UK Health Security Agency

Lead Exposure in Children Surveillance System (LEICSS) annual report, 2021

Summary of 2020 data

Health Protection Report
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Contents

Executive summary

This report summarises the surveillance of lead exposure in children in England from 1 January to 31 December 2020.

We last published a full annual surveillance report in March 2021 detailing 2019 case data. This report outlines 2020 case data and provides a shorter technical update of the surveillance. Our aim is to achieve more timely reporting of surveillance of case data. A full report with recommendations will be produced in 2022.

For the purposes of surveillance of cases in 2015 to 2020, a case is defined as a child:

- with a blood lead concentration ≥0.48µmol/L (equivalent to ≥10µg/dl), as detected in a UK Accreditation Service (UKAS) accredited biochemistry or toxicology laboratory
- reported to Health Protection Teams for public health intervention
- aged under 16 years at the time of first elevated blood lead concentration
- resident in England

Main points

Main findings of this report are that:

- 35 cases of lead exposure in children were notified in 2020
- most cases (60%) were directly notified to LEICSS by participating laboratories; substantially more cases (40%) were notified through other routes compared to previous years (normally around 20%)
- the median delay between a specimen being drawn and a case being entered onto HPZone was 18 days; in 2019 this delay was 8 days. This extended delay is thought to be due to pressures on the health system from the coronavirus (COVID-19) pandemic
- the number of cases detected was very much lower than the expected incidence of lead exposure based on international population survey data [1,2]
- the average detection rate for England between 2015 and 2020 was 4.62 cases per million children aged 0 to 15 years, although there was large regional variation
- cases were typically 1 to 4 years of age, male, and resident in more deprived areas
- the median blood lead concentration of cases was 0.71µmol/L (14.69 µg/dL) in 2020

Main messages and recommendations

Lead is a persistent environmental contaminant that can cause toxicity even at low blood lead concentrations. There is no known safe lower threshold of exposure.

Children exhibiting pica[1] or hand to mouth behaviour in environments with lead hazards are likely at highest risk of exposure.

Clinicians should be aware of important sources of lead exposure, children most at risk, and presenting symptoms and signs of exposure.

The UK Health Security Agency lowered the public health intervention concentration for lead from ≥10µg/dL (≥0.48µmol/L) to ≥5µg/dL (≥0.24µmol/L) for children under 16 years and for pregnant women, with effect from 5 July 2021. UKHSA is working with stakeholders to support this change and has produced updated guidance and advice to support this change including a series of stakeholder events.

The background to the change is described in the report 'Evaluation of whether to lower the public health intervention concentration for lead exposure in children'.

We also launched a free online training course, 'Tackling lead poisoning in public health', in July 2021, designed for professionals involved in responding to lead incidents who'd like to develop their understanding of lead poisoning and public health policy. Cases who fit the new case definition from 5 July 2021, with a blood lead concentration above the new public health intervention level, should be notified to UKHSA health protection teams for public health case management.

UKHSA's major efforts in health protection during 2020 and 2021 have focused on responding to the COVID-19 global pandemic. We have continued to respond to cases reported to UKHSA, but major developments in surveillance functions have been delayed. Therefore, we have produced this interim shorter report to publish 2020 case data in a timely manner. In 2022, we aim to produce a longer report with recommendations.

[1] The persistent ingestion of non-nutritive substances at an age where this is developmentally inappropriate.

Background

Purpose of this report

This report provides a summary of data extracted from the national LEICSS data set for cases of child lead exposure in residents of England reported to Health Protection Teams during 1 January to 31 December 2020. As the number of cases in each year is small, we have compared the 2020 metrics to the previous 2015 to 2019 5-year average, where relevant, using data from cases with report dates between 1 January to 31 December for each of these years. Figures are correct at the time of publication and may be subject to change as new information about cases becomes available.

This report, and previous years' annual reports, and other surveillance reports, are available at Lead exposure in children: surveillance reports.

Surveillance data indicators

Number of unique cases

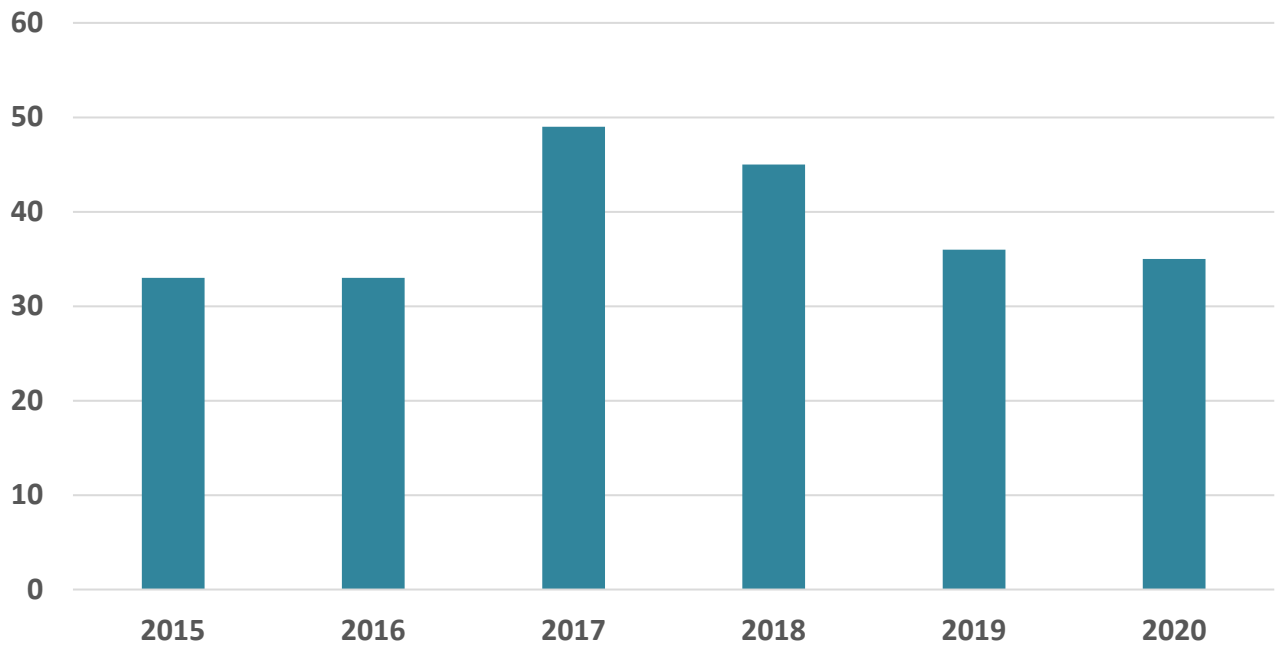
There were 35 unique cases detected in 2020 that met the case definition. Sixty per cent of cases were direct laboratory reports to LEICSS, substantially lower than the 2015 to 2019 average of 81% (Table 1). Figure 1 shows the number of cases report per year 2015 to 2020, England.

Table 1. Count and percentage of LEICSS cases, by reporting route to LEICSS, England 2020, and 2015 to 2019

Route of detection by LEICSS	Count of cases 2020* (% of total)	Count of cases* 2015 to 2019 (% of total)
Direct laboratory reports	21 (60)	159 (81)
HPZone search	14 (40)	37 (19)
Total	**35**	**196**

* Cases where both a valid specimen date and a valid date of entry onto to HPZone were extracted from HPZone; LQ – Lower Quartile, UQ – Upper Quartile.

Figure 1. Count of LEICSS cases, England 2015 to 2020



Timeliness of reporting of lab-detected cases to LEICSS and notification of Health Protection Teams

For the laboratory reported cases, the median delay between the date of specimen collection and the date the case was entered onto HPZone (as a proxy for date of report to HPTs) was 17.5 days, more than double the 2015 to 2019 median of 8 days (Table 2). It is likely that the pressures of responding to the COVID-19 pandemic are responsible for this increased delay.

Table 2. Time between specimen collection and entry of case onto HPZone for case management for lab-detected LEICSS cases, England 2020, and 2015 to 2019

Year	Cases	Cases with valid data*	Median days delay	LQ - UQ
2020	**21**	**20**	**17.5**	**10 to 30**
2015 to 2019	**159**	**152**	**8**	**6 to 13**

* Cases where both a valid specimen date and a valid date of entry onto to HP Zone were extracted from HPZone; LQ – Lower Quartile, UQ – Upper Quartile.

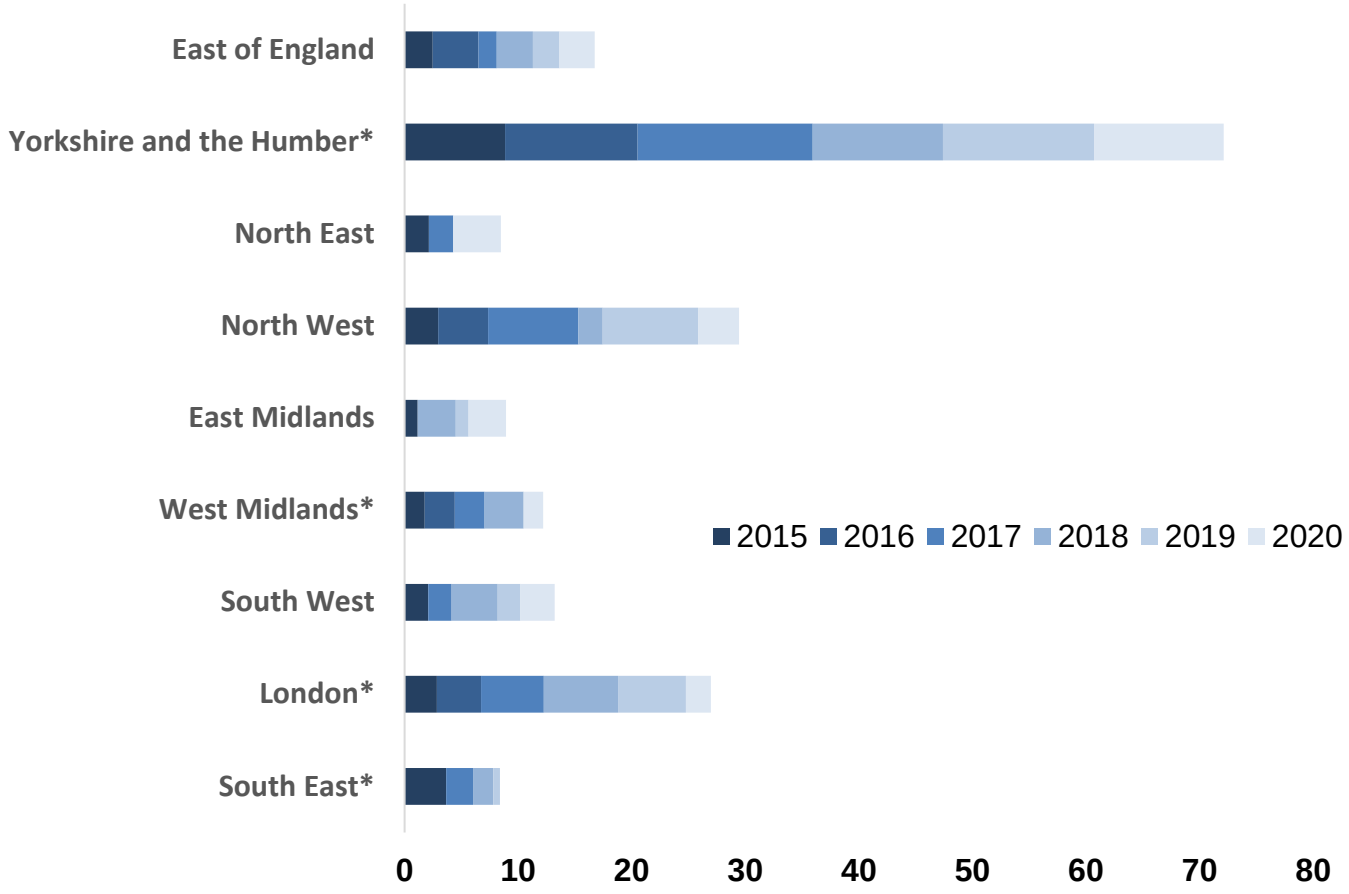
Occurrence and trends of cases of lead exposure in children

Count and detection rate (by LEICSS) of cases by Centre and year

The number of cases detected in 2020 was similar to those in 2019 (see Table 3). However, it is likely that the numbers continue to significantly under-ascertain the true number of cases (see section on ascertainment, page 10). No cases were detected in the South East region and there was a decline in cases detected in London during 2020 (63% decrease, see Figure 2, Table 3).

Note: this should not be interpreted as a reduction in incidence. The average detection rate for England between 2015 and 2020 was 4.62 cases per million children aged 0 to 15 years, although there was large regional variation. Yorkshire and Humber remains the highest reporting region (Figure 2, Table 3, Figure 3).

Figure 2. Graph showing detection rate of LEICSS cases per regional population of 0 to 15 year olds, per million, 2015 to 2020, England



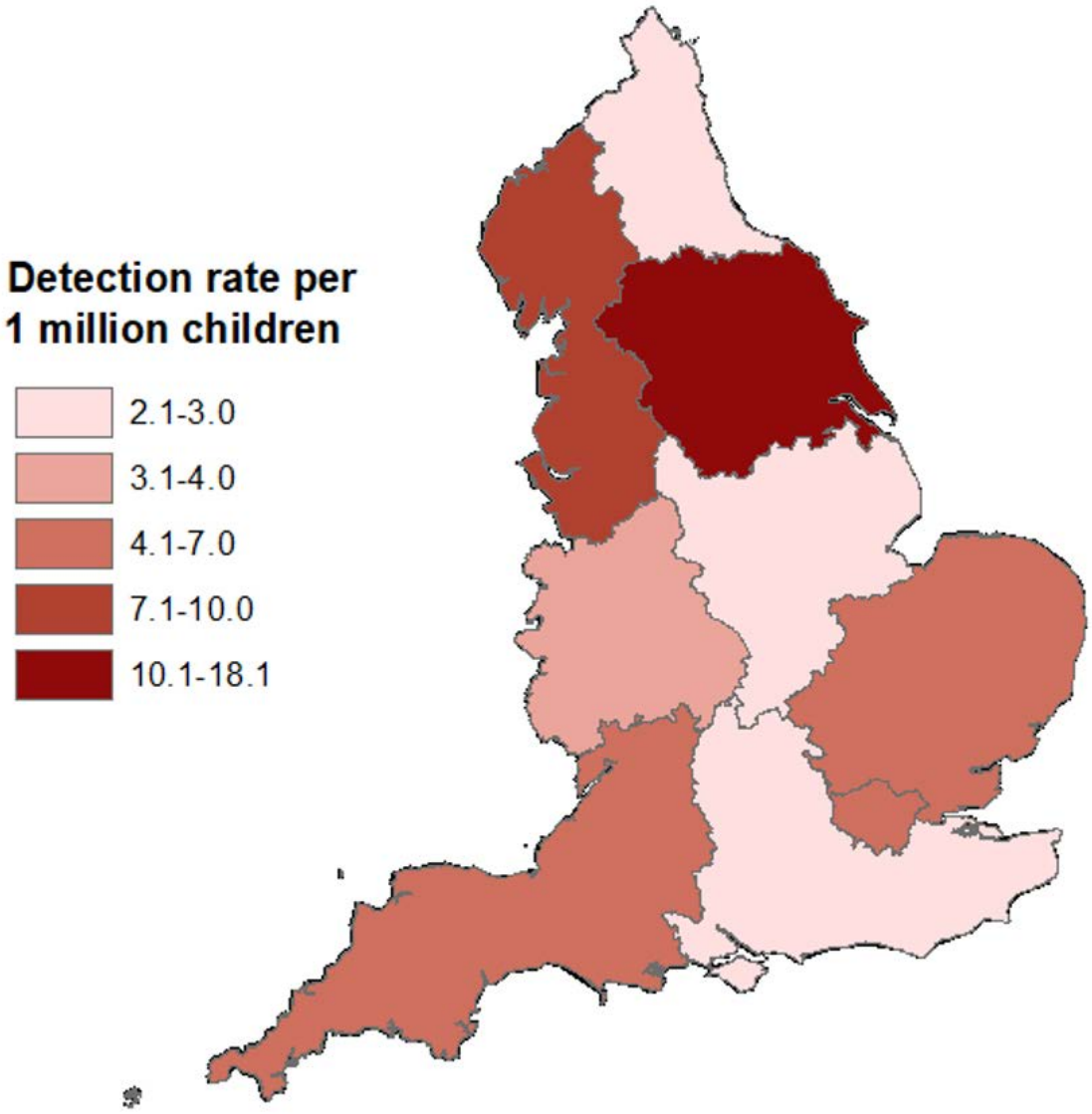
* Centres where an SAS laboratory that participates in the surveillance system is situated.
Note that 2019 population data was used as the denominator for 2020 cases

Table 3. Count and percentage of LEICSS cases, and average detection rate† of cases (per million 0 to 15 year old children) by Centre and year of notification, England 2015 to 2020

Centre or region	Cases 2015 (%)	Cases 2016 (%)	Cases 2017 (%)	Cases 2018 (%)	Cases 2019 (%)	Cases 2020 (%)	Cases 2015 to 2020 (%)	Average detection rate‡ of cases (per million per year) 2015 to 2020
South East*	6 (18)	0 (0)	4 (8)	3 (7)	1 (3)	0 (0)	14 (6)	**2.09**
London*	5 (15)	7 (21)	10 (20)	12 (27)	11 (31)	4 (11)	49 (21)	**6.76**
South West	2 (6)	0 (0)	2 (4)	4 (9)	2 (6)	3 (9)	13 (6)	**5.81**
West Midlands*	2 (6)	3 (9)	3 (6)	4 (9)	0 (0)	2 (6)	14 (6)	**3.05**
East Midlands	1 (3)	0 (0)	0 (0)	3 (7)	1 (3)	3 (9)	8 (4)	**2.26**
North West	4 (12)	6 (18)	11 (22)	3 (7)	4 (11)	5 (14)	33 (14)	**8.99**
North East	1 (3)	0 (0)	1 (2)	0(0)	0 (0)	2 (6)	4 (2)	**2.12**
Yorkshire and the Humber*	9 (27)	12 (36)	16 (33)	12 (27)	14 (38)	12 (34)	75 (32)	**18.07**
East of England	3 (9)	5 (15)	2 (4)	4(9)	3 (8)	4 (11)	21 (9)	**4.21**
England	**33**	**33**	**49**	**45**	**36**	**35**	**231**	**4.62**

† Should not be interpreted as an estimate of incidence – see note on ascertainment, page 10.
‡ The numerator for this indicator is incident cases in 2015-20, and the denominator is the summed mid-year estimate of the 0 to 15 population for 2017 multiplied by 4. Cases allocated to then-PHE Centre according to postcode of residence.
* Centres where an SAS laboratory that participates in the surveillance system is situated.

Figure 3. Average detection rate† of LEICSS cases (per million 0 to 15 year-old children) by Centre, England 2015 to 2020



† Should not be interpreted as an estimate of incidence – see note on ascertainment below.

The case detection rate and ascertainment

Because lead exposure below the level causing overt toxicity commonly causes few or non-specific symptoms, surveillance of clinically reported cases is likely to under ascertain the number of affected children. International population surveys, which more accurately estimate the number of children exposed to lead, suggest an expected incidence of cases of paediatric lead exposure higher than detected through LEICSS [1, 2, 3]. The figures above should not therefore be considered representative of the incidence of child lead exposure in England. Factors affecting case ascertainment are also likely to be driving the variation seen between regions. For instance, UKHSA is aware of a system introduced by Leeds SAS laboratory (based in Yorkshire and Humber) to actively prompt clinicians to consider testing for lead exposure in children whose blood is being tested for suspected iron deficiency, where that child is also known to have pica [4]. There is also active engagement of local clinicians by this laboratory. The 90% increase in testing and case reporting in this region following the introduction of this system demonstrates that differences in clinician awareness and testing rate strongly influence case ascertainment by the surveillance system (and potentially more than differences in the frequency of lead hazards in the environment between regions). Testing of cases in laboratories not reporting cases to LEICSS may also explain part of the regional variation in case ascertainment, though it is expected SAS labs perform the large majority of BLC tests in children in England. Non-reporting of cases by participating laboratories may also have (more rarely) occurred. Irregular case entry onto HPZone may have prevented some cases being detected by our search, though cases first notified to LEICSS are entered using a standard procedure. Estimating area-specific testing rates would aid the interpretation of case detection rates but is difficult given the supra-regional catchment of SAS laboratories.

Count and detection rate of cases by gender and age

The majority of cases in 2020 were male (63%), similar to the 2015 to 2019 proportion (66%) (Table 4). Across all age groups the detection rate was higher in males than females (Figure 4). This gender disparity is also evident in some international survey findings [2] and may reflect a pre-disposition for males to behaviours or comorbidities that result in lead exposure (such as autism [5], itself associated with pica [6]), or a greater susceptibility to lead toxicity, and hence clinical presentation [7].

Table 4. Count and percentage of LEICSS cases by sex, England, 2020, and 2015 to 2019

Sex	Count of cases 2020 (%)	Count of cases 2015 to 2019 (%)
Female	12 (34)	61 (31)
Male	22 (63)	129 (66)
Unknown	1 (3)	6 (3)
Total	**35**	**196**

The highest case detection rate was in children aged 1 to 4 years, both in males and females (Figure 4). This was also seen in 2020 with 54% of cases aged 1 to 4 years. However, this was slightly lower than the 5-year average (60%) (Table 5). Almost half of the cases in 2020 were aged 5 to 11 years, 10 per cent higher than the 2015 to 2019 average (30%). Two cases were detected aged under 1 year in 2020, and none in the oldest age group.

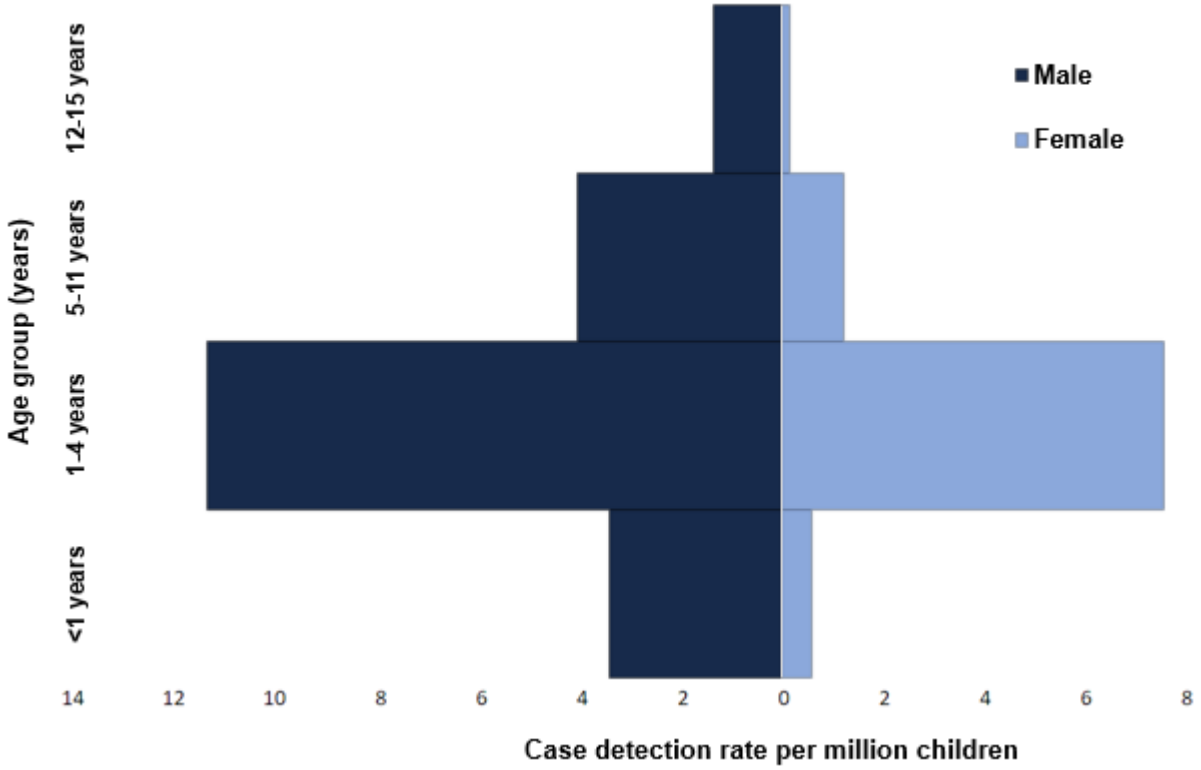
The high percentage of cases in pre-school age children may reflect a greater vulnerability to lead exposure due to mouthing behaviours, as ingestion of lead containing substances (particularly from deteriorating paint) is likely to be the predominant route of exposure in children [8], and mouthing behaviour is common in this age group. Alternatively, children in this age group may be tested more frequently. For the adolescents, it is unknown what the common exposure sources are. They may be detected after exposure pathways other than pica are explored.

Table 5. Count and percentage of LEICSS cases by age group*, England, 2020, and 2015 to 2019

Age group*	Count of cases 2020 (%)	Count of cases 2015 to 2019 (%)
Under 1 year	0 (0)	9 (5)
1 to 4 years	21 (60)	118 (60)
5 to 11 years	14 (40)	59 (30)
12 to 15 years	0 (0)	10 (5)
Total	**35**	**196**

*Age at date of entry onto HPZone

Figure 4. Average case age-gender* specific detection rate† per million 0 to 15 year old children per year, England 2015 to 2020 (n=223 cases with gender and age data)



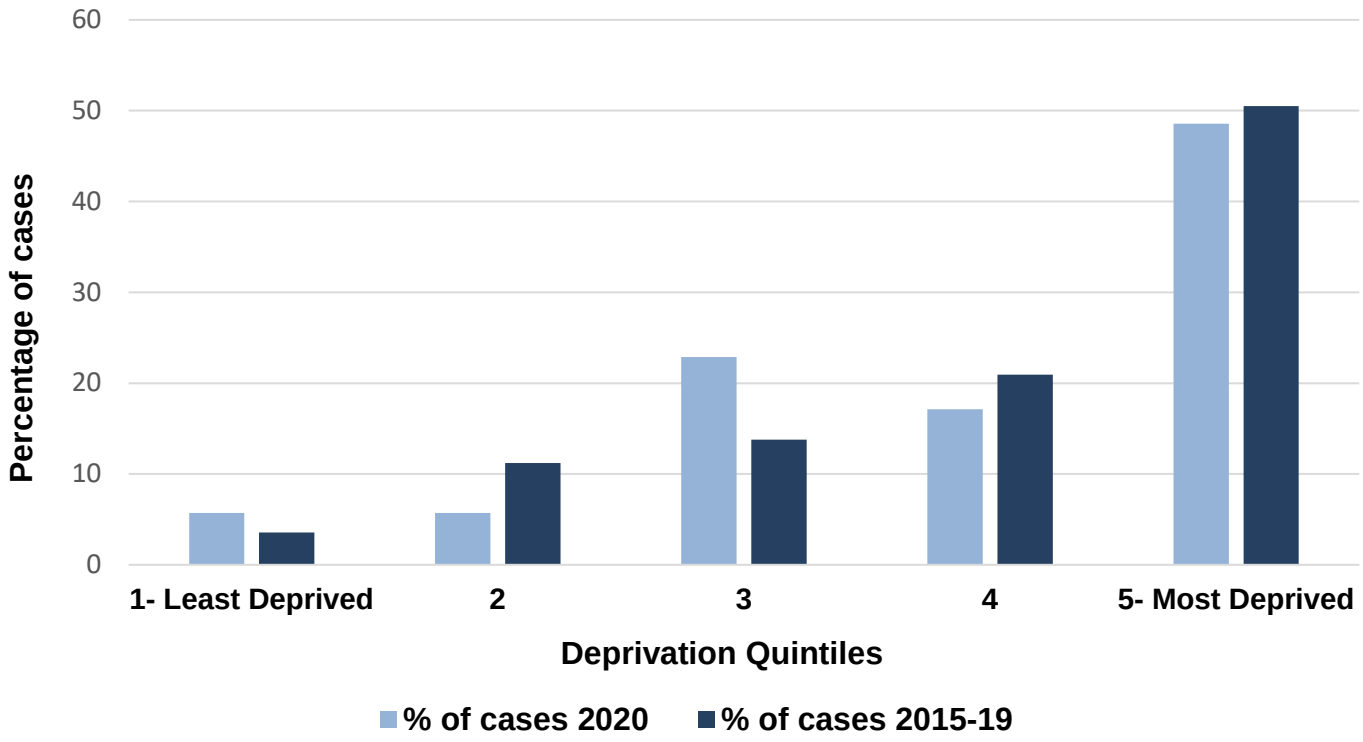
* Age at date of entry onto HPZone;
† The numerator for this indicator is the count of age-gender specific incident cases in 2015 to 2020, and the denominator is the summed mid-year estimate of the age-gender specific 0 to 15 year old population for 2017 multiplied by 4.

In the period of 2015 to 2020, 1 death of a child was notified in England (2015) partly or wholly attributed to lead exposure. A case report has since been published, showing the death occurred in a two-year-old boy with pica and iron deficiency, who ingested lead-containing paint, resulting in acute lead toxicity [4]. Lack of clinician awareness of the association between pica and lead exposure was cited as the root cause of the delayed diagnosis and subsequent death of the child.

Percentage of cases by quintile of index of multiple deprivation (IMD) status

IMD provides a measure of deprivation, evaluated across 7 domains[2], measured at the area-level. Sixty-six per cent of cases in 2020 lived in areas in the two most deprived quintiles of IMD, similar to the previous 5-year average (70%) (Figure 5). This is still higher than expected given that only 45% of the young English population reside in areas falling within these two quintiles[3]. More cases in 2020 (23%) resided in the third most deprived group, substantially higher than the 13% from 2015 to 2019.These observations are similar to patterns of lead exposure by socio-economic status in US national survey data [2], and may reflect greater exposure to lead containing hazards, a higher frequency of co-morbidities (for example, iron deficiency anaemia) or other factors pre-disposing to lead toxicity, and/or a greater tendency for clinician testing of children from deprived areas.

Figure 5. Percentage of LEICSS cases in each quintile of index of multiple deprivation ¥, England 2020 and 2015 to 2019



¥ Index of multiple deprivation (IMD) assigned to the Lower-level Super Output Area of the cases' residential postcode, using IMD scores from 2019

[2] See English indices of deprivation 2019.
[3] Calculated using ONS mid-year estimate populations for England, assigned to deciles of IMD 2019.

Blood lead concentrations of laboratory-detected cases

The median blood lead concentration (BLC) in 2020 was 0.71 µmol/L (14.69 µg/dL), very similar to the 2015 to 2019 median (0.74 µmol/L (15.32 µg/dL)) (Table 6). Ninety-five per cent (data not shown) of blood lead concentrations were <1.93µmol/L (<40 µg/dL) in 2015 to 2020, a concentration below which children would most likely be asymptomatic, or present with non-specific neuro-behavioural clinical manifestations [9], indicating these children were detected based on high index of clinical suspicion. One of the laboratory-detected cases reported to LEICSS in 2020, had a blood lead concentration <0.48 µmol/L (<10 µg/dL), this was excluded from the statistics as it did not meet the strict case definition.

Table 6. Blood lead concentration (µmol/L) of laboratory detected LEICSS cases, England, 2020, compared to 2015 to 2019.

Year	Cases with data/total cases	Minimum*	Maximum	Median	Lower Quartile	Upper Quartile	Mean
2020	21/21	0.48	2.28	0.71	0.58	0.92	0.89
2015 to 2019	159/159	0.48	3.30	0.74	0.55	1.15	1.04

* Only children with a BLC≥0.48µmol/L were eligible for notification to LEICSS

Duration of case investigation

Of the cases where the investigation had been concluded by the time of data extraction for this report (94%, January 2021), the median duration of the investigation was 7 weeks, the same duration as in 2019 but considerably shorter than the median for 2015 to 2018 of 12 weeks (Table 7). Unlike the previous year, in 2020 there was also a higher percentage of closed cases to total cases (94%, 81% in 2019). Possible explanations include improvements in the speed of case management, or cases being closed early due to pandemic cases being prioritised; further investigation would be required to determine the true cause.

Table 7. Duration, in weeks, of the public health investigation of LEICSS cases* reported to the surveillance system, England, 2020, and 2015 to 2019

Year	Closed cases/total cases (%)	Median duration (weeks)* (LQ-UQ)
2020	33/35 (94)	7 (3 to 17)
2015 to 2019	181/196 (92)	12 (5 to 32)

* Period between date entered onto HP Zone and date case closed on HPZone; cases must have been closed at date of data extraction from HPZone in January 2021; LQ – Lower Quartile; UQ – Upper Quartile.

References

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Resources

UKHSA's Environmental Public Health Surveillance System

The Environmental Public Health Surveillance System (EPHSS) collates and integrates data from selected databases on environmental hazard, exposures and health outcome data. Further details are provided on the EPHSS webpages. A lead exposure in children module incorporated into EPHSS allows for LEICSS data to be interrogated and analysed, producing user defined outputs for surveillance reporting purposes. 2020 case data has recently been added to EPHSS. Currently, the EPHSS platform is available to UKHSA staff, but will shortly become accessible to external users.

To stay updated with the work of UKHSA's Environmental Public Health Tracking (EPHT) group and EPHSS, email epht@phe.gov.uk. To find out more about gaining access to LEICSS outputs via EPHSS, email ephss@phe.gov.uk.

Further UKHSA resources for the public health management of cases of lead exposure

- Lead pages in the UKHSA chemicals compendium
- Lead Action Card UKHSA [internal document, updated in line with the new intervention level]
- Lead Exposure in Children Surveillance System: Surveillance Reports
- Evaluation of whether to lower the public health intervention concentration for lead exposure in children

Resources for clinicians

- Clinicians with clinical lead exposure queries should consult TOXBASE or contact the National Poisons Information Service

Contacts

- to notify cases (participating laboratories only): phe.leicss@nhs.net
- general enquiries: epht@phe.gov.uk
- lead surveillance module in UKHSA's Environmental Public Health Surveillance System: ephss@phe.gov.uk
- to notify cases directly to a Health Protection Team in England, identify the relevant HPT by entering the residential postcode of the case into the Find your local health protection team in England tool

Steering and working group members

Working group

Name	Organisation
Araceli Busby (surveillance lead)	UK Health Security Agency, North East North Central London, Health Protection Team
Geraldine White	UK Health Security Agency, North East North Central London, Health Protection Team
Giovanni Leonardi	UK Health Security Agency, Environmental Epidemiology
Helen Crabbe	UK Health Security Agency, Environmental Epidemiology
Neelam Iqbal	UK Health Security Agency, Environmental Epidemiology
Rebecca Close	UK Health Security Agency, Environmental Epidemiology

Steering group (including working group)

Name	Organisation
Robie Kamanyire Lorraine Stewart	UK Health Security Agency, Environmental Hazards and Emergencies
Kerry Foxall Ovnair Sepai	UK Health Security Agency, Toxicology
Alan Emond	University of Bristol/BPSU
Louise Ander	British Geological Survey
Sally Bradberry	National Poisons Information Service, City Hospital, Birmingham
Kishor Raja Carys Lippiatt	Supra-regional Assay Service Trace Elements laboratories
Mark Reacher Iain Roddick Vicky Watts	UK Health Security Agency, Field Service
Eirian Thomas	UK Health Security Agency, Chemicals and Environmental Effects Department
Andrew Kibble	Public Health Wales
Tim Pye	Lead Safe World UK

Acknowledgement to laboratories

NHS Supra-regional Assay Services Trace Elements laboratories

Birmingham
Leeds
Southampton
Guildford
London Charing Cross
London Kings College

Other laboratories notifying cases included in this report

The Doctors' Laboratory, London
Cardiff Toxicology Laboratories
Southmead Hospital, Bristol
Alder Hey Children's Hospital, Liverpool
Northern General Hospital, Sheffield
Birmingham Heartlands Hospital

Privacy notice

The purpose of LEICSS is to help track and investigate incidence, prevalence, trends and distributions of lead exposure in children under 16 years old in England to help inform prevention strategies and intervention programmes.

This involves collection of case information from local Health Protection Teams and participating laboratories regarding children who have a blood lead concentration >0.24µmol/L. This data is reported from several sources including NHS laboratory databases and internal UKHSA databases. This data is then uploaded to the Environmental Public Health Surveillance System (EPHSS) for selected, approved public health users to extract and produce surveillance reports. Personal identifiable information is removed before analysing the data. However, the postcode of cases is retained in order to map spatial distribution and trends in cases.

A data sharing agreement is agreed and signed with all participating laboratories for reporting case information to this surveillance programme.

The legal basis for collection of personal information

The legal basis for the collection of personal information varies according to the purpose for which it is used. Various categories of personal data, including data about the health and ethnic group of cases, are collected. In most cases, the sections of the General Data Protection Regulation sand the Data Protection Act 2018 that apply will be:

- GDPR Article 6(1)(e) ‘processing is necessary for the performance of a task carried out in the public interest’
- GDPR Article 6(1)(c) ‘processing is necessary for compliance with a legal obligation’
- GDPR Article 6(1)(a) ‘consent’
- GDPR Article 9(2)(i) ‘processing is necessary for reasons of public interest in the area of public health, such as protecting against serious cross-border threats to health’
- GDPR Article 9(2)(h) ‘processing is necessary for the provision of health or social care or treatment or the management of health or social care systems and services’
- GDPR Article 9(2)(a) ‘explicit consent’
- Data Protection Act Schedule 1 Part 1 (3) ‘public health’

Our duty of confidentiality

To fulfil its remit, UKHSA may need to use confidential patient information without asking for consent. The Agency has ‘section 251’ approval from the Secretary of State for Health and Social Care to do this for the following purposes:

- diagnosing, recognising trends, controlling and preventing, and monitoring and managing communicable diseases and other risks to public health
- medical purposes related to the diagnosis or treatment of cancer
- other medical purposes, including cancer screening, rare diseases registration and drug and alcohol treatment service monitoring

Related enquiries should be directed to: epht@phe.gov.uk

About the UK Health Security Agency

The UK Health Security Agency is an executive agency, sponsored by the Department of Health and Social Care.

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For queries relating to this document, please contact: ephss@phe.gov.uk

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