National Audit Office

Department for Transport

Transport accessibility to local services: a journey time tool

Examining transport accessibility to key local services in England

Technical Guide

OCTOBER 2020

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Contents

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Technical Guide

Examining transport accessibility to key local services in England

Summary

1 This paper sets out how the National Audit Office (NAO) combined journey times to key services by public transport and car with:

- the quality ratings of services;
- levels of deprivation; and
- levels of rurality.

The purpose of this was to explore trends in transport accessibility to different types of services and locations across England.

2 In this context, transport accessibility was defined as the journey time, by either car or public transport, to a defined service location. Other elements of accessibility – such as: the cost of travel; cultural, age, gender or disability barriers to travel; catchment areas for service eligibility; the ability to book an appointment; user choice; internet accessibility and connectivity; the capacity of a service location; service opening times; and the inclusivity of services provided at a location – were not included in this analysis.

3 This is a technical guide for readers wishing to understand how we developed this work. Readers may also wish to see our transport accessibility tool and the accompanying insights document.

Background

4 Public transport provision influences how people can access the services they need, including healthcare, education, employment, leisure and business facilities. In this analysis, we included journey times to: state-funded primary schools; state-funded secondary schools; state-funded further education colleges; acute hospital trusts[1]; GP surgeries; town centres; and large employment centres (**Figure 1**).[2]

1 Acute hospital trusts are NHS organisations providing acute hospital-based services.
2 Employment centres are based on the number of jobs available within each lower super output area (LSOA). These data are taken from Nomis (official labour market statistics provided by the Office for National Statistics).

Figure 1

Number of service locations included in the Department for Transport's journey time model in 2017 across England

Service	Number of locations
Large employment centres	785
Town centres	1,211
Primary schools	16,927
Secondary schools	3,173
Further education establishments	2,304
GP surgeries	7,353
Acute hospital trusts	277

Notes

1 Acute hospital trusts are NHS organisations providing acute hospital-based services.

2 Service locations are defined by the Department for Transport (DfT) (see Appendix Three) and we used lists of service locations received directly from DfT.

3 There may be differences in the number of service locations presented here and those recognised by other government departments. We (and DfT) are aware of some service locations, open in 2017, which were not included in the lists received from DfT or used in its journey time modelling.

Source: Department for Transport, *Journey Time Statistics: Notes and Definitions*, November 2019

5 The Department for Transport (DfT) and a number of other organisations[3] have identified that investment in local transport supports economic growth, helps build sustainable communities and works to reduce congestion. However, the nature and availability of local transport services in England are locally determined and highly variable. This work examines whether, when combined with rurality and deprivation, and the quality of the services themselves, variation in journey times is contributing to unequal access to services in England.

3 For example, the Transport Knowledge Hub, Campaign for Better Transport and What Works Centre for Local Economic Growth.

6 Research[4] shows how important service accessibility is for economic growth, productivity, societal inclusion and improved quality of life. We consider that the ability of users to access a public service they need is also a fundamental requirement for the service to deliver value for money (which incorporates economy, efficiency and effectiveness for government and the country as a whole). Against this background, we have undertaken the work described in this document to explore questions including the following:

- What do the data that DfT holds suggest about how local transport may affect users' ability to access key local services?
- How do public transport and car journey times to key services vary across England?
- How do journey times to key services affect different groups (including more/less deprived, more/less rural, and those reliant on public transport)?

Data

7 Our analysis used modelled journey times between 7am and 10am, via the public transport network or by car, to various locations in England. We used the most recent journey time data available from DfT, which was data for journeys based on the situation in 2017. These journey times were produced by DfT using a commercial software package called TRACC, owned by Basemap. The parameters of this model were defined by DfT. The output data we used from this model were the same data that DfT used to produce their journey time statistics. However, our subsequent analytical approach differed to ensure that we used the data in a way appropriate to our final use. Therefore, the outputs of our analyses are not directly comparable with the journey time statistics published by DfT. The differences between the two methods are outlined in Appendix One.

8 DfT provided TRACC-modelled journey times to the seven types of services we included (Figure 1) for 2017, at output area (OA) level,[5] for this analysis.[6] DfT also provided the geographic location of each destination (service location) included in the network, against which it calculated journey times to each service.

9 For five of the services, we also obtained data on service quality at each location point. For primary schools, secondary schools and further education establishments, we used inspection data from Ofsted and, for acute hospital trusts and GP surgeries, we used inspection data from the Care Quality Commission (CQC) as indicators of the quality of service available at each location.

4 See our insights document for an extensive review of the research.
5 An OA is the smallest geographical area defined by the Office for National Statistics (ONS), containing an average population of 309 individuals. There are 171,372 OAs in England.
6 DfT does not publish OA-level data but made it available to us on request.

10 In addition, we compared journey times with two other publicly available datasets:

- The English Index of Multiple Deprivation (IMD) 2019 published by the Ministry of Housing, Communities & Local Government, which is the official measure of relative deprivation for lower super output areas (LSOAs)[7] in England and ranks each of them from 1 (most deprived) to 32,844 (least deprived). See Appendix Two for information on why we used the 2019 IMD and how we derived the IMD for this analysis.
- The 2011[8] Rural-Urban Classification published by the Office for National Statistics, which categorises LSOAs in England into subsets of either 'rural' or 'urban', based on physical settlement and related characteristics.

Method

Journey time model

11 TRACC is a commercial software package, owned by Basemap. The parameters of the model used to generate the journey time data were defined by DfT. The model works by first defining origin and destination points. Origins are based on English OAs, where the starting point is set using a population-weighted centroid[9] that is shifted to the nearest road link of the road network. The destination points are defined as the locations of the services (such as a primary school).

12 DfT has derived a nationally consistent destination dataset for each of the seven services included in our analysis (see Appendix Three for more detail). Each destination (and origin) is located using a six-figure National Grid reference. For the large employment centres, this is taken to be the population-weighted centroid of each LSOA with over 5,000 jobs.

7 LSOAs are the next smallest geographical areas, after OAs, defined by the ONS, containing an average population of 1,500 individuals. There are 32,844 LSOAs in England.
8 The Rural-Urban Classification is based on census information and boundary areas. The most up-to-date version is based on the most recent 2011 census.
9 A population-weighted centroid is a summary reference point for the centre of the population in an OA and represents the spatial distribution of the population in that OA. Population-weighted centroids are calculated by the ONS.

Journey time calculations

13 All journey times calculated using the model are representative of the 'morning peak'. This is made explicit for public transport by requiring the journey to be completed between 7am and 10am, and for car journeys by using average traffic speeds between 7am and 10am. The model is designed to represent, as far as possible, the situation on a Tuesday in October of the year to which it relates – in this case 2017. Data for the second week of October are used since this provides a typical week, unaffected by major national holidays, school holidays or other seasonal effects.

Public transport

14 National public transport timetable data are publicly available.[10] The TRACC model uses these data as the basis for estimating journey times using public transport. When appropriate, these estimates incorporate the time to walk:

- from the point of origin to the road;
- from the road to the public transport stop (including bus and rail transit);
- between any interchange of public transport using the road;
- from the final stop to the destination via the road; and
- from the nearest point on the road network to the destination.

15 The journey assumes arrival at the first stop one minute before the initial departure, with any subsequent interchange waiting times included as part of the final journey time. In addition, any journey time up to 30 minutes, when it is possible to walk to a destination without using public transport, was included.

16 The model does not contain information on supplementary travel services, such as school bus services, community transport, patient transport services or demand-responsive travel. We have provided a summary of the full limitations of this modelling approach in Appendix Six.

10 Data for bus, local coach and other local transport services (such as light rail and ferry) are captured in the Traveline National Dataset; rail timetables are published by the Association of Train Operating Companies; and national coach services in the National Coach Dataset.

Car

17 Car journeys are calculated in a similar way except that, once the road network is reached, the journey proceeds along the road network, link by link, at speeds governed by data held in the model. These speeds are specific to the road type and, in some cases, the individual road link. The traffic data used are averages for the preceding 12 months, up to and including August 2017. The model uses a combination of data to estimate vehicle speeds on the road network. When available, vehicle speeds are obtained from Trafficmaster satellite navigation devices. When this is not possible, a national average dataset is used.

18 For more detail on the parameters used in both the public transport and car iterations of the journey time model, see Appendix Four. Our deviations from the methodology DfT uses to produce its journey time statistics are set out separately in Appendix One.

Our analysis

19 We undertook the same initial analysis for the public transport and car journey time datasets (**Figure 2** on pages 8 and 9). For each service, we ran a minimisation calculation to calculate the shortest journey time to a destination for every OA. We then aggregated up to LSOA level, based on an average of the journey times for the OAs included in each LSOA. We chose to aggregate to LSOA level to improve the visual clarity of the final outputs.

20 For the five services to which quality indicators could be applied, we matched inspection ratings from Ofsted/CQC to service destination locations provided by DfT (see Appendix Five) before re-running the above minimisation, using only the destinations identified as being rated 'good' or 'outstanding'.

21 In addition to calculating journey times to individual services, we calculated a 'transport accessibility metric' at LSOA level (**Figure 3** on page 10). For this metric, we rated each LSOA from 0–7 based on the number of services for which the mean journey time to a service was longer for that LSOA than the national average. In short, **our metric is a count of the number of services for which the mean journey time in the relevant LSOA is greater than the national average**. We used a mean value so that outliers (that is, very long or very short journey times to services) were given weight in the calculation. The model has a maximum journey time of 120 minutes, so any extreme outliers are already automatically prevented from being included in the output data.

Figure 2

Our methodological approach to calculating journey times to service destinations

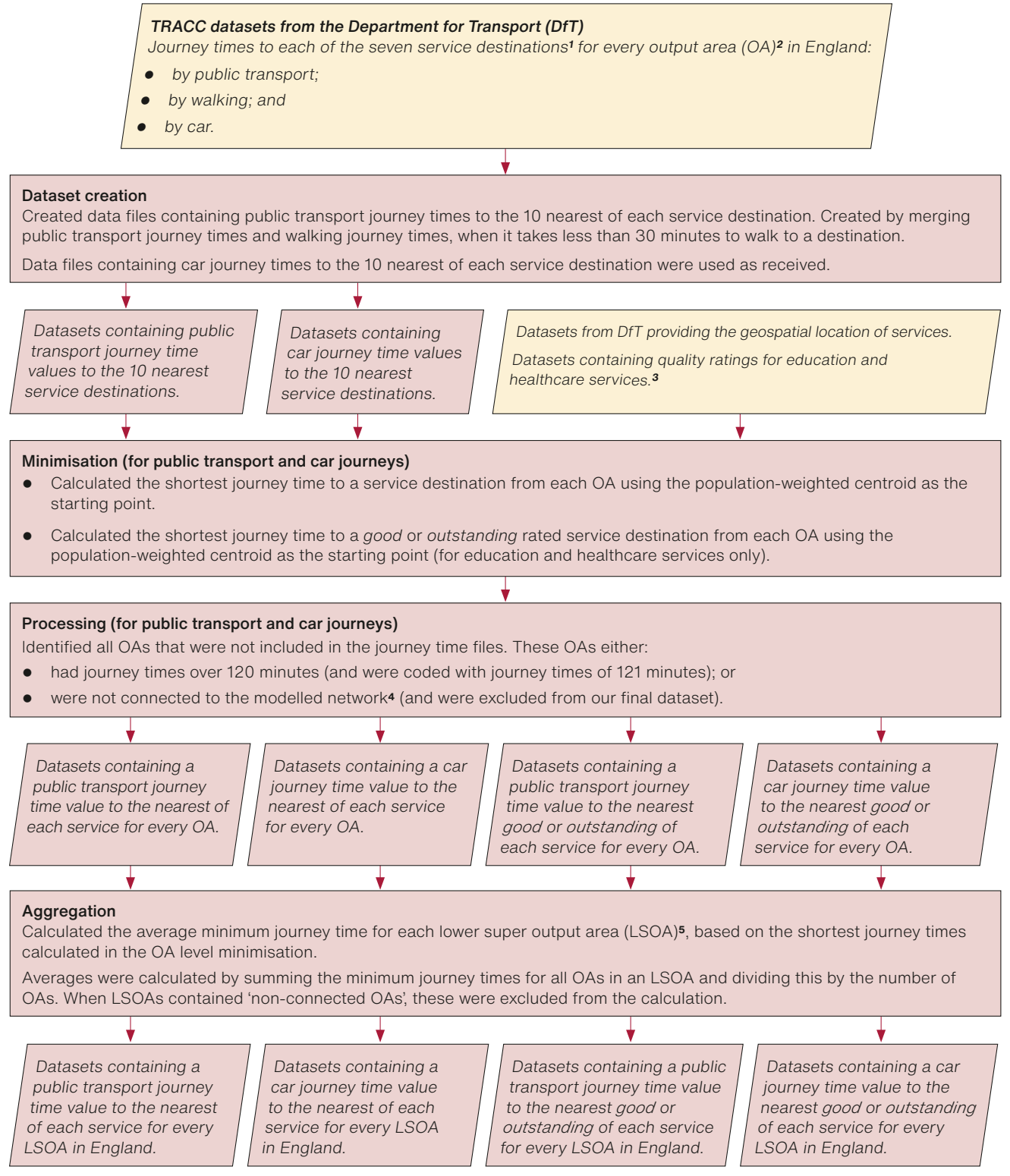


Figure 2 *continued*
Our methodological approach to calculating journey times to service destinations

Notes

1 The service destinations included were: primary schools, secondary schools, further education establishments, GP surgeries, acute hospital trusts, large employment centres and town centres.

2 An output area (OA) is the smallest geographical area defined by the Office for National Statistics (ONS), containing an average population of 309 individuals. There are 171,372 output areas in England.

3 Quality indicators for education and healthcare service destinations were obtained from inspection reports published by Ofsted and the Care Quality Commission respectively. They were applied to five of the seven services: primary schools, secondary schools, further education establishments, GP surgeries and acute hospital trusts. See Appendix Five for details on how ratings were matched to destination locations.

4 The total number of OAs in England is 171,372. There are 60 OAs not connected to the modelled network and therefore excluded from the dataset.

5 A lower super output area (LSOA) is geographical unit of area defined by the ONS, containing an average population of 1,500 individuals.

6 We did not use population weightings of service users in our calculations.

Source: National Audit Office

Data visualisation

22 We published our analysis in an interactive data visualisation tool. The tool displays:

- locations of service destinations and their quality ratings;
- average minimum journey times to single service destinations regardless of their quality rating, by public transport and walking, by LSOA;
- average minimum journey times to single service destinations rated as *good* and *outstanding* only, by public transport and walking, by LSOA;
- the increase in average minimum journey times for single service destinations rated as *good* or *outstanding*, compared with all destinations regardless of rating, by LSOA;
- the number of different service types for which public transport journey times are slower than the national average (our transport accessibility metric), by LSOA;
- an overlay of local authority, Parliamentary constituency, local enterprise partnership and clinical commissioning group boundaries; and
- the relationships between (a) deprivation and (b) rurality and the average minimum journey times for single service destinations by public transport and walking.

Figure 3

Our transport accessibility metric created using government data. It shows for each area how many services have a mean public transport journey time longer than the national average

Notes

1 Lower super output areas (LSOAs) are small geographical areas defined by the Office for National Statistics, containing similarly sized populations. There are 32,844 LSOAs in England, each containing an average population of 1,500 individuals.

2 Journey times are modelled for 2017.

3 Urban LSOAs, which tend to be better connected and therefore a lighter colour according to our index, are relatively smaller because of their higher population densities when compared with rural LSOAs. Better connected, urban areas may therefore be less visually prominent on this map.

Source: National Audit Office analysis of journey time modelling data provided by the Department for Transport

23 The tool was developed using 'R' and utilises a number of different technical packages. Notably, 'shiny' was used for the web-based design and interactive elements, and 'leaflet' for the geographical presentation. The 'leafgl' package was used to improve the speed of rendering the large number of LSOA boundaries within the map.

Results and discussion

24 This section summarises the technical progress made in undertaking this analysis. Prior to this work, there had been limited analysis of combined transport accessibility for individuals to multiple types of public service locations. In addition, previous analysis of accessibility to single types of public service locations had not typically taken into account the quality of service available at each location.

25 Using publicly available datasets, we have demonstrated an approach to understanding transport accessibility to multiple services. The creation of a combined metric of transport accessibility to numerous key public services offers the potential to contribute to a holistic view of public service accessibility across England and to add insights into its spatial variation.

26 The comparison of journey times taken by car or by public transport highlights where the lack of public transport provision may be preventing individuals from making sustainable transport choices, or accessing public services in a timely and fair way, when they do not have access to a car.

27 Matching service quality ratings to service locations enables more nuanced exploration of the service that users are able to access, and how this differs across local areas and across the country.

28 Considering transport accessibility alongside classifications of rurality and deprivation provides an opportunity to further explore how transport accessibility interplays with other demographic and topographic factors to influence the economic productivity, connectedness and quality of life experienced in a place.

29 For details of the results of these analyses, refer to our insights document published alongside this technical guide.

Limitations

30 Our analysis used data on journey times to key public services, produced using TRACC software and made available to us by DfT. We did not produce the raw journey time data ourselves. We undertook quality assurance checks on the raw journey time data we received to ensure, as far as possible, its completeness and accuracy. With regard to our own subsequent analysis, we sought quality assurance over our approach and aggregations of the data from our internal experts. We also obtained peer review from members of the relevant DfT statistics team.

Limitations of the journey time model

31 This analysis was based on journey time data derived using TRACC software. It was based on journey time data from 2017, because this was the most recent dataset available. The journey times were created using theoretical journeys based on timetabled information (for public transport journeys) and average traffic speeds (for car journeys). For these reasons, it cannot be used to establish a direct, causal relationship between government policy and the observed trends. Further details of the technical limitations of the journey time model are provided in Appendix Six.

Limitations in our approach to assessing the accessibility of services

32 At this stage, we have not sought to examine journey times to destinations weighted against the specific service user population (for example, considering only those aged 5–10 in journey times to primary schools). Our analysis did not contain any user-specific population weightings. In addition, only two variables (rurality and deprivation) were explored.

33 In our analysis, transport accessibility was considered as journey time to services only. Other elements of accessibility – such as: the cost of travel; cultural, age, gender or disability barriers to travel; catchment areas for service eligibility; the ability to book an appointment; user choice; internet accessibility and connectivity; the capacity of a service location; service opening times; and the inclusivity of services provided at a location – were not included in this analysis. To get a more comprehensive and nuanced understanding of variation in accessibility, further work needs to be undertaken with these additional variables examined.

34 Our analysis did not consider any organisational changes affecting health and care service delivery and quality since 2017. One of these is the creation of Strategic Transformation Partnerships (STPs) and, more recently, Integrated Care Systems (ICSs)[11] which bring together local authorities and NHS organisations to coordinate and improve health and care planning and delivery. STPs were announced in 2015 and are forerunners to Integrated Care Systems. The NHS Long Term Plan published in January 2019 stated an intention for every local area in England to have an ICS by April 2021. In some areas, STPs have evolved into ICSs, which have greater devolved, collective powers and responsibilities.

Limitations in matching service quality ratings to service locations

35 Our analysis explored journey times to 'good' and 'outstanding' education and healthcare services, as rated by Ofsted and CQC respectively. The location of services and journey times to them were provided by DfT and represented the situation in 2017. Due to the periodicity of inspection regimes of both Ofsted and CQC, we had to use proxy ratings for a number of locations (see Appendix Five for details). In addition, because of differences in the way DfT, Ofsted and CQC record their data, it was not possible to match ratings to all the locations defined by DfT. Appendix Five sets out how ratings were applied to locations, when proxy ratings were used and the number of locations for which it was not possible to identify a rating. As the data provided by DfT reflect the situation in 2017, we considered it appropriate to use the nearest available inspection ratings to 2017, obtained from published Ofsted inspections and provided to us by CQC. As we set out in Appendix Six, this has limited our analysis in excluding any updates to quality ratings made as a result of inspections taking place since 2017.

36 Further details of the limitations and assumptions made in this analysis are provided in Appendix Six.

Acknowledgements

37 This analysis was conducted by Dr Helen Roberts, an NAO senior analyst who holds a PhD in geography and has extensive experience in using geographical data in analysis. She is also the primary author of this publication. This project was completed under the supervision of Antonia Gracie ACA, under the direction of Lee-Anne Murray. Additional technical supervision was provided by Dr Marc Adams and additional support was provided by Charlie Acton, Laura Cole, Ben Coleman, Andrea Jansson and Laura McIntyre-Brown from the NAO.

11 More information on ICSs is available from NHSE.

Appendix One

Differences between our methodology and the Department for Transport's approach to producing journey time data

1 Our analysis used modelled journey time data produced by the Department for Transport (DfT) using TRACC software. The parameters of this model were defined by DfT. The output data we used from this model were the same data that DfT uses to produce its journey time statistics and accessibility indicators. However, our subsequent analytical approach differed to ensure that we used the data in a way appropriate to our final use (**Figure 4**). Therefore, the outputs of our analyses are not directly comparable with the journey time statistics published by DfT.

Figure 4

Differences between our methodology and the Department for Transport's (DfT's) approach to producing journey time data

Difference	Our method	DfT's method
Population weighting for service users	Did not contain any user-specific population weightings to ensure that we combined journey times to different services in our transport accessibility metric in a robust and comparable way.	Uses user-specific population weightings to produce its journey time statistics.
Added penalties	None added.	A five-minute penalty added to all public transport journeys as an allowance for catching the first public transport service. A five-minute penalty added to all car journeys as an allowance for parking the car at the final destination.
Treatment of walking journey times	Walking journey times combined with public transport journey times during analysis. Walking journey times capped at 30 minutes.	Walking and public transport journey times dealt with separately. All walking journey times included up to 120 minutes.

Notes

1 Both methods use the same input data which are modelled journey times produced using TRACC software.

2 Further details of the methodology used by DfT to produce its journey time statistics are provided in its published technical guide, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853603/notes-and-definitions.pdf

Source: National Audit Office summary based on Department for Transport technical documentation and our own methodology

Appendix Two

Creation of the Index of Multiple Deprivation used in our analysis

1 The English Index of Multiple Deprivation (IMD) is the official measure of relative deprivation for small areas (lower super output areas) in England. It ranks every small area in England from 1 (most deprived) to 32,844 (least deprived). The IMD is published by the Ministry of Housing, Communities & Local Government (MHCLG). We used the most recent publication, from September 2019, in this analysis. Given that our journey time data related to journeys made in 2017, the data used to create the domains of the IMD 2019 were the most appropriate compared with the data in the previous IMD, published by MHCLG in 2015.

2 The IMD is made up of seven domains of deprivation (**Figure 5**) with each of these domains including a number of indicators. The information from these seven domains is combined according to their respective weights.

3 The 'barriers to housing and services' domain includes consideration of the road distance to primary schools and GP surgeries. To ensure that our journey time analysis was not affected by collinearity,[12] we removed this domain from the IMD. We used transformed domain scores published by MHCLG (standardised by ranking and transformed to an exponential distribution) to build the revised IMD used in our analysis, in accordance with guidance published by MHCLG.[13] These transformed domain scores are specifically published by MHCLG with the intention of allowing users to combine the domains in different ways, using different weights and combinations, to create modified deprivation rankings.

12 Collinearity occurs when two predictor variables are correlated and therefore not independent of each other. This can be a problem when interpreting results. In this case, the two collinear variables were road distance to primary schools and GP surgeries, included in the barrier to housing and services IMD 2019 domain, and the journey times to primary schools and GP surgeries provided by DfT. Removal of this domain from the IMD 2019 removed the issue of collinearity between these variables.

13 Ministry of Housing, Communities & Local Government, *The English Indices of Deprivation 2019: Research report*, September 2019; Ministry of Housing, Communities & Local Government, *The English Indices of Deprivation 2019: Technical report, Appendix B*, September 2019.

Figure 5

Domains of the Index of Multiple Deprivation (IMD) 2019, their relative weightings in the index and the data used to create them

Domain	IMD 2019 domain weights	Date range from which the data used to create the domain is taken by the Ministry of Housing, Communities & Local Government (MHCLG)
Income deprivation	22.5%	Financial year 2015-16.
Employment deprivation	22.5%	Financial year 2015-16.
Education, skills and training deprivation	13.5%	Academic years 2014/15 to 2016/17. Census data from 2011.
Health deprivation and disability	13.5%	2013–2018.
Crime	9.3%	2016-17 to 2017-18.
Barriers to housing and services	9.3%	2015-16 to 2019. Census data from 2011.
Living environment deprivation	9.3%	2015–2017. Census data from 2011.

Notes

1 Definitions for each domain, and the approach to their calculation, are determined by MHCLG.

2 Figures do not sum due to rounding.

Source: Ministry of Housing, Communities & Local Government, *The English Indices of Deprivation 2019 Technical report*, 2019

Appendix Three

Destinations in the journey time model used by the Department for Transport

1 Our study included the following destination types: state-funded primary schools; state-funded secondary schools; state-funded further education establishments; acute hospital trusts; GP surgeries; town centres; and large employment centres. **Figure 6** provides information on how the lists of these destinations, and their geographical locations in England, were created by the Department for Transport for use in the model. **Figure 7** on pages 20 and 21 provides the location of these destinations in England. This analysis used locations as at 2017. Any new service locations, roadways or public transport services built or delivered since will not have been included in this analysis.

Figure 6

List of services for 2017, how they were defined by the Department for Transport and the data sources used

Service	How they were defined	Data source used to define them
Primary schools	Primary schools were defined by the location of all open, state-funded primary schools in September 2017.	Department for Education Edubase.
Secondary schools	Secondary schools were defined by the location of all open, state-funded secondary schools in September 2017.	Department for Education Edubase.
Further education colleges[1]	Further education colleges were defined by the location of all open, state-funded further education and sixth-form colleges/school sixth forms in September 2017.	Department for Education Edubase.
Acute hospital trusts	Acute hospital trusts were defined by the location of hospitals in 2017. Criteria were developed in consultation with the Department of Health & Social Care to reduce the list to capture only the key hospitals. This gave a final list of hospitals run by acute (non-specialist) trusts. As well as covering acute hospital trusts, this includes some with a largely or entirely community or rehabilitation role, where these happen to be managed by an acute trust. We concluded on balance that it was better to leave these in the list, rather than risk adding further subjectivity to the selection.[2]	Care Quality Commission's directory of places that provide care.
GP surgeries	GP surgeries were defined by the location of those with registered patients in October 2017. Grid references were derived from the postcode using the Office for National Statistics' (ONS's) postcode address file.	NHS Digital table of registered patients at GP practices.
Town centres	Town centres were defined by the location of town centres in 2004.	Ministry of Housing, Communities & Local Government's town centre and retail planning statistics for England and Wales.
Large employment centres	Employment centres were defined by the number of jobs available in each English lower super output area in 2017.	ONS's Business Register Employment Survey.

Notes

1 This definition of further education colleges is as received from the Department for Transport (DfT). The Department for Education uses different categories for types of 16 to 19 provision. To address this difference, we labelled the locations used in the DfT's journey time model as 'further education establishments (plus 16 to 19 schools and sixth forms)'. This is the label used in this document for this service type.

2 Acute hospital trusts are categorised by NHS England and NHS Improvement based on the type of provider operating at the location. Of the 277 locations received from DfT, 276 locations were acute non-specialist trust locations (operated by non-specialist trusts providing a wide range of services including both specialist and non-specialist) and one was a specialist trust location (operated by a specialist trust that provides a limited range of services and does not take in a full range of emergency cases).

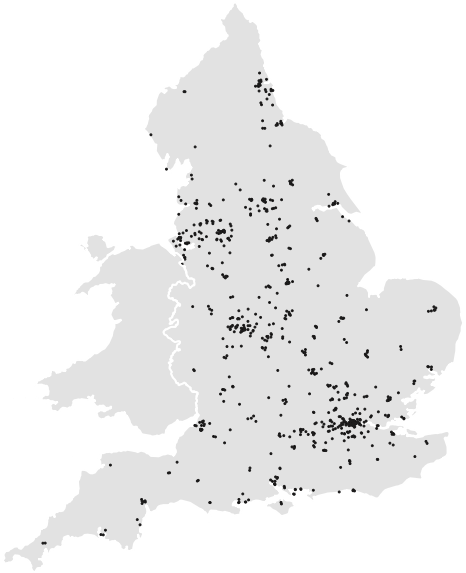
3 DfT used the data sources described to define the list of services included in its journey time model. Further information on these sources can be found in DfT's *Journey Time Statistics: Notes and Definitions* publication, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853603/notes-and-definitions.pdf

Source: Department for Transport, *Journey Time Statistics: Notes and Definitions*, November 2019

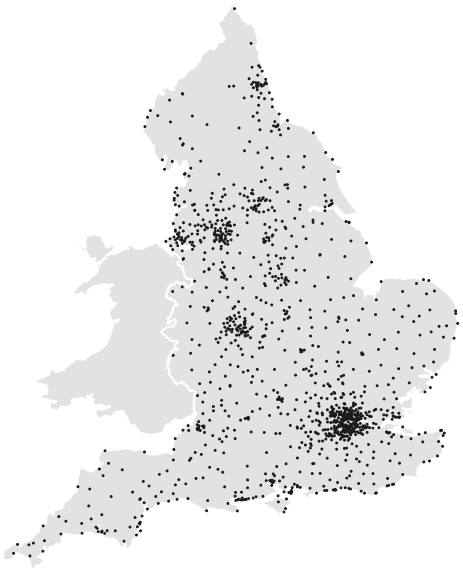
Figure 7

Locations of the services included in the 2017 journey time model in England

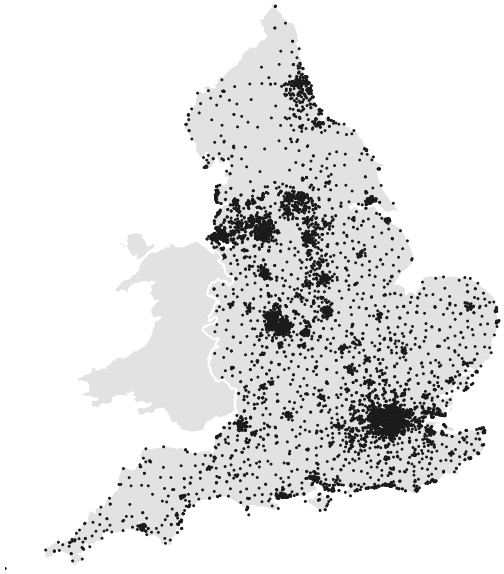
Large employment centres:
Total: 785



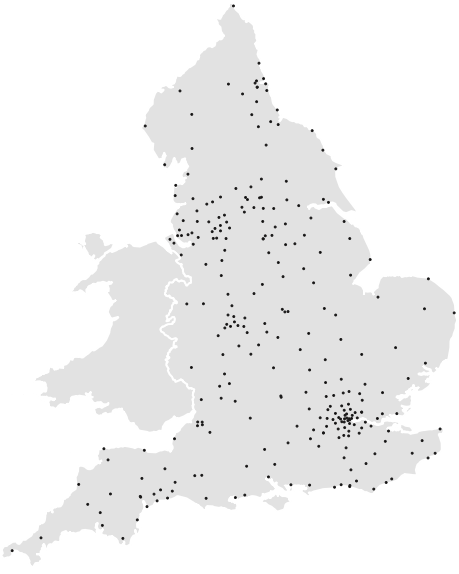
Town centres:
Total: 1,211



GP surgeries:
Total: 7,353



Acute hospital trusts:
Total: 277

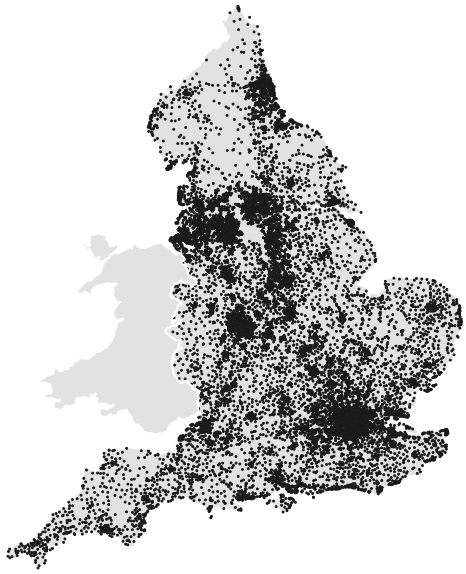


Note

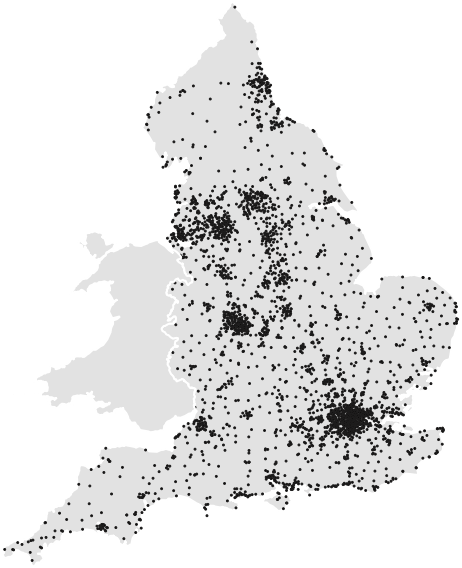
1 Our analysis used locations defined by the Department for Transport. These data do not include any service locations introduced after December 2017.

Source: National Audit Office analysis of the Department for Transport's destination (service location) information

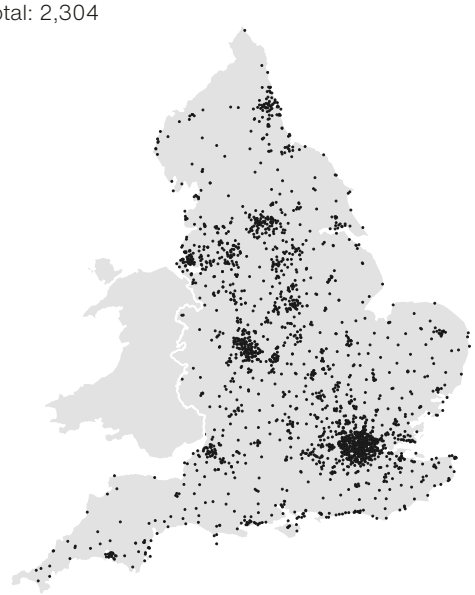
Primary schools:
Total: 16,927



Secondary schools:
Total: 3,173



Further education colleges:
Total: 2,304



Appendix Four

Parameters of the journey time model used by the Department for Transport

General parameters

- Maximum journey time of two hours.
- Maximum journey distance of 100 kilometres.

Public transport

- Interval within which the door-to-door journey must be completed is 7am to 10am on a Tuesday in the second week of October.
- Maximum walk distance of three kilometres. This applies to walks from the point of origin to first public transport stop, from last stop to destination, and also walking directly from origin to destination without using public transport. Walking speed on the road/path network of 4.8 kilometres per hour and a walking speed off the road/path network of 4.0 kilometres per hour are used in the model.
- Maximum number of potential first public transport stops considered in the routing algorithm is one (starting with the closest origin).
- Public transport speed is provided implicitly by the timetable information.
- Interchange time of five minutes (minimum interval between arriving at a stop and catching another service).
- Maximum straight-line distance between public transport interchanges of 500 metres.
- Stop-clustering at 150 metres, which groups together public transport stops within this distance of one another to speed-up processing. The individual timetables for each service are retained.

Car

- Data on actual vehicle speeds on each road network link are obtained from Trafficmaster satellite navigation devices and are used to estimate car speeds.
- These data are used to calculate average traffic speeds on each link of the road network (by direction if the link is bi-directional) and are used as the link speeds for cars in the modelling.
- Where the Trafficmaster sample for an individual link is too small (below 200 samples), national averages for the particular road type are used instead (**Figure 8**).

For further information on the model and the parameters used, see published guidance from DfT.

Figure 8

Average traffic speeds used in the 2017 journey time model, derived from Trafficmaster data

Road type	Default speed (km/h)
Motorway/urban motorway	77.6
A road	43.2
B road	41.9
Minor road	36.3
Local street	18.3
Private road (restricted access)	15.3
Private road (public access)	13.6

Source: Department for Transport, *Journey Time Statistics: Notes and Definitions*, November 2019

Appendix Five

How we matched destination locations with quality ratings

1 The destination locations for education and healthcare services were defined by the Department for Transport (DfT) (see Appendix Three). Whenever possible, our analysis considered the quality of service provided at these locations by matching ratings from published Ofsted inspections and provided to us by the Care Quality Commission (CQC) for these locations. **Figure 9** summarises the distribution of ratings assigned to the education and healthcare service locations included in our analysis. This appendix provides information on how this matching was undertaken.

Figure 9

Inspection ratings for education and healthcare service locations included in our analysis

Service	Outstanding	Good	Requires improvement	Inadequate	No rating	Total
Primary schools	3,111	11,574	1,589	462	191	**16,927**
Secondary schools	598	1,681	534	239	121	**3,173**
Further education establishments (including 16 to 19 schools and school sixth forms)	239	811	293	44	146	**2,304**[1]
GP surgeries	311	6,358	269	103	205	**7,353**
Acute hospital trusts[2]	12	91	164	10	0	**277**

Notes

1 In addition to the categories shown, between 2006 and 2017, 771 further education establishments were given a '9' rating. In this context, '9' ratings were given to schools with sixth forms that had been inspected but for which no specific grade for 16 to 19 provision had been stated. These ratings have not been included in this figure.

2 Acute hospital trusts are categorised by NHS England and NHS Improvement based on the type of provider operating at the location. Of the 277 locations received from DfT, 276 locations were acute non-specialist trust locations (operated by non-specialist trusts providing a wide range of services, including both specialist and non-specialist) and one was a specialist trust location (operated by a specialist trust that provides a limited range of services and does not take in a full range of emergency cases).

Source: National Audit Office analysis of Ofsted and Care Quality Commission inspection ratings

Education services

Primary and secondary schools

2 The location details of 20,100 primary and secondary schools in England were provided by DfT. Ofsted's schools 'Most Recent' inspection list (as at 31 December 2017) was used as the primary source of inspection data. We matched data between this database and the list of schools from DfT, using the Unique Reference Number (URN) of the school location.

3 In 592 cases, the URN provided did not exist on the Ofsted 'Most Recent' inspection list as at December 2017 (in 585 out of 592 cases, this was because the URN provided by DfT was for a later version of the school, which was not open in 2017). In these cases, we found the URN of the predecessor school, which was open in 2017, from the 'Links' on the Get information about schools (GIAS) database. In this way, 20,093 schools (99.97%) matched either with their given URN, that of their predecessor, on the Ofsted inspection list above.[14]

4 Using these matches, we were able to identify 2017 Ofsted ratings for the locations in the list provided by DfT and included in its modelled journey times. However, not all the schools had an Ofsted rating from an inspection undertaken in 2017. If the school open in 2017 was on the Ofsted list but had not been inspected since opening, we searched for its predecessor in the GIAS database. When a school had a single predecessor, we searched for the predecessor's URN on lists of annual Ofsted inspections undertaken each academic year from 2011/12 to 2016/17, and the 'Most Recent' school inspections as at August 2011. If present, we used the most recent inspection rating given up to August 2017 to provide a proxy quality rating for 2017. Ofsted has a statutory obligation to inspect schools rated as 'good', 'requires improvement' or 'inadequate' at least every five academic years.[15] We assumed that a rating given in the five preceding academic years to 2017 could accurately be taken to be the most up-to-date rating for these locations.[16]

14 Of the remaining six schools, five did not have a predecessor school listed (two were opened in 2018 and three were post-16 special institutions so were incorrectly included in the list of primary and secondary schools) and one had previously been an independent school so was not eligible for inclusion in this list.

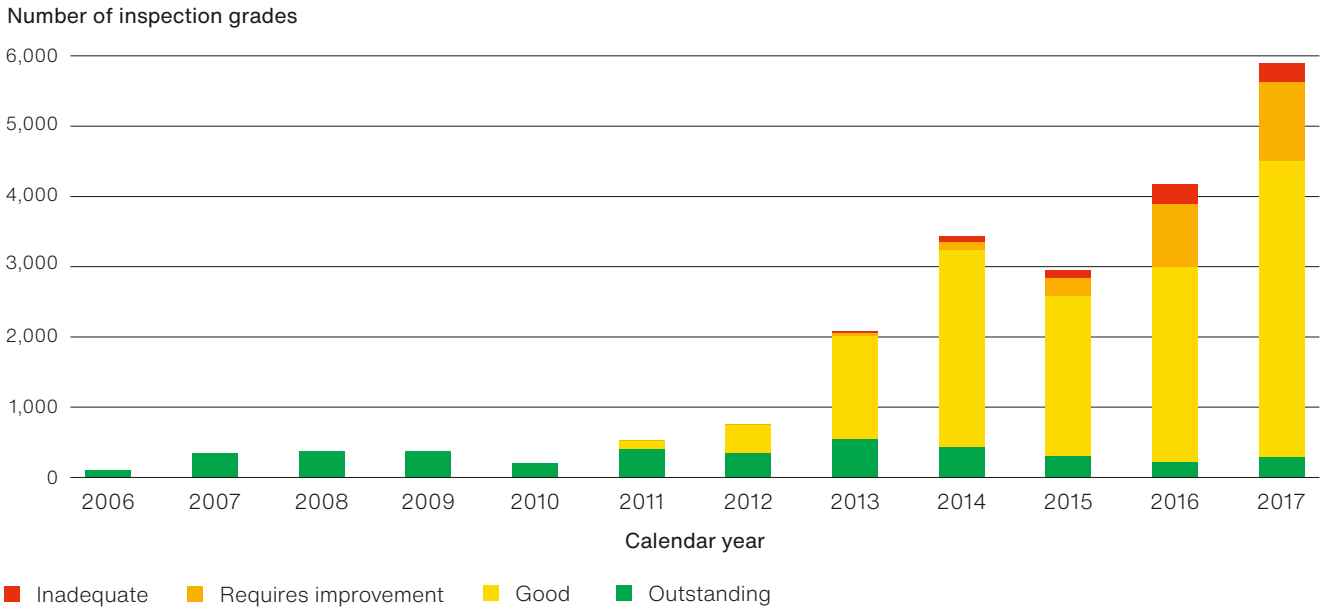
15 For consistency with the Ofsted inspection statistics and reporting, we used the Ofsted reporting 'academic year' running from 1 September to 31 August of the following year.

16 Inspections within five academic years of August 2017 went back to September 2011 because of the way that inspections 'within year' were recorded.

5 Locations rated as 'outstanding' are not subject to five-year statutory inspections and a considerable amount of time may elapse before re-inspection. We considered using a five-year cut-off period for 'outstanding' ratings to ensure consistency in the period used to identify proxy ratings for all locations and 'outstanding' locations. However, this left 1,556 schools that had been rated as 'outstanding' between 2006 and September 2011 and not re-inspected again in the intervening period. To ensure that our dataset was as complete as possible, we used all 'outstanding' ratings dating back to 2006. **Figure 10** shows the temporal distribution of ratings over the period of our analysis.

Figure 10

The distribution of Ofsted ratings for education locations included in our analysis, by calendar year of inspection



Notes

1 Includes primary schools, secondary schools and further education establishments (including 16 to 19 schools and school sixth forms) received from the Department for Transport as used in their journey time model as service location points.

2 In 2017, Ofsted had a statutory obligation to inspect schools rated as 'good', 'requires improvement' or 'inadequate' at least every five academic years. We assumed that a rating given in the five preceding academic years to 2017 could accurately be taken to be the most up-to-date rating for these locations. Locations rated as 'outstanding' were not subject to five-year statutory inspections and a considerable amount of time may have elapsed between re-inspections. To ensure that our dataset was as complete as possible, we used all 'outstanding' ratings dating back to 2006.

3 In addition to the categories shown, between 2006 and 2017, 780 further education establishments were given a '9' rating. In this context, '9' ratings were given to schools that had been inspected but for which no specific grade for 16 to 19 provision was stated. These ratings have not been included in this figure.

Source: National Audit Office analysis of Ofsted and Care Quality Commission inspection ratings

6 In some cases, a school did not have a rating for the 2011–2017 period because of a change in circumstances at the location during this time – for example, a secondary school may have converted to an academy. In these cases, if a predecessor school could be found in the databases, the most recent rating for this predecessor school (beginning from September 2011) was used as a proxy quality rating for 2017. **Figure 11** shows the number of predecessor establishment ratings used as proxies in our analysis.

Further education colleges and sixth forms

7 The location details of 2,304 further education establishments in England were provided by DfT. On examination, these locations could be subdivided into four types:

- secondary schools with a sixth form (1,965 locations);
- colleges (274 locations);
- schools catering only for pupils aged 16 to 19 (48 locations); and
- sixth form centres (17 locations).

Each of these types of location is covered by a different inspection approach (**Figure 12** overleaf) and we tailored our approach to matching inspection ratings to these different types of further education locations accordingly.

Figure 11

Use of predecessor establishments to assign proxy ratings to uninspected education establishments

Education service type	Number of predecessor establishments used as proxies
Primary schools	483
Secondary schools	179
Further education establishments (including 16 to 19 schools and school sixth forms)[1]	35

Note

1 The only type of further education establishment to which the use of predecessor ratings applied were secondary schools with a sixth form.

Source: National Audit Office analysis of Ofsted inspection ratings

Figure 12

Ofsted inspections of different types of further education establishments

Type of further education establishment	Approach to inspection
Secondary school with a sixth form	Inspection details are contained within Ofsted's school inspection statistics, within which Ofsted provides a separate judgement for 16 to 19 provision at a school. For some years, or in particular circumstances,[1] Ofsted did not always specify a separate inspection grade for 16 to 19 provision.
Colleges (including specialist colleges and sixth form colleges that are not schools)	These are further education colleges, including specialist colleges (for example, agricultural) and sixth form colleges that are not schools. Inspection details, including the overall effectiveness of the establishment, are contained in Ofsted's further education and skills inspection statistics.
Schools catering only for pupils aged 16 to 19 (academies, free schools and local authority-maintained schools)	For academies and free schools, inspection details are contained within Ofsted's further education and skills inspection statistics. For local authority-maintained schools, inspection details are contained within Ofsted's school inspection statistics.
Sixth form centres	These are not inspected by Ofsted.

Note

1 For example, if there were no, or very few, pupils in the sixth form.

Source: National Audit Office analysis of Ofsted inspection data, methodology and documentation

Secondary schools with a sixth form

8 Inspection ratings for 16 to 19 provision at secondary schools with a sixth form that were open in 2017 (or a predecessor) were retrieved from the processing performed above for secondary schools. In 93 cases, the URN provided did not exist on these Ofsted 'Most Recent' inspection lists and the predecessor establishment URN was used to retrieve the inspection rating for 16 to 19 provision. For 58 of these establishments, the inspection grade was '9' (see next paragraph), leaving 35 with usable inspection grades (Figure 9).

9 An additional grading of '9' can be given for 16 to 19 provision at schools with sixth forms alongside the four standard Ofsted gradings ('outstanding', 'good', 'requires improvement', 'inadequate'). According to Ofsted, judgements on 16 to 19 provision were not reported in 2012/13 and 2013/14 due to changes in legislation, although information on 16 to 19 provision was available from Ofsted reports. A '9' grading was used to indicate these cases. In other years, a '9' grading was given when providing an assessment of 16 to 19 provision was not applicable – for example, when a school had no, or very few, post-16 pupils. We considered using whole-school inspection ratings (secondary and post-16 provision) as a proxy for the quality of 16 to 19 provision when '9' ratings had been given, but we could not assure ourselves of the robustness and accuracy of this assumption. As a result, we retained '9' ratings in our final analysis as a unique category and excluded them from the destination datasets used to calculate journey times to 'good' or 'outstanding' locations. In our study period, 33.5% (771) of the further education establishments were graded as '9'.

Colleges and 16 to 19 schools

10 Ofsted's further education and skills 'Most Recent' inspection lists (as at February 2017, August 2017 and February 2018) were used as the primary source of inspection data for colleges and 16 to 19 schools. Three datasets were used to account for closures in locations during 2017 that would not have been captured if one cut-off date at the end of 2017 had been used. We matched data between these lists and the list of further education establishments from DfT using the URNs of the locations.

11 When the URNs for establishments on DfT's list could not be found on these three inspection lists, the predecessor establishment, if open in 2017, was traced on the GIAS database. This was then used to find inspection details on the three inspection lists. The URNs of 23 colleges could not be found: 12 had predecessors open in 2017 (two with single predecessors and 10 with multiple predecessors), which could be found on the three inspection lists; 10 had no inspection details (of which five were free schools or other new establishments that had not yet been inspected); and one was result of an establishment splitting and where the inspection details of the predecessor could not be assumed to be the same. When an establishment from the DfT list had multiple predecessors, the one matching the final college by name was used as the predecessor for matching with the list details.

12 We identified 43 colleges open in 2017 that had subsequently closed or merged, which were not included in the list of further education establishments we received from DfT and were therefore not included in the journey time model.

13 There were also three local authority-maintained 16 to 19 schools on DfT's list. Inspection details for these schools were retrieved from Ofsted's state-funded schools inspections data.

14 Ofsted has a statutory obligation to inspect further education establishments rated as 'good', 'requires improvement' or 'inadequate'. Ofsted had a range of different target inspection periods for further education in the period up to the end of 2017. As with schools, further education establishments rated as 'outstanding' were not subject to regular statutory inspections and a considerable amount of time could elapse before re-inspections. To ensure that our dataset was as complete as possible, we used all 'outstanding' ratings dating back to 2006. Figure 9 shows the distribution of ratings over the period of our analysis.

Sixth-form centres

15 Sixth form centres are not inspected by Ofsted. We have not matched the 17 sixth form centres included in the list of establishments from DfT to any inspection or quality rating. They appear as 'not rated' in the dataset.

16 Figure 8 summarises the inspection ratings for education service locations used in our analysis. A total of 191 primary schools, 121 secondary schools and 146 further education establishments remain without an inspection rating. Most of these are locations that have opened since 2014 but but have not yet been subject to an inspection. In addition, there remain a total of 771 further education locations graded as '9' for which no quality indication could be assigned.

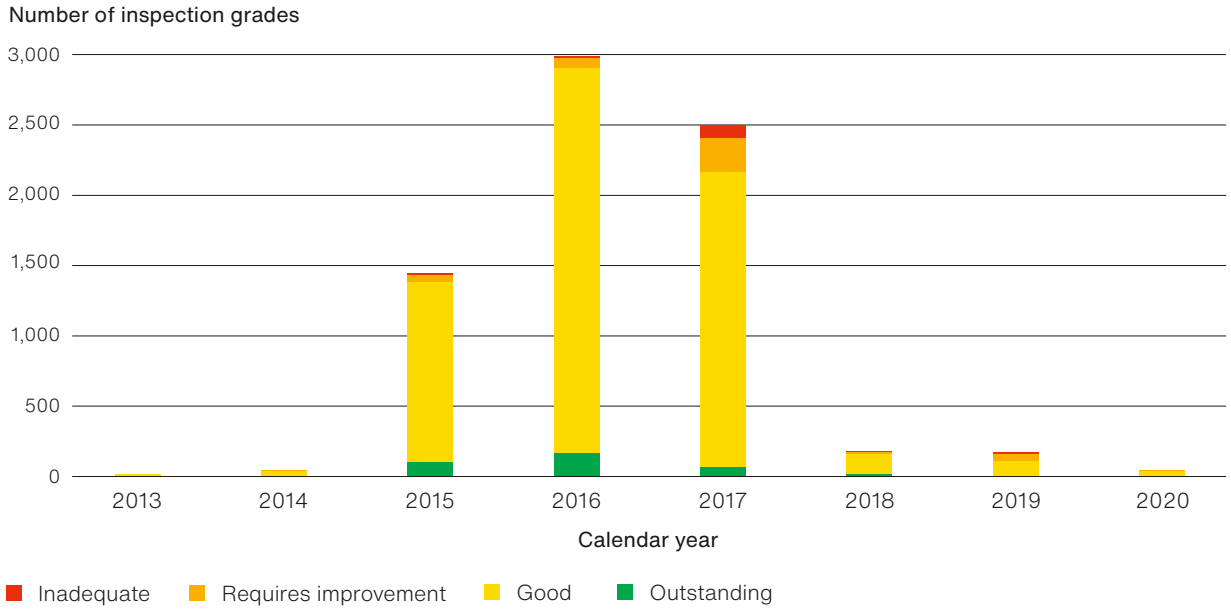
Healthcare services

17 The location details of acute hospital trust and GP surgery locations were provided by DfT. Inspection ratings for these locations were provided to us by CQC. CQC has three levels of inspection ratings: a provider rating given to the provider of a service at a location; a rating given at trust level to the trust providing the services at a location; and a location rating given to each establishment. Whenever possible, CQC provided us with the location rating. All GP surgery ratings used in our analysis were location ratings. For acute hospital trusts, 221 out of the 277 ratings used were location ratings. The remaining 56 were overall trust ratings used as a proxy for quality of service when a location rating was not available. CQC told us that, when a service does not have a location rating, the overall rating for the trust covers all its services. Some registered locations are not prioritised for inspection because CQC considers them low risk or they tend to be smaller sites offering fewer services.

18 The years of publication for the ratings received from CQC ranged from 2013 to 2020. **Figure 13** shows the distribution of publication years for the ratings used in our analysis. This range of years was required to ensure that as many locations as possible could be given a rating.

Figure 13

The distribution of Care Quality Commission ratings for healthcare locations included in our analysis, by calendar year of inspection



Notes

1 Includes acute hospital trusts and GP surgeries received from the Department for Transport (DfT) as used in their journey time model as service location points.

2 Acute hospital trusts are categorised by NHS England and NHS Improvement based on the type of provider operating at the location. Of the 277 locations received from DfT, 276 locations were acute non-specialist trust locations (operated by non-specialist trusts providing a wide range of services, including both specialist and non-specialist care) and one was a specialist trust location (operated by a specialist trust that provides a limited range of services and does not take in a full range of emergency cases).

3 To ensure that the dataset was as complete as possible, CQC provided us with ratings dating from 2013 to 2020.

Source: National Audit Office analysis of Care Quality Commission inspection ratings

19 Figure 9 summarises the inspection ratings for the healthcare service locations used in our analysis. A rating was identified for all acute hospital trust locations. However, 205 GP surgeries (2.8%) remain without an inspection rating. GP surgeries that did not have a rating disclosed were locations that had not been inspected or where it was not possible to make a certain match between the postcode of a location provided by DfT and a CQC rating. Ratings may be available from CQC for these 205 GP surgeries. However, because of difficulties in matching between the DfT locations and CQC ratings, CQC was unable to identify ratings in these cases.

Appendix Six

Assumptions and limitations of this journey time analysis

1 This analysis used journey times modelled for 2017. Any new service locations, roadways or public transport services built or delivered since will not have been included in this analysis. Public transport routes can change over time and the routes used to model public transport journeys made in 2017 may not reflect the journeys made on public transport routes today.

2 As the data provided by the Department for Transport (DfT) reflect the situation in 2017, we considered it appropriate to use the nearest available inspection ratings to 2017, obtained from published Ofsted inspections and provided to us by the Care Quality Commission (CQC). Some locations may have undergone a more recent inspection by Ofsted or CQC since 2017 that was not included in our analysis.

3 This analysis used a list of service destinations created by DfT in 2019 to reflect the services available in 2017. We have not undertaken any quality assurance of these lists and they may not match exactly the understanding of service locations within, for example, the NHS, the Department of Health & Social Care or the Department for Education. There is a high level of uncertainty regarding the healthcare destination locations and DfT do not have assurance over the nature or completeness of the acute hospital trust or GP datasets.

4 Our approach to matching ratings to the acute hospital trust and GP surgery locations provided by DfT used data published by CQC. However, because of the difficulty in matching the DfT and CQC datasets, the final ratings matched to acute hospital trust and GP surgery locations may not include all ratings published by CQC.

5 The timetable information used to model the public transport journeys was taken from one Tuesday in October in 2017, between 7am and 10am. Therefore, the modelled journeys are not representative of all the journeys it is possible to make using public transport, or of the times when the frequency or availability of public transport services is reduced – for example, in the evenings, overnight, on public holidays and at weekends. Journeys modelled are one-way only and do not consider the return leg from a service location back to the journey starting point.

6 Public transport journeys were modelled using timetable information only. Therefore, it was not possible to estimate delays to public transport services, or the real-time reliability of services, which may increased journey times for users in actuality.

7 The journey times modelled represented the shortest time between a point of origin and a destination. This approach does not take into account users' preference for opting to take longer routes between locations.

8 Supplementary travel services, such as school bus services, community transport, patient transport services and demand-responsive travel options were not included in this analysis. These services are provided by a range of public bodies to meet the needs of specific service users, often to fill gaps in general public transport provision, and are not part of the timetabled public transport network. DfT does not have responsibility for the delivery of these services and it does not collect data on them. No other body captures information on the frequency and routing of these services in a consistent way across England. Therefore, we were unable to include them in this analysis.

9 Journey times to services in the border areas of England with Wales and Scotland may not accurately reflect the reality of journeys taken by individuals living in these areas if the nearest available service is not situated in England. Service locations in Wales and Scotland are not included in the way DfT models journey times, and so are not included in this analysis.

10 Independent schools were not included in this analysis. The independent sector educates around 7% of the total number of schoolchildren in England. As at January 2017, a total of 583,268 pupils were being educated in independent schools in England.[17] Of these, 45% were in pre-school or primary education, 39% were in secondary education and 16% were in sixth form/college education.

11 Private healthcare providers, who may provide urgent or emergency healthcare services similar to those provided by NHS non-specialist acute trusts, were not included in this analysis. In 2017, 21% of total current healthcare expenditure was financed through non-government expenditure.[18]

12 This analysis did not take account of the online availability of some services, making them accessible from non-traditional locations where there is adequate digital connectivity removing the need to travel – for example, online or telephone GP appointments.

17 The number of pupils educated in independent schools in 2017 was published by the Department for Education, available at: https://www.gov.uk/government/statistics/schools-pupils-and-their-characteristics-january-2017

18 Government and non-government healthcare expenditure for 2017 was estimated by the Office for National Statistics, available at: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthcaresystem/bulletins/ukhealthaccounts/2017

13 Our analysis did not consider any organisational changes affecting health and care service delivery and quality since 2017. One of these is the creation of Strategic Transformation Partnerships (STPs) and, more recently, Integrated Care Systems (ICSs) which bring together local authorities and NHS organisations to coordinate and improve health and care planning and delivery. STPs were announced in 2015 and are forerunners to Integrated Care Systems. The NHS Long Term Plan published in January 2019 stated an intention for every local area in England to have an ICS by April 2021. In some areas, STPs have evolved into ICSs, which have greater devolved, collective powers and responsibilities.

14 This analysis did not take account of any healthcare service provision provided in the community by the GP surgeries or acute hospital trust locations included in the model. These would not require an individual to travel from their home to access the service.

15 The journey time model had a threshold journey time of 120 minutes. Any journey over 120 minutes was recorded as '1000000'. In our analysis, we converted any journey time recorded as '1000000' to 121 minutes, to reflect the nature of it being over the specified threshold, and to enable us to include a representative journey time in the averaging-up of journey times from output area to lower super output area.

16 Multimodal public transport journeys that use, for example, a bus and a train, were included in this model. However, it did not take into account any multimodal journeys that use a car in combination with any other form of transport or walking, such as park-and-ride services.

17 Cycling journey times were not included in this model.

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