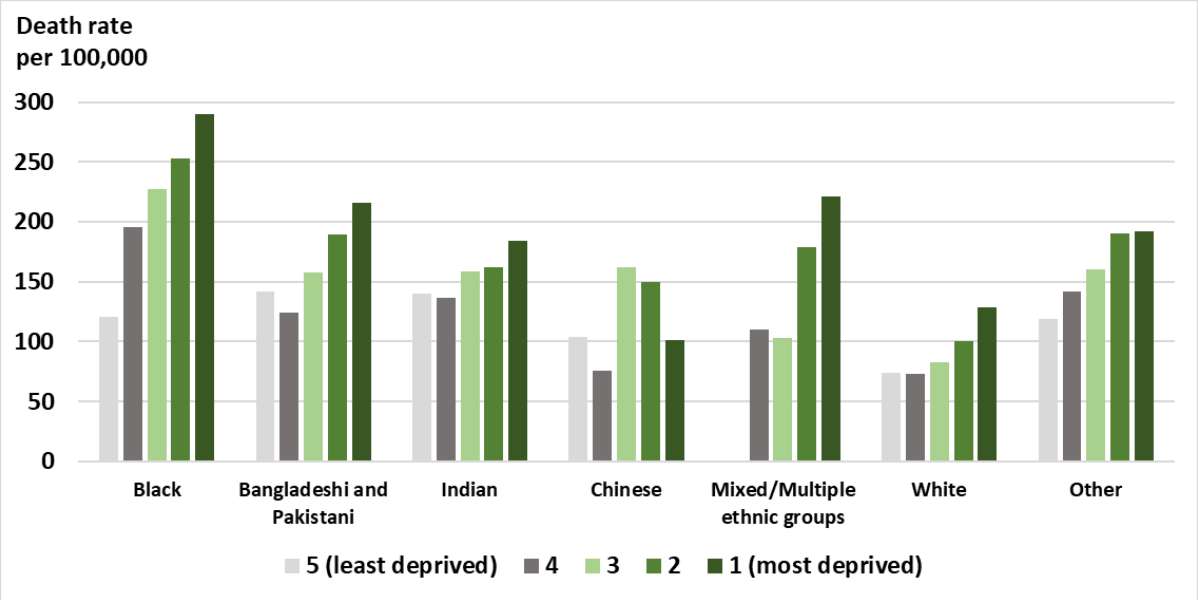


Note: Insufficient numbers of deaths for Chinese women
Source: ONS, 2020 (9).

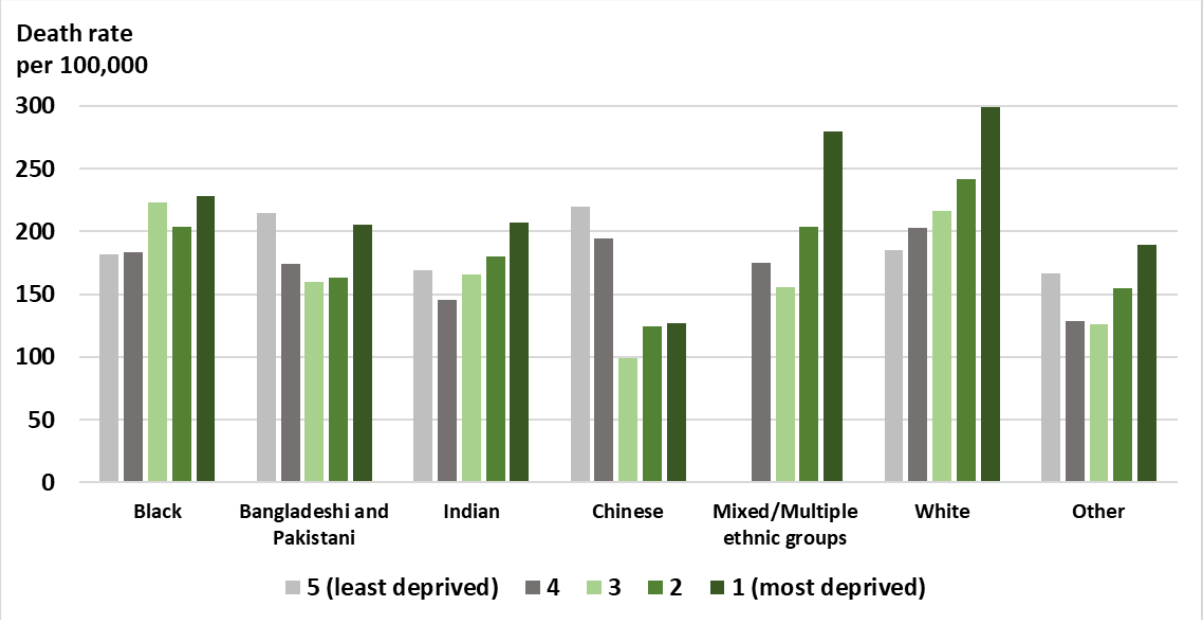
When ethnicity is examined by area deprivation quintile, in Figure 1.6, it is clear that there are steep gradients in COVID-19 mortality within most ethnic groups related to area deprivation– with the steepest gradients being for black men- Figure 1.6(a). Black men living in the least deprived quintile had similar COVID-19 death rates to other non-white groups, but higher rates in all other quintiles. On the other hand, gradients in death rates for other causes were less clear for men in most ethnic groups except for white men and those of mixed ethnic origins- Figure 1.6(b). Raised mortality among black men is therefore a result of COVID-19 infection among those living in more deprived areas.

Figure 1.6 Age standardised death rates from COVID-19 and other causes by ethnicity and deprivation quintiles, males aged 9 to 110, England and Wales, 2 March 2020 to 15 May 2020

a) COVID-19



b) Non-COVID-19 causes



Source: ONS, 2020 (9).

As Figures 1.4 to 1.6 have shown, the risk of dying from COVID-19 is highest for men in BAME groups relative to the white population, particularly in more deprived areas. PHE, using the most recently recorded ethnicity on hospital episode records, showed that after accounting for the effect of sex, age, deprivation and region, people of Bangladeshi ethnicity had around twice the risk of death when compared to people of White British ethnicity . In their analysis, people of Chinese, Indian, Pakistani, Other Asian, Caribbean and Other Black ethnicity had between 10 and 50 percent higher risk of death from COVID-19 when compared to White British (6) (2)

Table 1.3 shows an ONS analysis, published in June 2020, of the risk of death from COVID-19 by ethnic group and sex relative to the white population (9). For both men and women, after adjusting for age, the risk of death from COVID-19 is significantly higher for all minority ethnic groups (except Chinese women) than it is for whites. After adjusting for a broad range of factors that contribute to these differences, including being key workers and exposure to others (see list accompanying Table 1.3) there remains a significantly higher risk of dying of COVID-19 for Black and men and women (relative risks of 2.03 and 1.41, respectively), for men and women with Indian ethnicity (1.59 and 1.14, respectively) as well as for men with Bangladeshi or Pakistani backgrounds and for those with "other" ethnic backgrounds (1.51 and 1.44, respectively). The factors included in the fully adjusted model accounted for between 44 and 70 percent of the excess mortality for men in these broad ethnic groups – as compared to the excess after adjusting only for age.

Table 1.3 Risk of death involving COVID-19 by ethnic group and sex relative to the white population, persons in private household in 2011 Census

Sex	Ethnicity	a) Age adjusted model		b) Fully adjusted model	
Male					
	Bangladeshi/Pakistani	2.53	*	1.51	*
	Black	3.28	*	2.03	*
	Chinese	1.47	*	1.23	
	Indian	2.06	*	1.59	*
	Mixed	1.52	*	1.13	
	Other	2.15	*	1.44	*
Female					
	Bangladeshi/Pakistani	2.02	*	1.08	
	Black	2.36	*	1.41	*
	Chinese	1.05		0.97	
	Indian	1.73	*	1.14	*
	Mixed	1.33	*	1.00	
	Other	1.72	*	1.12	

Notes: * indicates significantly raised risk compared to white people of the same sex
Cox proportional hazards models adjusting for:
a) Age.
b) Fully adjusted models also include region, population density, area deprivation, household composition, socio-economic position, highest qualification held, household tenure, multigenerational household flags and occupation indicators (including key workers and exposure to others) in 2011
Source: ONS, 2020 (9).

SECTION 1 SUMMARY

In summary, the risk of dying of COVID-19 is associated with a number of social and demographic factors – these include occupational exposure as well as age, gender, ethnicity and living in a deprived neighbourhood. How these factors may have affected the mortality of bus drivers is discussed in Sections 2 and 3. Possible influences on Covid-19 mortality, included in the ONS analysis of ethnicity but not included in their analysis of occupation, include household composition, multigenerational households and local population density. Including these will require further research beyond the scope of this report but which will, to some extent, be examined in stage 2 of this study.

2. MORBIDITY AND MORTALITY OF THOSE EMPLOYED BY EACH BUS COMPANY

Across the bus companies operating for TfL, 34 workers are reported to have died of COVID-19. Of these deaths, 29 were to bus drivers. However, one occurred to a driver who went on sick leave for other reasons before February 2020 and the other occurred in June 2020. Thus 27 deaths occurred between March and May 2020, the period covered by this report, and were to bus drivers working since the start of the epidemic in London, February 2020. Two of these drivers were described as agency workers and one as "part-time", so that their occupational exposure may have differed from others working full-time for the same company.

In this section, we focus on the overall demographic characteristics of all bus company staff and how COVID-19 positive tests and death rates varied between companies. This provides the context for analysis of both of socio-economic and health differences of drivers who died, described in Section 3, and of the actions taken by bus companies, described in Section 4. Table 2.1 compares the age distribution of all staff who died of COVID-19 to the age profile of all staff.

Compared to the national figures for bus and coach operators described in Section 1, bus staff in London were more likely to be from BAME backgrounds than for the UK as a whole (54 percent compared to 19 percent), younger (29 percent aged 55 and over compared to 41 percent) and had the same proportion of female workers (nine percent) (4).

While only 4 percent of staff were aged over 65, they accounted for 18 percent of COVID-19 deaths. Conversely, while those aged under 50 comprised over half of staff they contributed fewer than 10 percent of these deaths. As indicated in Section 1.1, this increase in deaths with age reflects national patterns (10). There were no COVID-19 deaths among the nine percent of staff who were female. BAME staff comprise 52 per cent of all staff but 73 percent those who died from COVID-19. This higher percentage is not surprising, given the recent analyses by PHE and ONS described in Section 1.1, although we do not have data on the age distribution of BAME staff needed to make direct comparisons.

Table 2.1 Demographics of all bus staff in London and of those who died of COVID-19

Age	COVID-19 deaths bus workers	All bus staff
Under 50	9%*	54%*
50-54	36%*	17%*
55-59	27%	15%
60-64	9%	10%
65+	18%*	4%*

Sex	COVID-19 deaths bus workers	All bus staff
Female	0%	9%
Male	100%	91%

Ethnicity	COVID-19 deaths	All bus staff
White	23%	34%
BAME	73%*	52%*
Not stated	5%	14%

* A z-test for significance was calculated. Percentages have an asterisk (*) where differences are statistically significant.

Source: IHE using data provided from TfL, 2020.

There are 10 bus companies operating for TfL in London, these vary greatly in fleet size and in the number of staff and bus drivers they employ. Go Ahead, Arriva London and Metroline, employ the largest numbers, respectively, as shown in Table 2.2.

Table 2.2. Analysis of data about companies

Bus company	Total number of employees	Total number of bus drivers on TfL routes
Abellio	2600	2100
Arriva London	5387	4728
Go Ahead	7631	6309
HCT	540	489
Metroline	5054	4118
RATP Dev	3600	2900
Stagecoach London	3548	3065
Sullivans	221	187
Tower Transit	1500	1200
UNO	250	10
Totals	30,331	25,106

Source: IHE using data provided from TfL, 2020.

There was considerable variation between companies in positive COVID-19 test rates and in deaths as a percentage of positive tests (Table 2.3). This may reflect, for example differences in the availability of tests and risk factors including the age structure of drivers, pre-existing health conditions, area deprivation, as discussed in Section 1.1.

Table 2.3 Rates of COVID-19 positive tests and mortality by company, March to May 2020

Bus company	Positive test rate of drivers (percent)	Number of bus driver deaths	Driver COVID-19 deaths as a percent of positive tests	COVID-19 crude death rate of drivers (per 100,000)	COVID-19 crude death rate of all employees (per 100,000)
Abellio	0.38	2	25	95	77
Arriva London	0.11	2	40	42	37
Go Ahead	0.65	6	15	95	79
HCT	0.41	1	50	204	185
Metroline	0.80	8	24	194	237
RATP Dev	0.59	2	12	69	56
Stagecoach London	0.39	1	8	33	28
Sullivans	0.00	0	-	0	0
Tower Transit	1.00	5	42	417	400
UNO	0.00	0	-	0	0
Totals	0.52	27	21	108	106

Note: Deaths to drivers at Abellio include an agency driver, working one day per week for them. Deaths at Metroline include one driver who worked part time for them.

Source: IHE using data provided from TfL, 2020.

Among bus companies with over 1,000 workers, there were two with markedly higher death rates than the others – Tower Transit and Metroline. In both cases, drivers from these companies had higher positive test rates for COVID-19 than other companies (1.0 and 0.8 percent compared to an average of 0.52 percent).

Based on the data above, without more detail of age structure, it is not possible to draw any conclusion that these or any other operators have had statistically significant levels of COVID-19 or fatalities from the disease. However, approximate estimates are included in Section 3 based on ages below 65.

3. ANALYSIS OF INDIVIDUAL DEATH DATA ON BUS DRIVERS

3.1 CHARACTERISTICS OF BUS DRIVERS WHO DIED

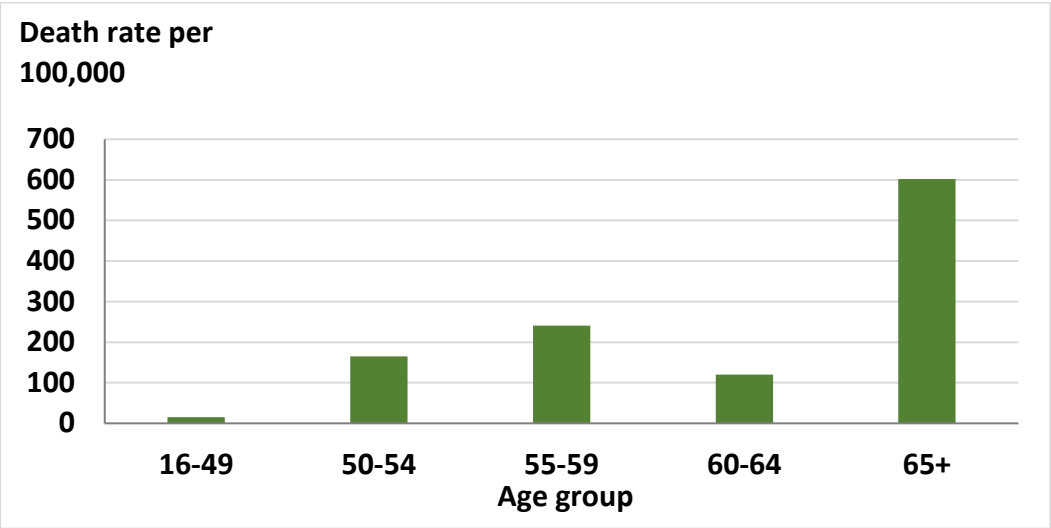
This section provides an analysis of individual COVID-19 related death data and describes demographic characteristics of bus drivers who died from Covid-19 and whether they had an underlying health condition. Area level deprivation is clearly associated with poorer outcomes from COVID-19 in England and data on deprivation levels of where bus drivers who died of COVID-19 lived are provided below. In order to estimate when drivers became infected with COVID-19 and how this relates to the timing of deaths and timing of interventions from bus companies, this section also provides an analysis of when bus drivers who died of COVID-19 ceased work during the March to May period and an analysis how long they survived after ceasing work.

As indicated in Section 1.1, both ONS and PHE have shown that COVID-19 mortality risk is higher in men, people from the most deprived areas, BAME, urban areas, many key non-health occupations including bus and coach drivers and for those who had underlying health conditions (5) (2). We show, in this section that TfL bus drivers who died with COVID-19 in the period March to May 2020 each fitted several of these categories, leading to an accumulation of risk.

MORTALITY BY AGE

All the bus drivers who died were men and death rates were particularly high at ages 65 and over as shown in Figure 3.1. This is normal for COVID-19 deaths in the general population – COVID-19 rates for England at age 65 to 69 and 70 to 74 were around five and nine times, respectively, the rates for those aged 20 to 64. However, most deaths of bus drivers in this age group were to those aged exactly 65, while, in contrast, those in the general population were to people aged 75 and over (2). This difference reduces the ability to determine the extent to which London bus drivers' age specific death rates from COVID-19 differed from the rates in the general population. For this, a more detailed age breakdown of all TfL bus drivers aged 65 and over is required. This detail will be sought in the second stage of this study.

Figure 3.1 Death rates per 100,000 of bus drivers from COVID-19 by age group, March to May 2020



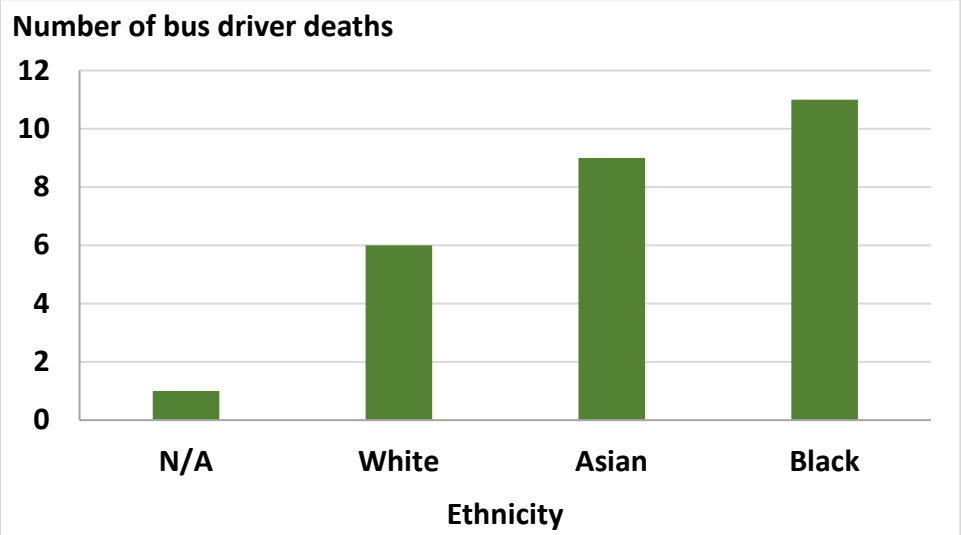
Source: Authors using TfL data, 2020.

For deaths below age 65, it is possible to make an approximate comparison with the age standardised deaths rates presented in Table 1.2. Using the estimates in Figure 3.1 for those aged under 65, the age standardised COVID-19 rate for bus drivers in London is 68, compared to 44 for bus and coach drivers in England and Wales and 19 for all occupations in England and Wales, described in Table 1.2.

MORTALITY BY ETHNICITY

Figure 3.2 shows the distribution of bus driver deaths between March and May by broad ethnic categories - 41 percent were Black, 33 percent were Asian and 22 percent were White.

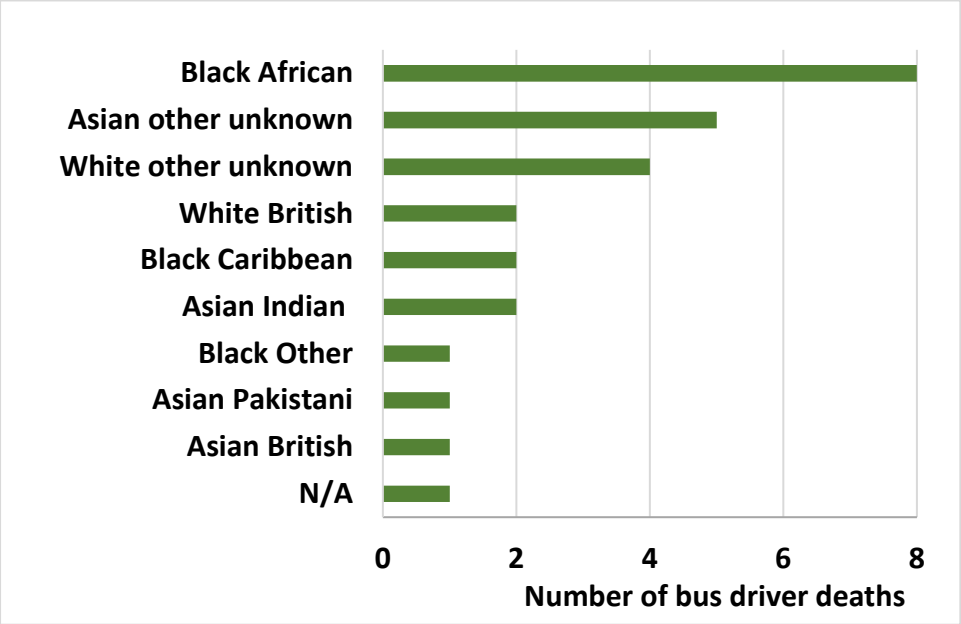
Figure 3.2 Numbers of deaths from COVID-19 of bus drivers by broad ethnic categories, March to May 2020



Note: N/A indicates not available
Source: Authors using TfL data, 2020.

To provide some comparability with Figures 1.4 to 1.6 in Section 1, Figure 3.3 provides more detail on the ethnicity of bus drivers who died. However, without comparable figures on all bus drivers, it is not possible to say how closely this accords with the findings by ONS and PHE on BAME mortality in London and nationally.

Figure 3.3. Ethnicity of London bus drivers who died of COVID-19, detailed ethnicity categories, March to May 2020



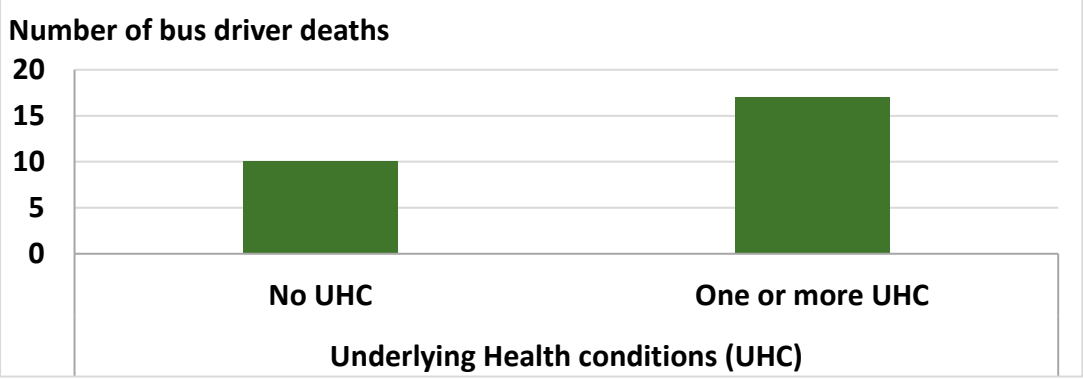
Source: Authors using TfL data, 2020.

MORTALITY BY PRE-EXISTING HEALTH CONDITIONS

Pre-existing co-morbidity has been linked in the emerging literature to higher risks of severe clinical outcomes and/or mortality due to COVID-19. The key risk factors for poor outcomes are pre-existing cardiovascular disease (CVD), diabetes, hypertension and obesity (11). A study by Jankowski et al. showed that multiple co-morbidities appear to confer cumulative risk among health care workers during the COVID-19 pandemic (12). Rates of CVD, hypertension and diabetes are particularly high in some BAME communities (6).

Figure 3.4 shows that 17 of the bus drivers who died from COVID-19 had one or more underlying health conditions (UHC) and ten had not reported pre-existing conditions. To verify this, relatives agreed to provide a total of 16 death certificates, of which 13 related to bus drivers. Of these, ten certificates mentioned other conditions contributing to death, seven of which contained mentions of hypertension.

Figure 3.4 Numbers of bus drivers who died from COVID-19 who did or did not have underlying health conditions, March to May 2020



Source: Authors using TfL data, 2020.

Analyses of the relationship between ethnicity and the presence of underlying health conditions among bus drivers that died of COVID-19 show that eight out of nine Asian bus drivers who died had one or more underlying conditions with five out of six White bus drivers having an existing condition. By contrast, out of the 11 Black bus drivers who died of COVID-19, only three had underlying conditions, This may indicate that that Black drivers were more likely to die of COVID-19 independently of whether they had pre-existing health conditions. However, this needs to be interpreted with caution due to the possibility of under-reporting of previous health in a small number of cases. Among the 13 deaths certificates provided to us for drivers, in four cases shown in Table 3.1 no underlying conditions were recorded but the certifying doctor identified hypertension as contributing to the death. In a further three cases, hypertension was identified by the certifying doctor but was not among the underlying health conditions recorded. Of these seven cases, three related to black driver (out of the six deaths certificates available for this group).

Table 3.1 Numbers of bus drivers who died with COVID-19, by underlying health conditions and ethnicity, March to May 2020

Underlying health conditions		
Ethnicity	**None**	**One or more**
Asian	1	8
Black	8	3
White	1	5
N/A	0	1

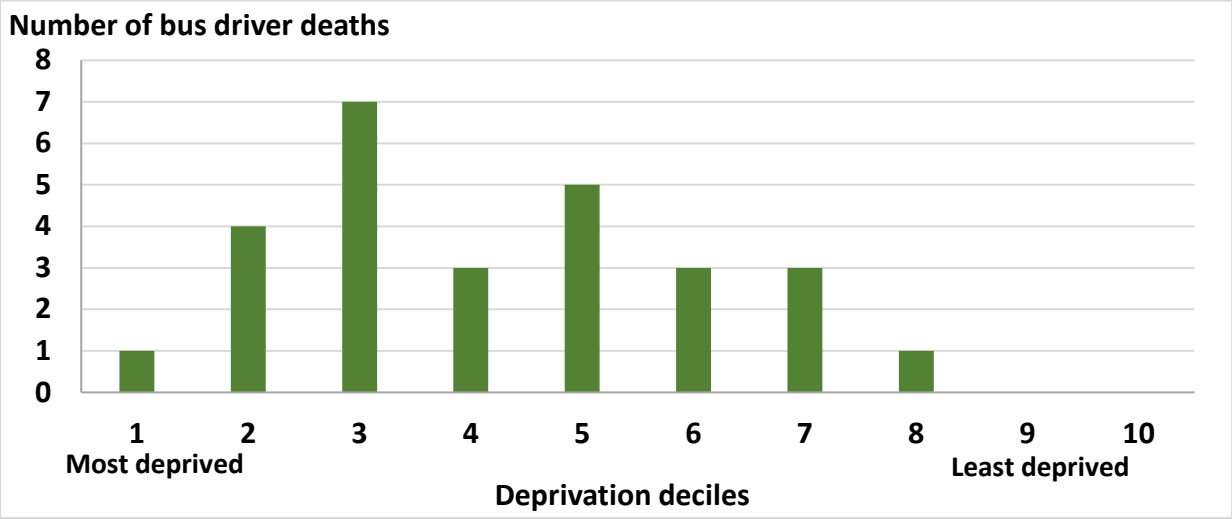
Source: Authors using TfL data, 2020.

This analysis of bus driver deaths by ethnicity and by contributory heath conditions suggest that the vulnerabilities to COVID-19 in national data, presented in Section 1, apply strongly to bus drivers from black and Asian backgrounds. However, without comparable information on all bus drivers, these risks cannot be quantified. This will be examined in stage two of the review.

MORTALITY BY AREA DEPRIVATION

Figure 3.5 shows that the London bus drivers who died of COVID-19 lived mostly in areas identified by the Index of Multiple Deprivation as being in the second, third and fifth most deprived deciles This can be summarised by saying that seventy-four percent of bus drivers who died (20 out of 27 deaths) lived in neighbourhoods with above-average levels of deprivation. This is more clustered and not as clearly graded as that shown across deprivation deciles in London in Section 1. However this might be explained by the low number of individuals in the sample and may also be because most bus drivers live mainly in the same type of neighbourhoods as those who died, in which case the death rates for the deciles in which deaths were concentrated would not necessarily be so different from other deciles as the crude numbers suggest. However, we do not currently have access to the residential information on all employed bus drivers. This would therefore require further data in the second stage of the study.

Figure 3.5 Numbers of bus drivers who died of COVID-19 in March to May 2020 by deprivation quintiles of their area of residence

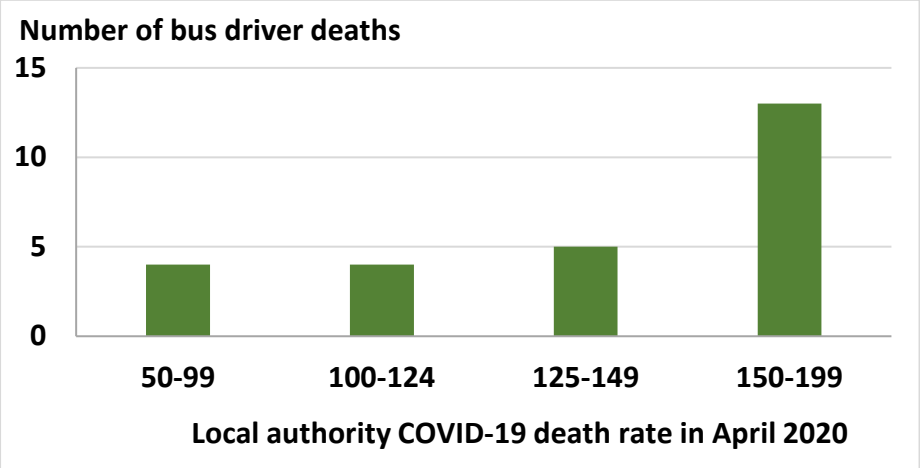


Note: Deciles are based on the national distribution of Index of Multiple Deprivation scores for Lower Super Output (LSOA) areas. Deaths were allocated to these deciles based on the LSOA in which the driver lived.
Source: Authors using TfL data, 2020.

MORTALITY BY LOCAL AUTHORITY

There is a relationship between the distribution of deaths of bus drivers and the COVID-19 mortality rates in the local authorities in which they lived. Figure 3.6 shows that, 48 percent of bus driver deaths were to men living in the quarter of local authorities which experienced the highest levels of COVID-19 mortality in April 2020 - that is those authorities whose COVID-19 rates in April were in the top quarter of all authorities in London when ranked by their COVID-19 death rates. As context to this relationship, among the local authorities in which these bus drivers lived, nine of the ten local authorities with the highest age-standardised mortality rates for deaths involving COVID-19 over this period were London Boroughs (see Annex table A.2) (1).

Figure 3.6 Deaths among bus drivers in March to May 2020 by local authority COVID-19 death rate in April 2020



Source: Authors using TfL data, 2020.

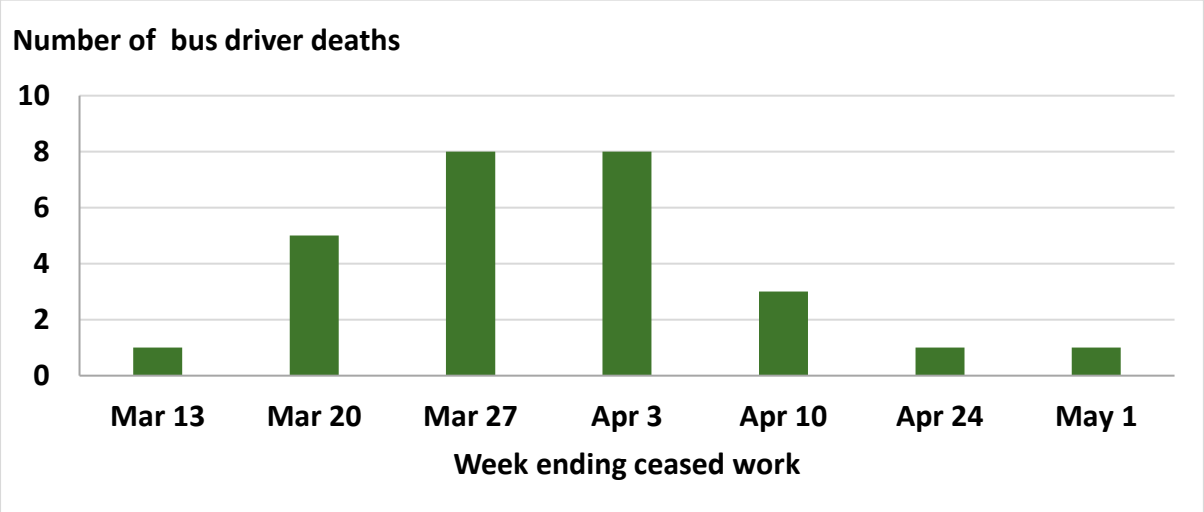
Analyses of deaths among London bus drivers by garage location, indicates that they are not clustered in local authorities with high COVID-19 death rates. The largest number of deaths- eight - occurred to drivers from six garages in local authorities with COVID-19 rates of 100 to 124 per 100,000. Nor was there much clustering in specific garages. Of the 24 garages that reported COVID-19 deaths, 21 reported the death of bus drivers due to COVID-19 in the period covered by this analysis. Of these, 16 garages reported one death and four reported two deaths. However, one garage located in Westminster reported three deaths of drivers due to COVID-19. These drivers all had pre-existing health conditions and ceased working during the second half of March. The location of the garage in Westminster does not account for this small cluster – although other factors such as routes driven and area of residence may do so. In particular, Westminster did not experience a particularly high rate of mortality in March and April. The age standardised death rate among men in the general population of Westminster was 41.8 per 100,000 in March, slightly higher than the death rate in London (40.6 per 100,000). In April, the death rate in Westminster (84.7 per 100,000) was lower than the London COVID-19 death rate for men (127.4 per 100,000) (13).

3.2 CEASING WORK AND LENGTH OF SURVIVAL TO DEATH

This analysis of when bus drivers ceased work is important for assessing whether interventions were implemented in a timely way. It is also useful as background for further assessments of whether interventions were effective in preventing bus drivers from becoming ill from COVID-19 in Section 4.

Figure 3.7 shows that the majority, 59 percent, of the London bus drivers who died of COVID-19 by May 2020 ceased work during the week ending on the 27th March, which was the week during which lockdown took place (23rd March), and the following week. In this context, the incubation period (the time from exposure to development of symptoms) is believed to be between two and 14 days, with the average being five days. Since over 80 percent of drivers who subsequently died had ceased work by 3rd April, this suggests that most of those who died had become infected in March. The relationship between death, ceasing work and the actions taken by bus companies and national government are considered in Section 4.

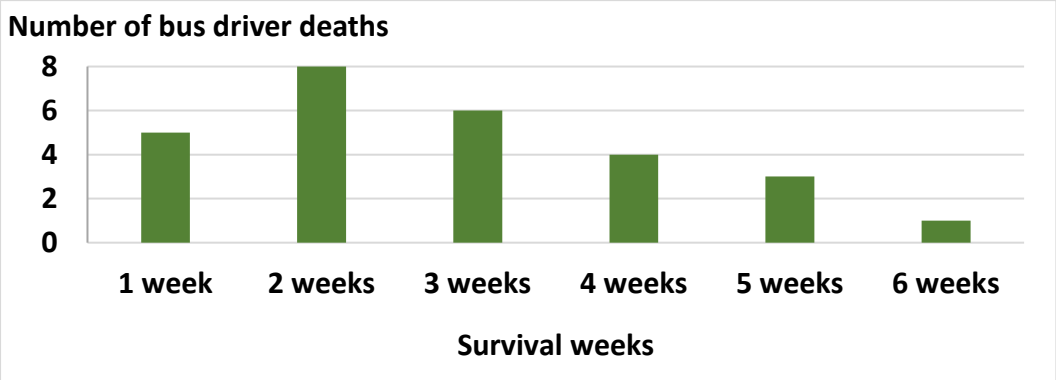
Figure 3.7 Numbers of bus driver who died with COVID-19, by week when the driver ceased work, March to May 2020



Source: Authors using TfL data, 2020.

In order to make the link between week of ceasing work (Figure 3.7) and week of death, Figure 3.8 shows the length of survival from ceasing work to death. Five drivers ceased work within a week of death, eight ceased work two weeks before death, with decreasing numbers in each successive week. This highlights the narrow window in which illness and death were concentrated in late March and early April.

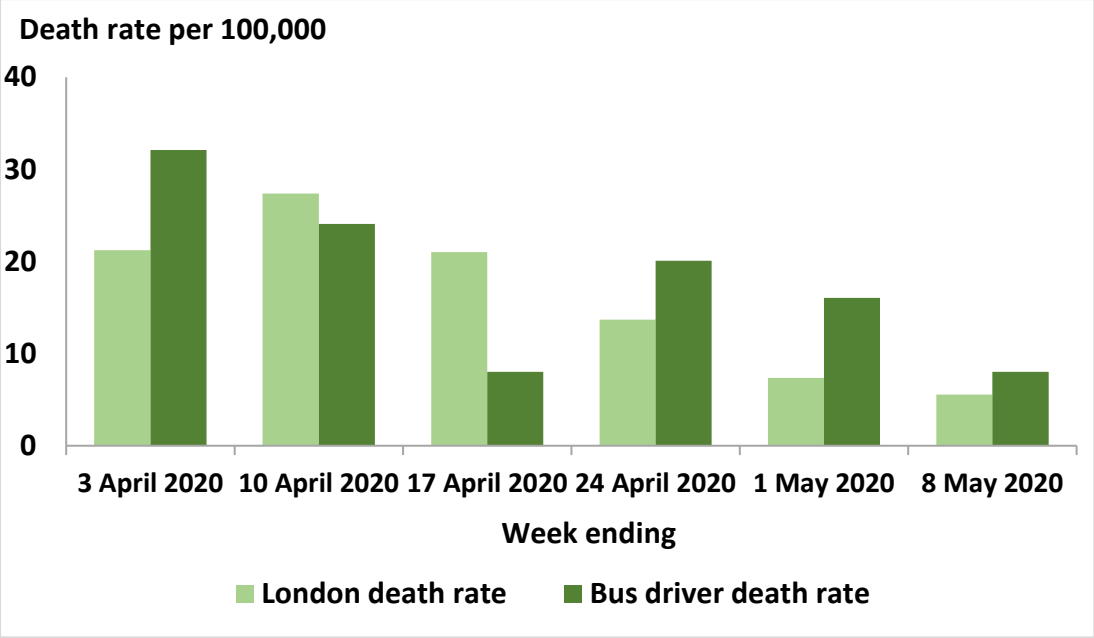
Figure 3.8 Number of weeks between date when bus drivers ceased work and date of death, March to May 2020



Source: Authors using TfL data, 2020.

Levels of mortality by week are also important. Figure 3.9 shows that across all weeks shown, except for the weeks ending on the 10th of April and 17th April, COVID-19 mortality was higher among bus drivers working on TfL routes than for the general population of London. In contrast to the rates for bus drivers, the general population rates include deaths to older people.

Figure 3.9 Crude weekly death rates, London and bus driver Covid-19 mortality at ages 16 and over, weeks ending 3 April to 8 May



Note: Death rates for London are based on the population aged 16 and over
Source: Authors using TfL data and ONS, 2020.

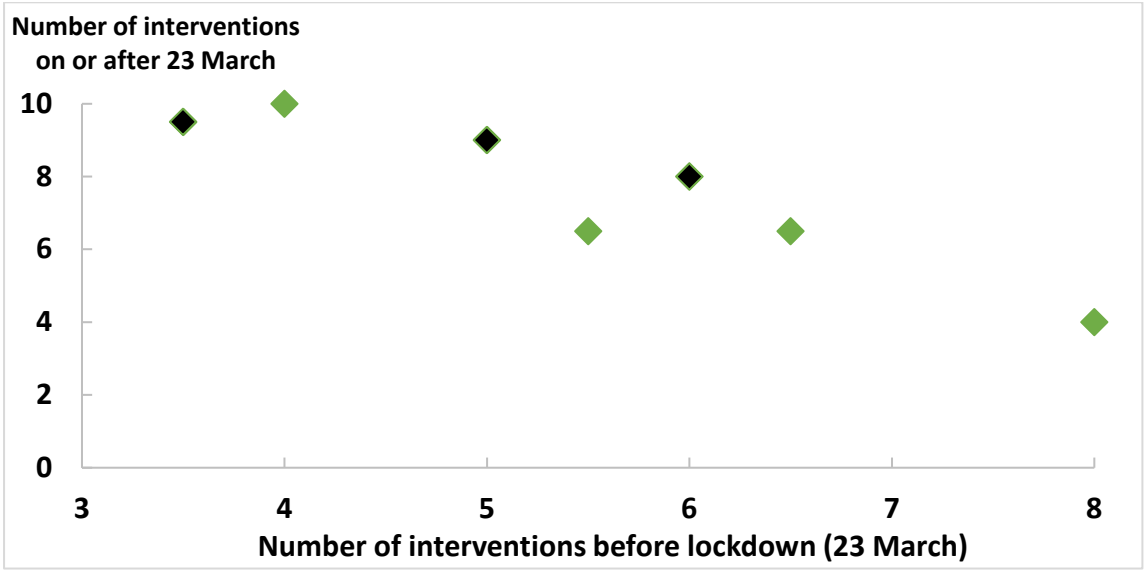
4. TIMING OF ACTIONS TAKEN BY BUS COMPANIES

TfL operating bus companies implemented a series of interventions to prevent their workers from being infected by COVID-19. Some of these were specific to particular companies – those that had canteens, had available car parking spaces or conducted temperature testing trials. Public announcements, including those relating to COVID-19, were largely conducted through a centralised TfL system. Provision of gloves often related to pre-COVID arrangements.

For this analysis, we focused on 14 actions to prevent Covid-19 transmission, each of which was reported by a minimum of eight companies. These actions comprised those related to vehicles (daily antiviral cleaning, enhanced cleaning, holes on assault screens, restricted access to front seats and middle door boarding), to drivers (communications, HR policies and advice, hand sanitiser, wipes and masks) and to premises (access to toilets, enhanced cleaning, adapted premises/social distancing, health and safety/union reps stood down and cleaning inspections). On average, bus companies had completed 13.3 out of the 14 by early June. Timing of actions varied across companies – between four and eight actions were initiated by companies before lockdown on 23 March – an average of 5.3 per company.

A number of companies also initiated actions shortly after lockdown while numbers of deaths remained at a high level – an average of 2.6 per company were initiated between 23rd March and 3rd April. Companies also initiated a number of actions after 3rd April, by which time mortality had peaked (an average of 5.4 actions per company after this date). Figure 4.19(b) shows the extent to which companies varied in taking action before 23rd March or after 3rd April. While the average number of actions initiated before 23rd March and after 3rd April was similar – 5.3 and 5.4, respectively -– some companies initiated most of their actions before lockdown and others initiated the majority of their actions after 3rd April.

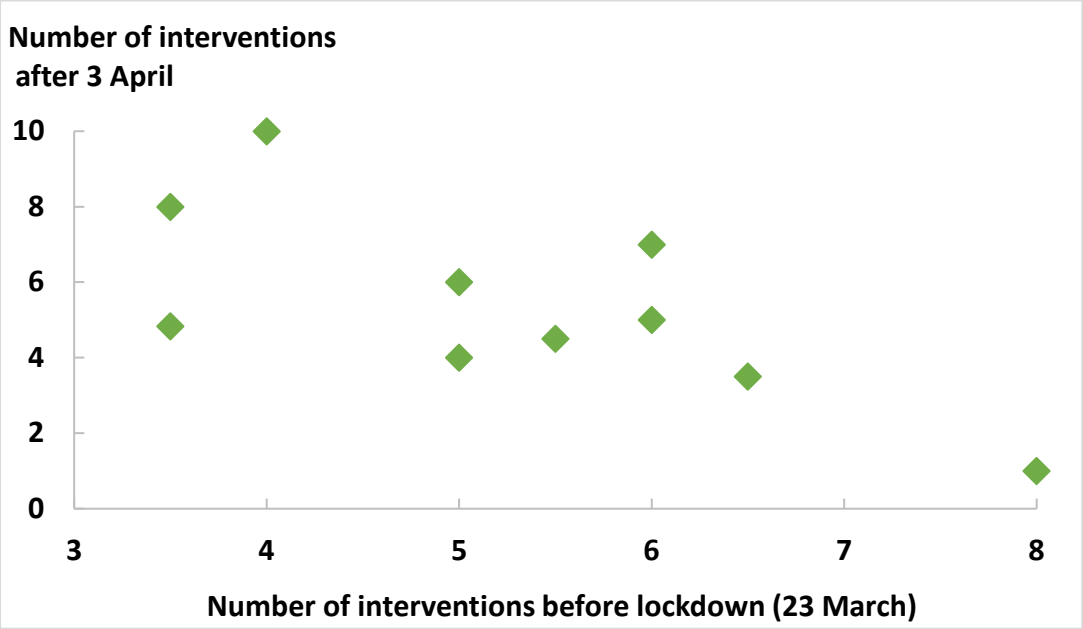
Figure 4.1. (a) Number of interventions taken by bus companies before lockdown (23 March) and on or after that date



Note: Where two or more bus companies had an identical pattern of interventions, this is indicated by:

Source: Authors using TfL data, 2020.

Figure 4.1. (b) Number of interventions taken by bus companies before lockdown (23 March) and after 3 April

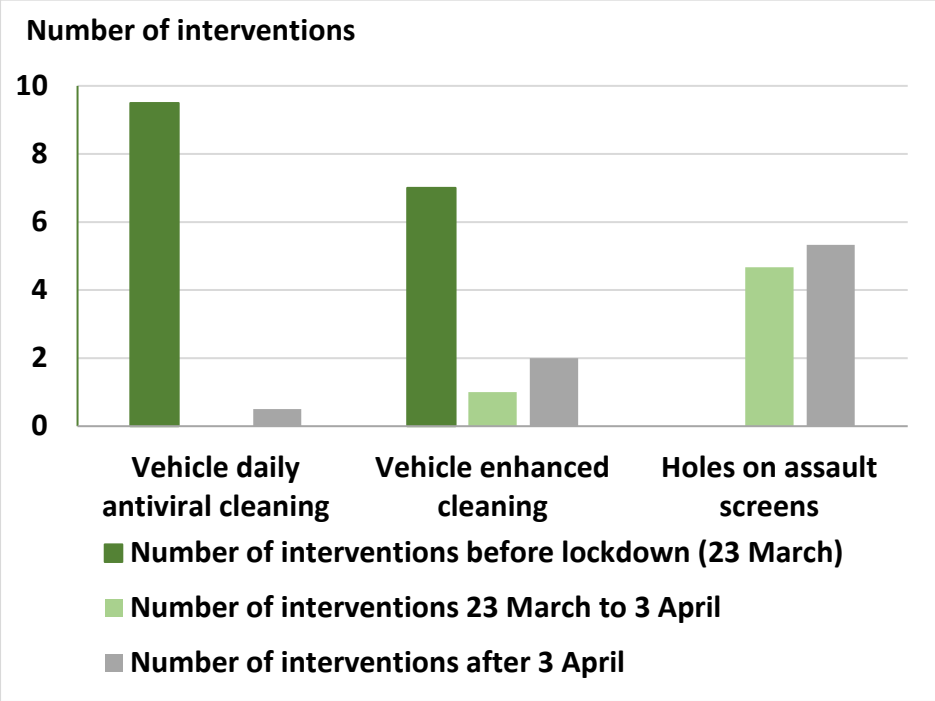


Source: Authors using TfL data, 2020.

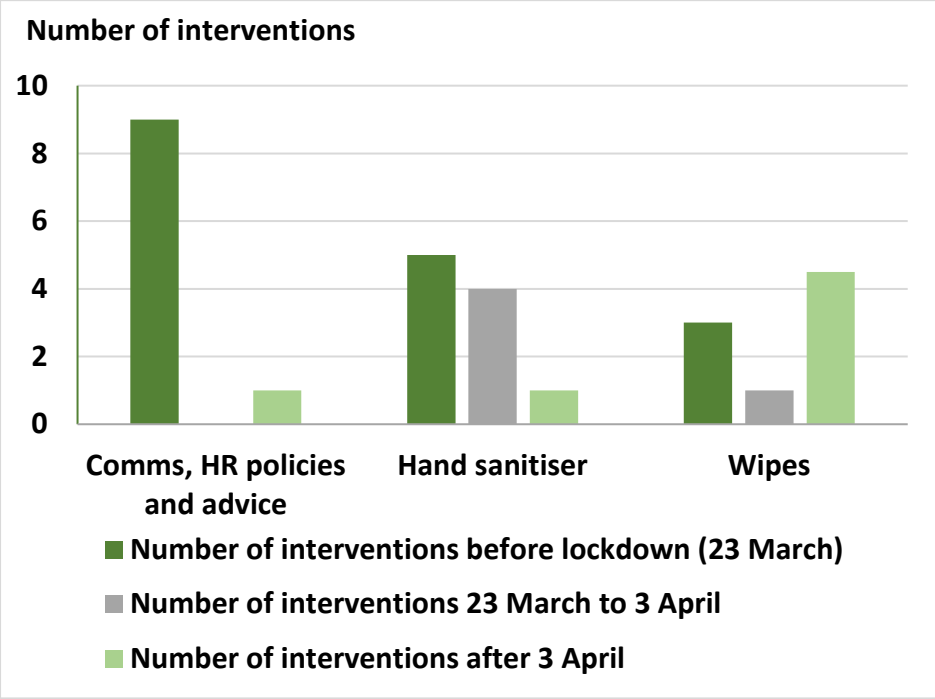
In Figure 4.2, we have focused on the timing of three of the interventions affecting the drivers' buses and three affecting the availability of protective equipment for the personal use of drivers. This indicates a clear patterning to the timing of the introduction of these actions as advice from Government and/or TfL changed or became clearer. Thus, antiviral cleaning and advice to drivers was initiated by most companies before 23rd March, while closing of holes in assault screens and provision of wipes was more common after 3rd April. However, some companies-initiated action sooner and others later than the timing of advice would suggest. The action included in Figure 4.1 that stands out as being uniformly initiated was middle door boarding. This was implemented by all companies on 20th April, when TfL announced that customers "will not be required to touch in" with their payment card or device from that date.

Figure 4.2 Number of COVID-19 preventive interventions implemented by bus companies by (a) type of bus-related actions (b) driver-related actions, in total and before lockdown on the 23rd of March

a) Bus-related interventions



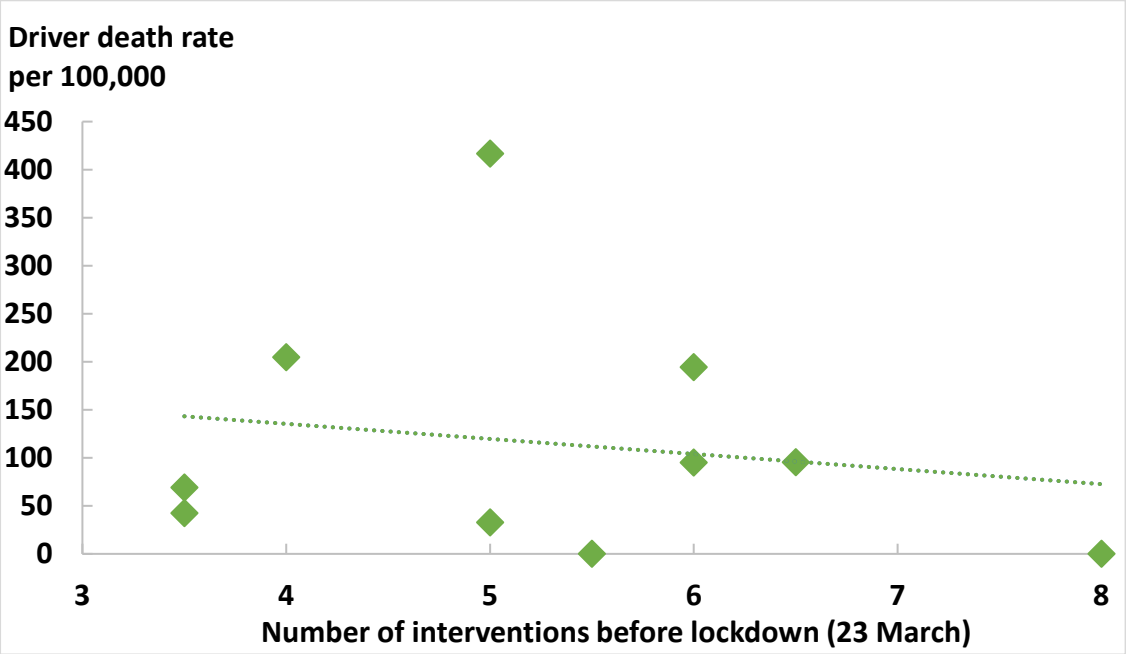
b) Driver-related interventions



Source: Authors using TfL data, 2020.

Figure 4.3 shows that the relationship between the number of interventions that London TfL operators implemented before lockdown and the number of bus drivers who died of COVID-19 is weak. In statistical terms the number of deaths is small and there is no statistical correlation.

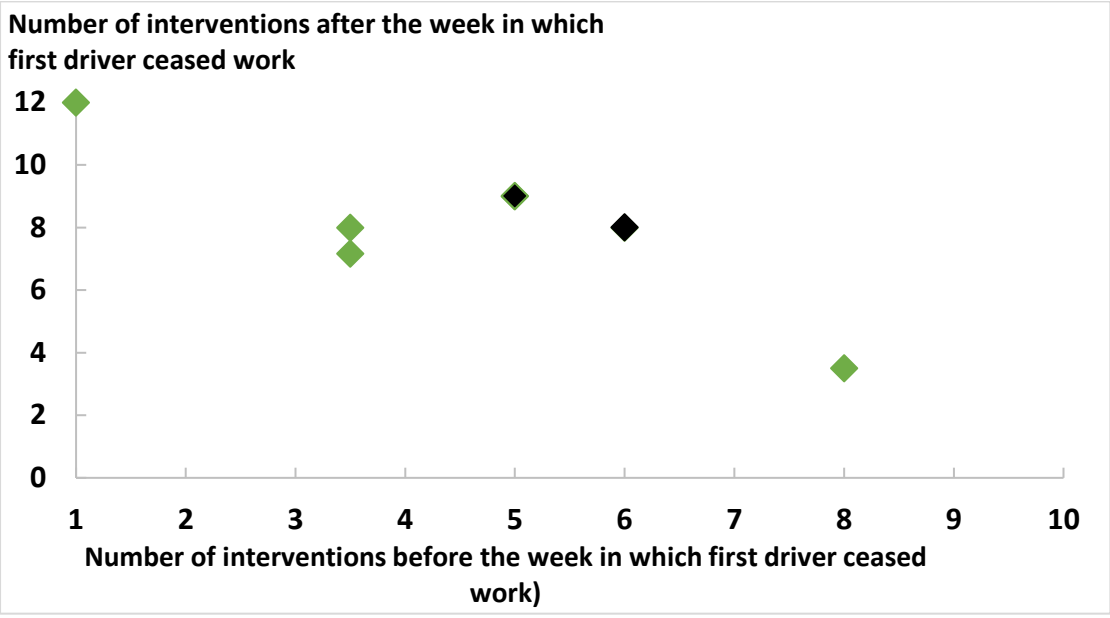
Figure 4.3 Number of interventions before lockdown by bus company and COVID-19 death rates



Source: Authors using TfL data, 2020.

Similarly, taking action before drivers who subsequently died with COVID-19 went off sick varied between operators as shown in Figure 4.4. In view of the short timescales, these patterns are not markedly different from those in the figures relating to the date of lockdown and are dependent on the timing of a single driver in each company becoming ill.

Figure 4.4 Total number of interventions in the weeks before and after the week in which the first driver, who subsequently died, stopped working



Note: Where two or more bus companies had an identical pattern of interventions, this is indicated by:

Source: Authors using TfL data, 2020.

SUMMARY

In summary, while the timing of actions by most companies was similar – largely related to the advice they were getting at the time – the majority of actions were probably initiated after most of the drivers who died had become infected and were certainly initiated after lockdown reduced passenger numbers and changed many other aspects of community behaviour. There was, additionally, variation between bus operators in the timing of initiating these actions before and after the key dates discussed above.

5. FURTHER WORK NEEDED

High levels of hypertension and cardiovascular disease in those who died with COVID-19 may be indicative of both the sedentary nature of bus driving and work stress (14) (15). These risks to bus drivers in London have been known since Morris published papers on higher levels of coronary heart disease among London bus drivers than conductors in 1953 and the link between occupation, hypertension and heart disease in London bus men in 1966 (14) (16). The relevance to bus drivers today, with their greater ethnic diversity, is not something we have been able to investigate – beyond the audit of pre-existing conditions at death - but warrants further investigation.

For this study, we did not have adequate information about the characteristics of the bus driver workforce that affect risk of COVID-19 mortality. In particular, detailed age distributions of the workforce overall, as well as the age distributions by ethnicity, garage in which they worked, and area in which they lived. Information is also need on pre-existing health conditions, housing and household circumstances of the workforce. We also need to be able to relate these factors to mortality and other conditions in London at the time – for which more detailed information is required than is currently published.

To this end, the second phase of this study is intended to explore the characteristics described in the previous sentence in more details, as well as the views of bus drivers, including undertaking a survey of their attitudes to COVID-19 safety measures.

6. CONCLUSIONS

This analysis confirmed that bus drivers in London had higher mortality from Covid-19 than the rate in all occupations. It has shown that many of the TfL bus drivers who died, as well as all working in a front-line occupation, possessed several other characteristics that put them at higher risk of death from COVID-19 in the period March to May 2020 – living in more deprived areas in London (and in particular in boroughs with the highest COVID-19 rates), being from a BAME background and age 65 and older. From the incomplete audit of deaths, we were able to undertake, several had underlying health conditions that have long been associated with bus driving as a sedentary occupation and likely contributed to the severity of their COVID-19 infection.

Levels of risk of death from COVID-19 associated with each of these have only recently been quantified by both ONS and PHE i.e. well after the deaths occurred. While most of these factors are out of the control of the bus operators, it is important that they do their best to both minimise exposure to risk by all drivers and consider how those at heightened risk can be identified and given guidance on both reducing and preventing those risk factors that are avoidable.

In particular, the audit of death certificates, revealed that where certifying doctors identified hypertension as a contributory factor to the death of a bus driver from COVID-19, it was not recorded on the information held by bus companies. As such, bus companies need to be more proactive in understanding existing health conditions of bus drivers, supporting better health and identifying those most at risk of COVID-19 mortality.

PHE have, in recent weeks, published a report on understanding the impact of COVID on BAME groups. This sets out a series of recommendations. Among these, those most relevant to every employer in the country is the need for strategies to create healthy and supportive workplaces (within and outside the health service) that have zero tolerance for discrimination and empower BAME staff to raise concerns about occupational risk and safety (6).

We also analysed 14 of the actions that were identified by bus operators and TfL as potentially reducing Covid-19 transmission and were initiated in the period March to early June by most operators. On average, they implemented 13.3 of these actions. However, there was variation in the timing of implementation. On average, 5.3 actions were taken before lockdown took place on 23rd March and a similar number after the peak of mortality was reached in the week ending 3rd April. While the timing of actions by most companies was similar – largely related to the advice they were getting at the time – this indicates that the majority of actions were probably initiated after most of the drivers who died had become infected and were certainly initiated after lockdown reduced passenger numbers and changed many other aspects of community behaviour. There was, additionally, variation between bus operators in the timing of initiating these actions before 23rd Marchand after 3rd April.

Despite the variation between bus companies, the data on the relationship between death rates and actions taken, as well as on the number of actions taken before the first driver ceased work prior to dying, suggest that delays in taking action are unlikely to have contributed to the death rates from COVID-19. This does not mean that all the actions were ineffective – simply that so many were taken close to or after lockdown on 23rd March and hence they were not really tested. Lockdown changed the environment both within buses (fewer passengers) and in the community (more people staying at

home, furloughed and implementing other preventative measures) and were effective at reducing mortality for bus drivers as well as the general population.

For future health emergencies such as local spikes in COVID-19, lessons need to be learned both from the deaths that occurred and how actions were rolled out across bus companies during the COVID-19 outbreak in London. In line with developing Government and WHO guidelines and scientific evidence about specific preventative measures for buses, better planning and a more coordinated implementation is required across all bus companies. For drivers who appear most at risk, an increased range of actions is needed to protect them. As passenger numbers increase, it will be important to have confidence that the planned actions to protect drivers are likely to be effective. Further data and analyses are needed to address these issues, including during the second stage of this research project.

RECOMMENDATIONS

- Many bus drivers are at high risk of COVID due to the occupation of bus driving and proximity to the public, their age, sex, pre-existing health conditions, BAME and area of residence. All bus drivers and particularly those with multiple risk factors need enhanced protection through early interventions on ill-health prevention and reducing exposure during epidemics. Companies have taken a wide range of actions, but not at the same pace. As passenger numbers increase again, it will be important to have confidence that the planned actions are likely to be effective, are led by the scientific evidence and are implemented simultaneously across bus companies with clear recommendations for early adoption of measures in the event of a second spike. There is scope for TfL to develop clear guidance on rapid and simultaneous implementation of measures in the event of spikes of infection in London or increased infection rates among staff.
- BAME staff, especially those living in poorer areas, are more at risk of becoming severely ill and dying from COVID-19. The recommendations in PHE's recently published report "Beyond the data: Understanding the impact of COVID-19 on BAME groups" should be implemented. In particular that employers should have strategies to create healthy and supportive workplaces (within and outside the health service) that have zero tolerance for discrimination and empower BAME staff to raise concerns about occupational risk and safety
- TfL's occupational risk assessment tool should be used by London bus companies to identify those most vulnerable - with the oversight of TfL- to reduce the risk of employee's exposure to and acquisition of COVID-19.
- The contribution of pre-existing health conditions, known to increase the severity of COVID-19, suggests a need to introduce criteria for staff by TfL and bus operators to be offered additional protection. This would enable TfL and bus companies to make arrangements to protect those now known to be more vulnerable, as understanding of the disease increases. Improved engagement with health promotion initiatives and uptake of preventive interventions is also essential, to reduce the risk of diseases such as hypertension, diabetes and cardiovascular disease.

References

1. **ONS. Deaths involving COVID-19 by local area and socioeconomic deprivation: deaths occurring between 1 March and 31 May 2020. Published: 12 June 2020.**

2. Public Health England. Disparities in the risk and outcomes from COVID-19. London, PHE publications: 2020.

3. ONS. Coronavirus (COVID-19) related deaths by occupation, England and Wales: deaths registered between 9 March and 25 May 2020. [Online] 25 June 2020. [Cited: 8 July 2020.] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/bulletins/coronaviruscovid19relateddeathsbyoccupationenglandandwales/deathsregisteredbetween9marchand25may2020.

4. ONS. . Which occupations have the highest potential exposure to the coronavirus (COVID-19)? [Online] https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/whichoccupationshavethehighestpotentialexposuretothecoronaviruscovid19/2020-05-11.

5. ONS. Deaths involving COVID-19, England and Wales: deaths occurring in April 2020. 15 May 2020.

6. Public Health England. Beyond the data: Understanding the impact of COVID-19 on BAME groups. PHE publications, London: 2020.

7. McQuillan R, Dozier M, Theodoratou E, Li X, McSwiggan E, Goodwin L, et al. What is the evidence on ethnic variations in COVID-19 incidence and outcomes? Edinburgh: UNCOVER (Usher Network for COVID-19 Evidence Reviews); 2020.

8. Cutler D, Stantcheva S, Alsan M, Yang D. Disparities in COVID-19 Reported Incidence, Knowledge, and Behavior.

9. ONS. Coronavirus (COVID-19) related deaths by ethnic group, England and Wales: 2 March 2020 to 15 May 2020. *Coronavirus (COVID-19) related mortality by religion, ethnicity and disability: England and Wales, 2 March 2020 to 15 May 2020.* [Online] 19 June 2020. [Cited: 19 June 2020.] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/coronaviruscovid19relateddeathsbyethnicgroupenglandandwales/2march2020to15may2020.

10. ONS. Deaths registered weekly in England and Wales, provisional, up to week ending 5 June. [Online] 2020. [Cited: 18 June 2020.] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/weeklyprovisionalfiguresondeathsregisteredinenglandandwales.

11. Platt L, Warwick R. Are some ethnic groups more vulnerable to COVID-19 than others? London: Institute for Fiscal Studies; 2020.

12. Jankowski j, davies A, English P, Friedman E, mcKeown H, Rao M, et al. Risk Stratification for Healthcare workers during the COVID-19 Pandemic; using demographics, co-morbid disease and clinical domain in order to assign clinical duties.

13. ONS. Impact of registration delays on mortality statistics in England and Wales: 2018 . ***https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/impactofregistrationdelaysonmortalitystatisticsinenglandandwales/2018.***

14. Morris, JN et al. *Incidence and prediction of ischaemic heart disease in London busmen.* London : Lancet,10 September 1966:553-9.

15. Chandola, T et al. ***Work Stress and Coronary Heart Disease- What are the mechanisms?*** **London : Eur Heart J, 2008 29:640-648, .**

16. Morris, JN, et al. ***Coronary heart-disease and physical activity of work.*** **London : Lancet, 21 November 1953:1053-1057.**

Annex

Table A.1. Number of deaths and age-standardised rates, men, deprivation deciles in England, deaths occurring between March and April 2020

Decile	March 2020		April 2020	
	Deaths	Rate	Deaths	Rate
1 (most deprived)	2,624	160.2	4,118	256.4
2	2,587	147.7	4,215	246.7
3	2,525	135.1	3,998	217.1
4	2,510	120.3	3,842	184.4
5	2,609	114.8	3,819	170.1
6	2,546	105.5	3,934	164.3
7	2,603	103.9	3,778	153.1
8	2,506	99.2	3,653	145.0
9	2,398	93.3	3,771	147.6
10 (least deprived)	2,234	84.4	3,387	127.6

Source: ONS, 2020 (5).

Table A.2 Death rates in local authorities of residence of at least one bus driver who died with COVID-19

Area of usual residence	March		April	
	Deaths	Rate	Deaths	Rate
Barking and Dagenham	21	47.9	55	114.3
Brent	61	63.1	198	194.7
Camden	18	23.6	71	90.9
Croydon	56	43.3	183	144.2
Ealing	47	44.4	174	163.8
Enfield	44	40.2	171	162.1
Hackney	27	48.1	93	166.9
Hillingdon	34	32.2	110	108.2
Lambeth	45	71.3	104	135.8
Luton	15	21.7	83	122.4
Medway	11	10.4	52	57.0
Newham	46	71.9	136	188.2
Redbridge	41	44.2	127	132.4
Waltham Forest	26	39.1	97	129.7
Wandsworth	36	50.1	81	108.4
Westminster	34	41.8	67	84.7