

Paediatric Multisystem Inflammatory Syndrome temporally associated with SARS-CoV-2 (PIMS-TS): prospective, national surveillance, United Kingdom and Ireland, 2020

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Abstract

Background

Paediatric Multisystem Inflammatory Syndrome temporally associated with SARS-CoV-2 (PIMS-TS), first identified in April 2020, shares features of both Kawasaki disease (KD) and toxic shock syndrome (TSS). The surveillance describes the epidemiology and clinical characteristics of PIMS-TS in the United Kingdom and Ireland.

Methods

Public Health England initiated prospective national surveillance of PIMS-TS through the British Paediatric Surveillance Unit. Paediatricians were contacted monthly to report PIMS-TS, KD and TSS cases electronically and complete a detailed clinical questionnaire. Cases with symptom onset between 01 March and 15 June 2020 were included.

Findings

There were 216 cases with features of PIMS-TS alone, 13 with features of both PIMS-TS and KD, 28 with features of PIMS-TS and TSS and 11 with features of PIMS-TS, KD and TSS, with differences in age, ethnicity, clinical presentation and disease severity between the phenotypic groups. There was a strong geographical and temporal association between SARS-CoV-2 infection rates and PIMS-TS cases. Of those tested, 14.8% (39/264) children had a positive SARS-CoV-2 RT-PCR, and 63.6% (75/118) were positive for SARS-CoV-2 serology. In total 44.0% (118/268) required intensive care, which was more common in cases with a TSS phenotype. Three of five children with cardiac arrest had TSS phenotype. Three children (1.1%) died.

Interpretation

The strong association between SARS-CoV-2 infection and PIMS-TS emphasises the importance of maintaining low community infection rates to reduce the risk of this rare but severe complication in children and adolescents. Close follow-up will be important to monitor long-term complications in children with PIMS-TS.

Funding

PHE

Introduction

Children make up only a small proportion of coronavirus disease 2019 (COVID-19) cases, hospitalisations or deaths.¹ Several countries in Europe,²⁻⁸ the Americas⁹⁻¹² and Asia¹³⁻¹⁵ have, however, reported cases of a rare Paediatric Inflammatory Multisystem Syndrome temporally associated with SARS-CoV-2 (PIMS-TS). The symptoms and signs are similar to both Kawasaki disease (KD) and toxic shock syndrome (TSS), and are typically characterised by single- or multi-organ dysfunction, although less serious presentations, such as abdominal pain, vomiting and diarrhoea have also been reported.¹² The first reports of KD-/TSS-like presentations with COVID-19 first emerged in April 2020,^{16,17} and PIMS-TS cases have since been reported globally.¹⁸ In the United States, where PIMS-TS is termed Multisystem Inflammatory Syndrome in Children (MIS-C), 1,659 cases and 26 deaths were reported by 08 January 2021.¹² In Europe and elsewhere, most PIMS-TS reports have been limited to small case series with varying case definitions. Following the first reports of PIMS-TS cases in London, England,¹⁶ Public Health England (PHE) initiated enhanced prospective national surveillance of PIMS-TS, along with KD and TSS, in the United Kingdom (UK) and the Republic of Ireland through the British Paediatric Surveillance Unit team (BPSU). Here we present the epidemiology, temporal and geographical association with SARS-CoV-2 incidence, clinical and analytical findings, and outcomes of the first tranche of cases reported up until 24 July 2020.

Methods

Literature review

A literature search was conducted to compare the BPSU data with other similar scale studies of PIMS-TS cases published to date (Supplementary Material 1).

Data collection

This study was conducted through the BPSU of the Royal College of Paediatrics and Child Health (RCPCH), a unit established three decades ago to study rare paediatric diseases. Paediatricians across the UK and Ireland receive monthly email requests to report cases of rare conditions listed on the “Orange Card”, including nil returns. Around 90% of paediatricians complete the Orange Card each month.¹⁹ PIMS-TS was added to the Orange Card from 04 May 2020 onwards, and paediatricians reporting cases were contacted to complete an electronic questionnaire regarding demographics, concurrent medical conditions, symptoms, signs, investigations, treatments and laboratory results.

Case definitions

The BPSU reporting case definition was purposely broad to capture all potential cases and included children aged <16 years, with illness onset from 01 March 2020, who had PIMS-TS,²⁰ typical/atypical KD,²¹ or typical/atypical TSS,²² regardless of SARS-CoV-2 status (Table 1, Supplementary Material 2).

Data analysis

Reported cases were categorised according to criteria for individual syndromes. Descriptive analysis was undertaken in STATA v.15.0 (StataCorp, Tx). Since case numbers in most categories were small, P-values were not calculated in comparisons between categories. The geographic distribution of PIMS-TS cases was compared to SARS-CoV-2 infection rates per 10,000 population by lower tier local authority. Only qualitative analysis was performed because PIMS-TS rates at local authority level were too low to make meaningful quantitative comparisons. Geographical analysis was performed in Python using the GeoPandas (v.0.8.1) package alongside ArcMap software (ESRI). Temporal analysis was performed using published national and regional SARS-CoV-2 infection rates in England.²³ Lag time was defined as the number of days between peak regional SARS-CoV-2 incidence and peak PIMS-TS cases. Mean weight by age and sex data²⁴ were used to calculate Z-scores $[(value - population\ mean)/population\ SD]$ and identify children who were overweight (2 standard deviations (SDs) above their mean weight for age and sex).

Latent Class Analysis

Latent Class Analysis (LCA) aims to define unobserved groups of cases within the data, based on indicator (yes/no) variables. The method identifies possible clustering models which group cases into distinct latent classes. The fit of each model is assessed using a Bayesian Information Criterion score, with the best fitting model being the one which minimises this score. The selected model provides a conditional probability for membership of the identified latent classes, given the 'yes/no' value of each indicator variable. The R package poLCA (v.1.4.1) was used to identify latent classes based on the 23 indicator variables corresponding to the PIMS-TS, KD and TSS definitions, along with variables confirming SARS-CoV-2 infection by RT-PCR or serology (Supplementary Material 3).

Results

Literature Review

Data from eight published studies are summarised alongside the BPSU dataset in Tables S1.2 and S1.3.

BPSU surveillance

There were 449 cases reported to BPSU. Eighty-nine duplicates were removed, 12 were ≥ 16 years old and five had onset dates pre-01 March 2020. This left 343 cases with illness onset between 01 March and 15 June 2020; 268 were classified as PIMS-TS and included in the analysis (Figure 1a). The remaining 75 cases included 56 cases that did not fulfil the PIMS-TS, KD or TSS criteria (35 because of C-reactive protein (CRP) < 100 mg/L, eight because CRP level was missing; 13 lacked other criteria), 13 with KD only, two with TSS only and four with KD/TSS.

Of the PIMS-TS cases, 246 were in England, six in Scotland, 11 in Wales, two in Northern Ireland, and three in the Republic of Ireland. Cases were categorised based on pre-defined syndromic criteria (Figure 1b) and included 216 cases classified as PIMS-TS only without features of KD or TSS, 13 with PIMS-TS and complete/typical KD (PIMS-TS/KD), 28 cases with PIMS-TS and TSS (PIMS-TS/TSS) and 11 with all three phenotypes (PIMS-TS/KD/TSS). Data are presented for all 343 children by phenotype (Supplementary Material 4). Two cases were classified as TSS only, and four as KD and TSS; these were included in total cases only.

Demographics

The median age of cases was 8.2 (IQR 4.0-12.1) years, with PIMS-TS/KD cases being younger (5.2 years) and PIMS-TS/TSS cases older (8.8 years) than PIMS-TS only cases (7.8 years; Table 2). Males were over-represented in all categories, 19.0% (51/268) had co-morbidities, and 13.4% (36/268) were overweight. Although the numbers of children with multiple syndromes were small, a higher proportion of PIMS-TS/KD and PIMS-TS/TSS cases were Asian (46.2% and 42.9%, respectively) or Black (23.1% and 35.7%, respectively), while White children were underrepresented (15.4% and 14.3%, respectively) compared to PIMS-TS only cases where 48.6% were White, 20.4% Asian and 19.4% Black. Of the 63 cases in Asian children, 50 were from the Indian subcontinent (Bangladeshi/Indian/Pakistani/Nepali/Sri Lankan/Afghani), one was East Asian and ten did not have additional information. Parental occupation was reported for 105 cases and 77.1% had a healthcare (39.0%; n=41) or non-healthcare keyworker (38.1%; n=40) parent.

Clinical characteristics

Presenting symptoms by category are presented in Supplementary Material 4. PIMS-TS/KD/TSS cases had the highest proportion with cough, sore throat, neck pain, pale/mottled skin and neurological involvement (Table S4.2), while $> 80\%$ of PIMS-TS/TSS cases had hypotension, age-specific tachycardia or required fluid boluses – higher than other phenotypes. Cases meeting the TSS criteria had higher rates of: abdominal pain, vomiting, respiratory involvement, cold hands/feet and urinary

output <2ml/kg/hr. Changes of extremities were seen less frequently in PIMS-TS/KD/TSS cases (18.2%) than PIMS-TS/KD cases (84.6%). Additionally, a widespread, polymorphous (not vesicular) rash (82.1%) and conjunctivitis (82.1%) were frequently reported for PIMS-TS/TSS cases but were less common among PIMS-TS only cases (40.7% and 32.9%, respectively).

Where tested, ST or T wave changes were the most common ECG findings (14.7%; 24/163) (Table S4.4). None of the children had a myocardial infarction but five had a cardiac arrest: 10.7% (3/28) PIMS-TS/TSS cases and 0.9% (2/216) PIMS-TS only cases. Of the cases that had an echocardiogram, 38.4% (78/203) had decreased myocardial contractility, 26.6% (54/203) had coronary artery abnormalities (dilation/aneurysm), 20.2% (41/203) had pericardial effusion and 16.3% (33/203) had mitral or aortic valve insufficiency (Table S4.4). Pericardial effusion and mitral or aortic valve insufficiency were more common among PIMS-TS cases associated with another syndrome.

SARS-CoV-2 testing

Nearly all cases (264/268, 98.5%) had an RT-PCR test for SARS-CoV2 infection but only 44.0% (118/268) had SARS-CoV-2 serology. Of those tested, 14.8% (39/264) children were RT-PCR positive and 63.6% (75/118) were seropositive. Overall, 35.1% (94/268) had evidence of current or previous SARS-CoV-2 infection (Table S4.5). Where reported, 46.6% (125/268) had had a household contact with confirmed SARS-CoV-2 or COVID-19-like symptoms in the 4 weeks prior to illness (Table S4.5).

Laboratory findings

PIMS-TS/TSS cases had higher values of CRP, D-dimers, ferritin, INR, NT-proB-type Natriuretic Peptide and fibrinogen, and PIMS-TS/TSS and PIMS-TS/KD/TSS cases had higher values of triglycerides, amylase, creatine kinase, urea, creatinine, neutrophils, and ALT (Table S4.7). Most cases had low albumin (86.9%), with PIMS-TS/TSS and PIMS-TS/KD/TSS cases having lower values than other presentations. For all PIMS-TS cases, where reported, the median (IQR) CRP was 223 (162-289) mg/L, ferritin 543 (284-1049) ug/L, and D-dimers 3400 (1757-6921) ug/L.

Treatment

92.9% (249/268) cases were reported to have received antibiotics, 73.1% (196/268) aspirin/other anticoagulant, 55.6% (149/268) steroids, 70.5% (189/268) immunoglobulins, and 6.7% (18/268) antivirals. Ten (3.7%) children each received monoclonal antibodies against TNF- α and an interleukin-1 receptor antagonist, respectively, one other child received both (0.4%), and four others (1.5%) received monoclonal antibodies against the interleukin-6 receptor.

Outcomes

In total, 44.0% (118/268) children were admitted to a Paediatric Intensive Care Unit (PICU) (Table 2), which was proportionately more common among cases meeting TSS criteria (67.9% [19/28] with

PIMS-TS/TSS, 54.5% [6/11] with PIMS-TS/KD/TSS). This group was also more likely to require conventional ventilation or high frequency oscillation (35.7% PIMS-TS/TSS, 45.5% PIMS-TS/KD/TSS) than PIMS-TS only (13.0%) or PIMS-TS/KD (7.7%), as well as inotropes – just over half of cases, compared to around a quarter of PIMS-TS only or PIMS-TS/KD cases. Three children died (all male), accounting for 3.6% (1/28) with PIMS-TS/TSS and 0.9% (2/216) with PIMS-TS only. Two had underlying comorbidities (anorexia and obesity, respectively). One was an infant and the other two were aged 10-15 years. The cause of death included stroke, ruptured coronary aneurysm and invasive fungal infection secondary to bone marrow suppression.

Agreement with clinical classification

In terms of clinician-reported syndromes, 68.1% (147/216) PIMS-TS only cases were reported as suspected PIMS-TS only, with 29 remaining cases reported as suspected PIMS-TS plus TSS or KD (Supplementary Material 5).

Time and place

Overall, 46.3% (124/268) of cases were reported from Greater London (Table S4.10). The most notable difference was ethnicity distribution: 35.3% of Greater London cases were Black and 27.6% White compared to 13.4% and 57.7% cases, respectively, outside London. Cases within London were also older with 5.6% under 1 year and 46.0% 10-15 years, compared to 11.1% and 29.9%, respectively, outside London.

Geographic analysis

Geographic analysis identified clustering with Lower Tier Local Authorities (LTLAs) reporting higher numbers of confirmed COVID-19 cases per 10,000 population up to 01 July 2020 (Figure 2a). There was no association with population size, or regions with the highest COVID-19 prevalence (London, the West Midlands and the North-West). Smaller urban areas with high COVID-19 prevalence (Leicester, Luton) reported more cases than other cities of similar size with COVID-19 rates (Nottingham, York). Notably, too, the South West, a region with low COVID-19 incidence, reported relatively more cases during the surveillance period.

Temporal analysis

Temporal analysis found the 246 PIMS-TS cases in England followed the epidemic curve of COVID-19 in the English regions, as defined by the Public Health England Centres (PHECs), between March and July 2020 with a median lag of approximately 16.3 (IQR 9-23) days, although this varied between PHECs (Figures 2b and 2c). Notable were reports of cases from the East of England, East Midlands and the South West during periods of low regional COVID-19 prevalence.

Latent Class Analysis

Figure 2d shows a graphical representation of the different classes identified by LCA, and the probability of membership conditioned on each indicator variable. Class 1 (n=75) consisted solely of PIMS-TS only cases; Class 2 (n=88) contained 66.7% (16/24) of cases that met KD criteria; Class 3 (n=105) contained 61.5% (24/39) of cases that met TSS criteria (Table 3). Ethnicity distributions varied between the groups, with Black, Asian, Mixed and Other ethnicities accounting for only 40.0% cases in Class 1 (13.3% Black, 17.3% Asian), 53.4% in Class 2 (15.9% Black, 26.1% Asian), and 73.7% in Class 3 (34.3% Black, 25.7% Asian). Additionally, the median age of cases in Class 2 was 4.5 (IQR 1.5-7.5) years, compared to 7.8 (IQR 3.1-11.2) years in Class 1 and 11.2 (IQR 8.4-13.9) years in Class 3.

Class 1 cases had the least severe presentations, with a lower proportion reporting dermatological/cardiac/haematological/neurological involvement, compared to other syndromes. This group did have high proportions with vomiting/diarrhoea (65.3%), abdominal pain (60.0%), hypoalbuminaemia (66.7%), and raised D-dimers (54.7%), although these were all more prevalent in Class 3 cases. Only 14.7% (11/75) reported a cough and, while 25.3% (19/75) reported tachypnoea, none required respiratory support.

Class 2 cases had the highest proportions with dermatological involvement, with >75% having KD features of rash, conjunctivitis or lips/mucosa signs. This group also had 68.2% (60/88) presenting with vomiting/diarrhoea, and 88.6% (78/88) had hypoalbuminaemia. Cough (34.1%; 30/88) was relatively more common, while abdominal pain (33.0%; 29/88) less common. One case died.

Class 3 cases had the most severe disease, with the highest proportions having multi-organ involvement. Their median duration of hospitalisation was 9.5 days (IQR 8-13) compared to 5 days (IQR 4-8) and 6 days (IQR 4-11) in Classes 1 and 2, respectively. There were two deaths in Class 3.

Discussion

Enhanced prospective national surveillance identified 268 cases that fulfilled a broad case definition for PIMS-TS since the start of the COVID-19 pandemic in the UK and Ireland. These included 216 with PIMS-TS only, 13 PIMS-TS/KD, 28 PIMS-TS/TSS and 11 PIMS-TS/KD/TSS. Cases differed in age, ethnicity, clinical presentation, cardiovascular involvement and disease severity. Children classified as PIMS-TS and another syndrome were more likely to require intensive care support and longer hospitalisation stay than those with PIMS-TS only. There was a temporal and geographical association between community SARS-CoV-2 prevalence and PIMS-TS cases, both nationally and regionally, with a median lag of 16 days between COVID-19 and PIMS-TS cases in England. LCA

identified three different classes which broadly divided into PIMS-TS only (Class 1), PIMS-TS/KD (Class 2) and PIMS-TS/TSS (Class 3), with Class 2 cases tending to be younger, and Class 3 older.

The age distribution of cases (median 8.2 years; IQR 4.0-12.1 years) was similar to that described in other large^{9,10} and smaller^{3-5,14,15} case series, and this included the 570 cases described by Godfred-Cato *et al.*¹⁰ (median 8 years; IQR 4-12 years) that included cases up to 20 years of age. In common with most other cohorts, males were overrepresented.^{3,7,9-11} The percentage of patients with comorbidities and/or overweight was largely similar to reported studies (Table S1.2), although a smaller percentage had comorbidities in Latin America⁹ and India,¹⁵ and a greater proportion were obese in the US.¹⁰ The low case fatality rate was also consistent with the international literature (Table S1.2).

The percentage of white children with PIMS-TS in our cohort (42.5%) was higher than in the US (13.2%)¹⁰ or France (Paris, 25.0%),⁸ where higher proportions of Hispanic and/or Black ethnicities were reported, likely reflecting the ethnic diversity of their respective populations. Nonetheless, Black and Asian ethnicities in our cohort were hugely over-represented relative to the UK population,²⁵ and accounted for a disproportionate proportion with the most severe presentations. Although this may in part be due to London having the highest COVID-19 infection rate in the first wave, it may also be due to overrepresentation of these ethnicities among key workers and lower socioeconomic groups: both at increased risk of COVID-19.

Notably, Asian children other than from the Indian Subcontinent, who are known to be increased risk of KD, appeared to be under-represented among PIMS-TS cases. Whether the observed ethnic disparities among children with PIMS-TS, as observed with COVID-19 cases too, are due to genetic or socio-economic risk factors – or both – remains to be established.²⁶

SARS-CoV-2 infection was confirmed by RT-PCR in 14.8% of PIMS-TS cases. Although some studies reported similarly low PCR-positivity rates,^{4,9,15} most reported higher positivity rates (38.1-75.0%).^{3,5,7,8,10,11,14} The large variation is likely due to test availability in addition to case definitions, since the US MIS-C definition, used by several studies, required confirmed SARS-CoV-2 infection or known exposure.^{3,9-11,14} However, SARS-CoV-2 antibody-positivity (63.6%) was similar to the reported range (50.0-90.5%),^{3-5,7-11} although only 44.0% in our cohort were tested for SARS-CoV-2 antibodies.

The following rates of system involvement were within the ranges reported in the literature: (a) 52% with cardiovascular involvement (*vs.* 12-100% in the literature) (b) 99% with gastrointestinal involvement (*vs.* 42-100%), and (c) 32% with neurological involvement (*vs.* 13-56%).^{3-5,7-11,14,15}

Despite the BPSU case definition not being limited to those with confirmed SARS-CoV-2 infection or

known COVID-19 exposure, the distribution of symptoms was broadly similar to the US report:¹⁰ 53% (UK) vs. 55% (USA) with rash, 50% vs. 48% conjunctival injection, 99% vs. 91% gastrointestinal involvement, 32% vs. 38% neurological involvement, 26% vs. 29% cough, 16% vs. 13% requiring mechanical ventilation, 9% vs. 5% with complete KD; the main differences being a lower proportion with cardiovascular involvement and ICU admission in our cohort (Table S1.3).

LCA validated the findings of the different phenotypes in our cohort and identified three separate classes which broadly defined patients with PIMS-TS only, those with KD features and a third group with TSS manifestations. Such characterisations are likely to be useful for clinical management of children presenting with such a wide syndrome. The Class 3 patients, for example, had very high proportions with cardiac involvement, vomiting/diarrhoea, abdominal pain, hypotension, low albumin, and raised D-dimers and ferritin, were older, as well as the highest proportions with positive SARS-CoV-2 PCR or antibody, and were most likely to present with multiorgan failure requiring inotropic support and assisted ventilation. In contrast, Class 2 patients had more typical KD features, while Class 1 patients had features of PIMS-TS only and a milder course of illness. These findings are similar to the LCA analysis performed in US children, where Classes 2 and 3 corresponded to their Classes 3 and 1, respectively.^{10 27,28}

Cardiovascular assessment was performed at the discretion of the clinician and was, therefore, more likely to be undertaken for more severe cases. Whilst most children had favourable cardiovascular outcomes, the clinical presentation of five children with cardiac arrest and the need for inotropes in a significant proportion of cases suggests that such children need careful cardiovascular assessment,^{27,28} even after recovery to assess their risk of long-term complications as has been reported for KD.^{21,29}

Current epidemiological evidence strongly indicates an association between SARS-CoV-2 infection and PIMS-TS 2-4 weeks later.^{2,12} In our cohort, a substantial proportion of tested children were SARS-CoV-2 RT-PCR and antibody negative. This could be because PIMS-TS occurred in the cusp between elimination of the virus and antibody development. The mechanism by which SARS-CoV-2 infection leads to PIMS-TS is unknown but would provide useful insight into the pathogenesis of both KD and TSS which have remained elusive so far. It also remains unclear whether PIMS-TS and KD represent a continuum of illness or are completely distinct syndromes.³⁰ A recent study reported similar immune and plasma protein profiles but different autoantibody targets among KD and PIMS-TS cases, although the sample size was small.³¹

^{20,26}In our surveillance, 35 children had PIMS-TS features but did not meet the case definition only because their CRP level was below the arbitrary 100 mg/L cut-off. It is likely that these were milder

cases along the PIMS-TS spectrum, which needs to be taken into account in future case definitions. As the number of reported cases continue to increase worldwide, it is important to reach a consensus in naming and case definitions so that the data are more comparable between countries and across continents. We purposely opted for a broad reporting case definition to capture as many cases as possible but needed to define boundaries to reduce the reporting of non-PIMS-TS cases. We also asked clinicians to report TSS and KD cases that were not associated with SARS-CoV-2 for comparison, but there were very few such cases reported for comparison. As ours was a paediatric study, we also limited our surveillance to <16 year-olds who would be managed by paediatricians since, in the UK and Ireland, older children and adults would typically present to adult services.³² Additionally, the BPSU methodology requires paediatricians to report cases to the investigators. Mild cases and those that were not hospitalised or had short hospital stays may, therefore, be missed. Also, since so many reported cases were SARS-CoV-2 negative, it possible that some KD and TSS cases might have been misclassified as PIMS-TS. Moreover, the BPSU was also the only source of reporting; we therefore, cannot comment on the completeness of case ascertainment, especially in nations that reported very few cases. After reporting a case, paediatricians completed a questionnaire using the information documented in the medical records, so some data, such as the child's height or parental occupation, for example, may not be documented. Finally, the investigation and treatment of cases was at the discretion of the clinician and, therefore, variable both geographically and over time with increasing recognition, knowledge and experience with managing PIMS-TS cases.

Conclusions

The strong association between SARS-CoV-2 and PIMS-TS emphasises the importance of maintaining low community infection rates to reduce the risk of PIMS-TS. Understanding the relationship between SARS-CoV-2 infection and PIMS-TS could provide useful insight into the pathogenesis of both KD and TSS. Close follow-up will be important to monitor rapidly changing epidemiology as well as the short- to long-term complications in children with PIMS-TS.

Contributors

SNL, GO and RL conceived the study. SNL, GO, PD, TB, CEP, DJ, EW, BD, RW, CW, OS, MGS, MR, CEJ, AVR, NG, JA and RL were responsible for study design/methodology. RL, JA, ZA-C and JF contributed to project administration. SNL, JF, EB, BW, JS, NG contributed to the original draft and JF and JS

conducted the formal analyses. JF, JS, EB, BW were responsible for data validation. EB, BW and JF conducted the literature review. All authors contributed to reviewing and editing the manuscripts.

Declaration of interests

Prof. Semple reports grants from DHSC National Institute of Health Research UK, grants from Medical Research Council UK, grants from Health Protection Research Unit in Emerging & Zoonotic Infections, University of Liverpool, during the conduct of the study; other from Integrum Scientific LLC, Greensboro, NC, USA, outside the submitted work. Dr. Ramanan reports personal fees from Eli Lilly, personal fees from Roche, personal fees from SOBI, personal fees from UCB, personal fees from Abbvie, personal fees from Novartis, outside the submitted work.

Acknowledgements

PHE, BPSU and the authors would like to thank all the paediatricians across the UK and the Republic of Ireland for their unending support with this and all other BPSU studies.

Data sharing statement

Applications for relevant anonymised data should be submitted to the PHE Office for Data Release.

Ethics Approval

PHE has legal permission under Regulation 3 of The Health Service (Control of Patient Information) Regulations 2002, to conduct national surveillance of communicable diseases in England and, as such, individual patient consent is not required. Public Health Wales, through the established order legislation, is required to conduct surveillance of communicable diseases in Wales and, as such, individual patient consent is not required. The surveillance protocol was approved by the Public Benefit and Privacy Panel for Health and Social Care in Scotland (Ref: 2021-0041, 19th May 2020).

Funding

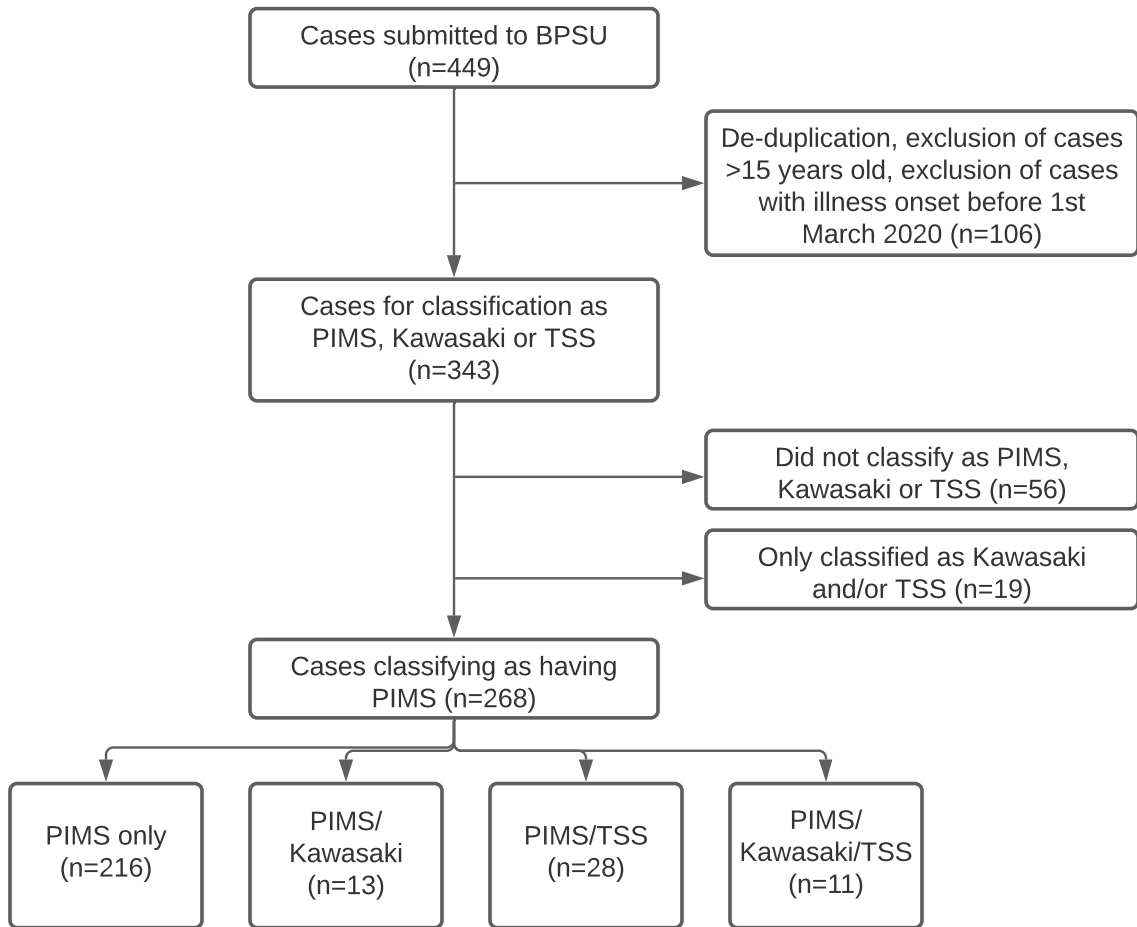
This surveillance was internally funded by PHE and did not receive any specific grant funding from agencies in the public, commercial or not-for-profit sectors.

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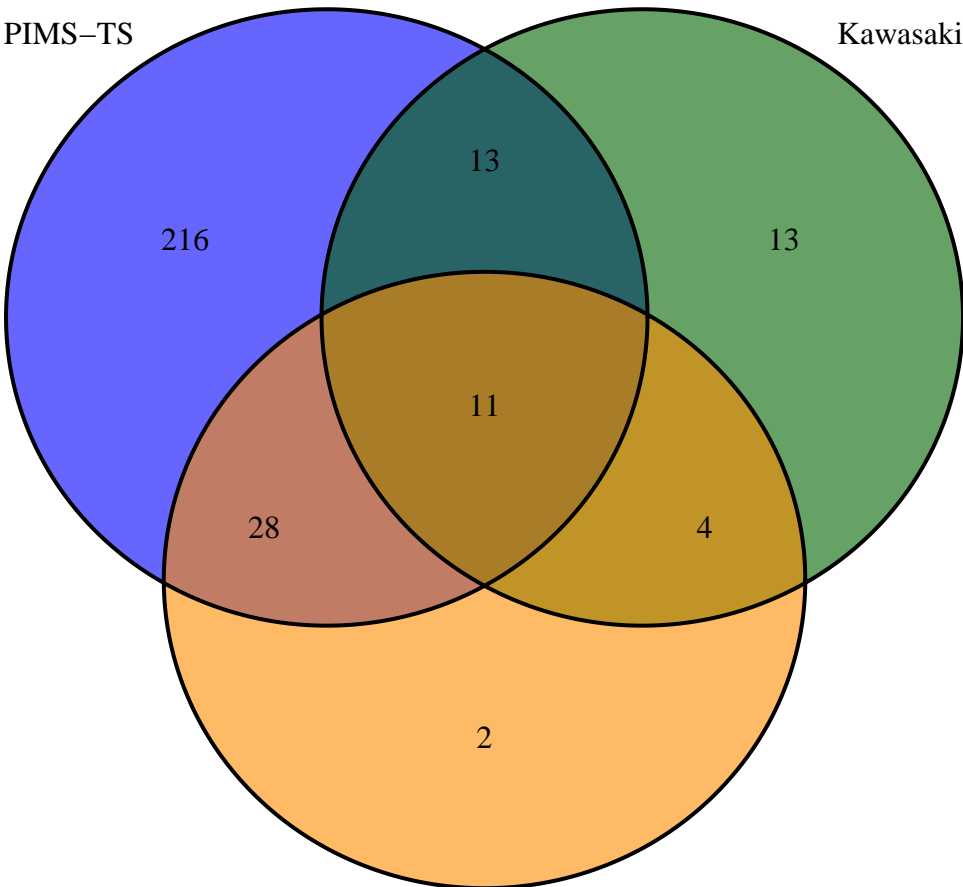
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PIMS-TS


Kawasaki




TSS

Legend

**Confirmed COVID-19
Cases per 10k
Population**


 Less than 20

 20 to 40

 40 to 60

 60 to 80

 80+

 PIMS-TS cases

