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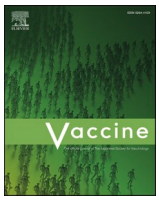

Short communication

Clinical characteristics of cases during the 2024 pertussis epidemic in France, January 2024 to December 2024

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ABSTRACT

The French national surveillance of pertussis consists of several units, including general practitioners (GPs). Here, we report on the clinical characteristics of cases from January to December 2024 from primary care surveillance in France.

During this period, a total of 689 pertussis cases were reported by GPs participating in the surveillance. The national incidence rate in general practice was estimated to be 244 cases per 100,000 inhabitants (95 % CI: 224–264). Sixty-one per cent of cases were female and 86 % had received at least one dose of pertussis vaccine. Among cases vaccinated with at least three doses, 77 % had been vaccinated for less than 5 years. The median age of the cases was 13 years, with children aged 1 to 6 years old being the most affected population.

We reported here an increase in the incidence of pertussis in primary care in France since the beginning of 2024, peaking in July 2024. The characteristics of the cases appear to have shifted towards younger age and a higher proportion of individuals who had received at least one dose of the pertussis vaccine in their lifetime, regardless of whether it was administered according to the recommended schedule, compared with previous outbreaks. This study highlights the need for timely vaccination, especially in the young population.

1. Introduction

Pertussis, also known as whooping cough, is a highly contagious disease caused mainly by *Bordetella pertussis*. Pertussis is known to follow epidemic cycles of 2 to 5 years [1]. French national surveillance of pertussis, coordinated by Santé publique France (the French public health institute) is composed of several entities. First of all, a network called '3 Labos' automatically extracts biological data from medical analysis laboratories scattered throughout the country (77% of French laboratories are covered by this system). At the hospital level, two different sources of information are used: the 'Réseau national de la coqueluche' (Renacoq) collects data on paediatric forms of pertussis in 42 hospital units (since 2016, only infants less than 12 months old are monitored), and a network called 'OSCOUR' collects individual data from almost 700 emergency services (covering 96% of all emergency service consultations). Additionally, the Center for epidemiology on

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medical causes of death (CépiDc) study deaths' causes registered on death certificates (coded according to ICD-10), including pertussis. Two last networks complete this primary care monitoring. SOS Médecin, a group of associations providing 24-h general practitioner (GP) consultations, shares daily data on outpatient consultations (reasons for consultation and medical diagnosis). Finally, the French Sentinelles network monitors pertussis in primary care [2]. The last epidemic peaks in France were observed in 2012–2013 and 2017–2019 [3]. As it was observed for several other respiratory pathogens, pertussis incidences dropped by the beginning of the Covid-19 pandemic in France, and remained low during Covid-19 years [4]. In early 2024, the incidences of pertussis began to rise in France. Here, we report on the clinical characteristics of January to December 2024 cases from the Sentinelles primary care surveillance in France.

1.1. Material

The French Sentinelles network, created in 1984, is a nationwide network of GPs taking part in epidemiological studies and in the continuous surveillance of nine health indicators [5]. Since 2017, GPs report each week the number of pertussis cases they have diagnosed (during office visits or home visits) and describe patients' characteristics using a standardized form. Pertussis cases are defined as patients in whom the GP suspects pertussis, based on clinical judgement, and who are either laboratory (positive PCR or positive culture for *Bordetella*) or epidemiologically confirmed (contact with a biologically-confirmed case) [6]. Quantitative and descriptive data on pertussis cases reported to the French Sentinelles network from 1 January 2024 to 31 December 2024 were used for the current analysis. Weekly and monthly incidences and incidence rates of pertussis diagnosed by GPs were computed and characteristics of cases were described. Quantitative data on pertussis cases reported to the network from 2017 to 2023 (number of cases, calculation of monthly and annual incidences and incidence rates of pertussis diagnosed by GPs) and qualitative data on pertussis cases reported from 2017 to 2020 were used for comparison. Details of the calculation of the incidence of pertussis diagnosed by GPs and the data collected can be found in an article published in 2022 [3].

2. Results

2.1. Increase in confirmed cases diagnosed in general practice in 2024

From 10 April to 31 December 2020, no cases were reported to the French Sentinelles network. One case was reported in 2021 and another in 2022. In 2023, six cases of pertussis were reported (estimated national incidence in general practice of 1438 cases [95 % CI: 233–2,643]), all of which were registered in the second half of the year [6]. From 1 January 2024 to 31 December 2024 (week 1 to week 52), Sentinelles GPs reported 689 pertussis cases: 3 in January, 2 in February, 1 in March, 20 in April, 50 in May, 111 in June, 185 in July, 150 in August, 87 in September, 38 in October, 25 in November, 17 in December. National incidence rate of pertussis diagnosed in general practice during this year 2024 was estimated at 244 cases per 100,000 inhabitants (95 % CI: 224–264), corresponding to a likely incidence of 162,587 cases (95 % CI, 149,090-176,084) diagnosed by GPs at national level. Since 2017, the equivalent incidence rate previously varied between 0 (in 2021 and 2022) and 17 cases per 100,000 inhabitants in 2017 (95 % CI, 12–22).

Looking at the monthly incidence rates in general practice in 2017–2024 (Fig. 1) and the weekly incidence rates in general practice in 2024 (Fig. 2), we observe an increase in pertussis incidence rates in general practice from the beginning of 2024, which accelerated from week 13 of 2024 (end of March). The incidence rates in general practice peaked in July and decreased significantly in September and October.

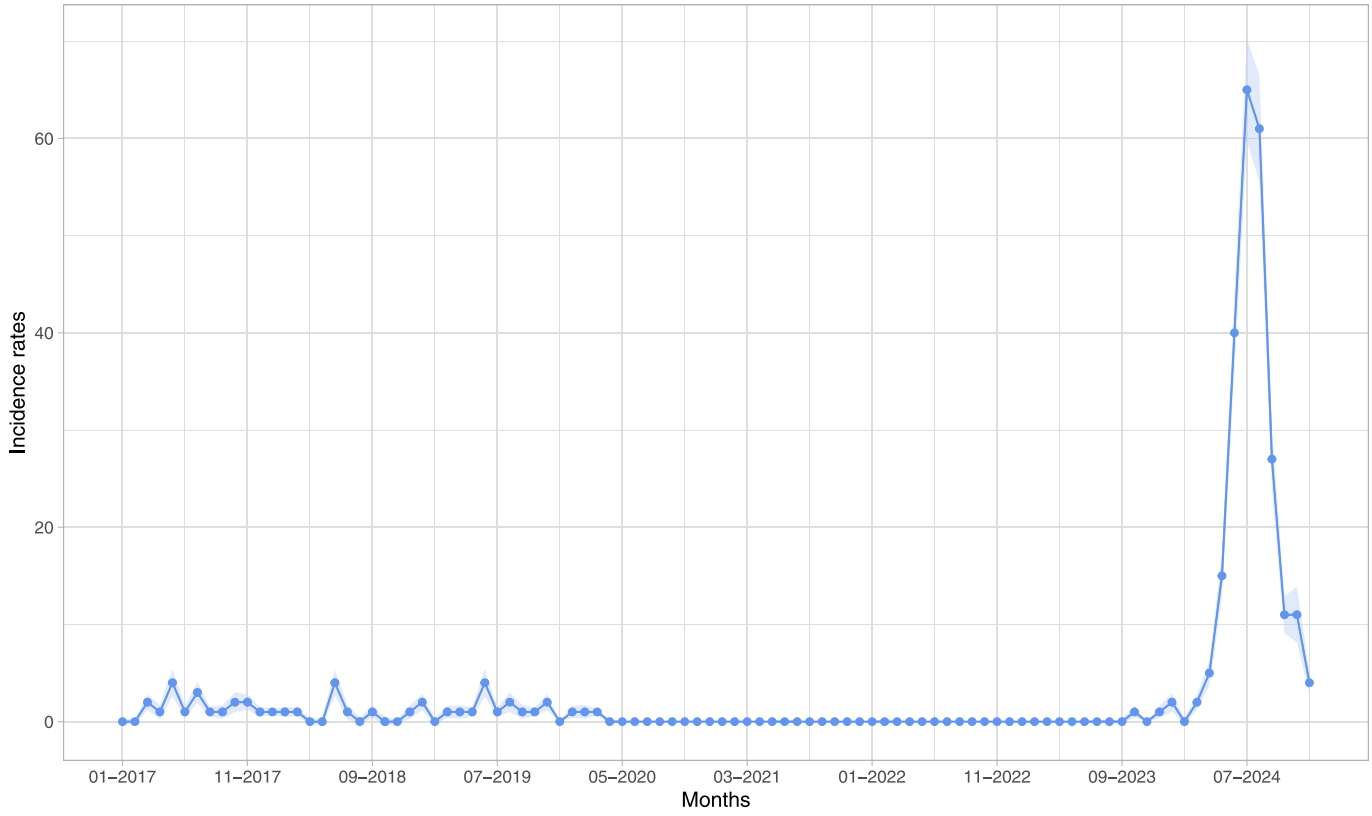

Fig. 1. Monthly incidence rates of pertussis diagnosed in general practice per 100,000 inhabitants, French Sentinelles network, France, January 2017 – December 2024.

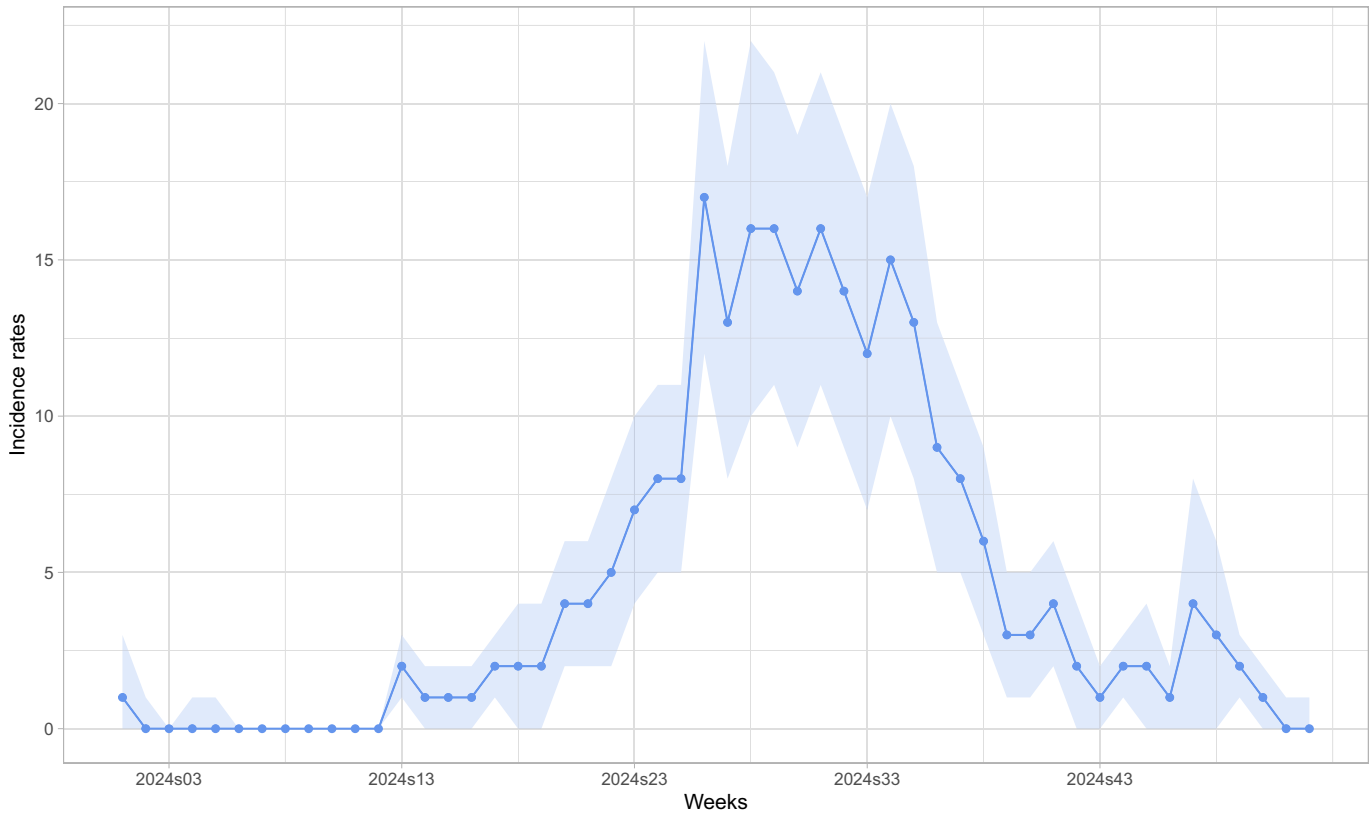

Fig. 2. Weekly incidence rates of pertussis cases diagnosed in general practice per 100,000 inhabitants, French Sentinelles network, France, 2024w1 to 2024w52.

2.2. Characteristics of cases

Of the 689 notified cases, 61 % were female ($n = 417$) (Table 1), and incidence rates in general practice were significantly higher in females than in males (Table 2). Forty-seven percent of cases were 15 years old or older ($n = 320$) (66 % in 2017–2020). The age group with the highest incidence rate in general practice was 1 to 6 years old, with 1,173 cases per 100,000 inhabitants (95 % CI: 996–1,350), followed by 7 to 13 years old with 546 cases per 100,000 inhabitants (95 %CI: 444–648).

Most cases (87 %, 597/685) were laboratory-confirmed, 595 by PCR, 2 by culture. On 413 cases for which the species were provided, 410 were infected by *B. pertussis*, one was infected by *B. holmesii*, two by *B. parapertussis*.

Cough was reported in almost all cases (669/670 cases with data on cough), mainly nocturnal (72 %, 438/607) and with paroxysms (90 %, 565/630) (Table 3). Only 9 % of cases (54/614) presented with whooping. Most patients consulted within the first two weeks of cough (76 %, 488/641). In cases under 1 year of age, 62 % (5/8) consulted less than 7 days after the onset of cough (31 % in patients older than 1 year of age) and 50 % (4/8) reported fever (20 % in patients older than 1 year of age). Four cases were hospitalized: a one-month-old infant whose mother was vaccinated during pregnancy (no information on when the mother was vaccinated during her pregnancy), a 3-year-old vaccinated boy (3 doses), a 10-year-old girl with unverified vaccination status (unknown number of doses and last injection date), a 26-year-old woman (unknown vaccination status).

Among 552 cases with known immunisation status, 86 % (477) had received at least one vaccine injection. Among cases vaccinated with at least three doses of pertussis vaccine and with information on the date of last vaccination, 77 % (146/190) had been vaccinated for less than 5 years. Among cases vaccinated with at least three doses of pertussis vaccine, the median delay between last injection and pertussis diagnosis was 3 years (Q1: 2 years; Q3: 4 years). Four cases received a vaccine injection a few days before pertussis diagnosis, when they were already coughing. Of the 365 cases aged less than 15 years, the vaccination status is known for 329 children, of whom 311 were vaccinated with at least one dose, regardless of the date of vaccination (95 %). The number of doses is known for 257 children, of whom 245 (95 %) had received the correct number of doses for their age. Half of these 257 children (135/257) were two years or less from their next dose. In people aged 15 years and over, vaccination status is unknown in 30 % of cases (97/320) and the number of doses is unknown in 64 % (107/166) of vaccinated adults.

Most cases (63 %, 380/602) reported persons who were coughing in their environment, mainly siblings (31%, 157/507) or children from day care/school (17 %, 87/507).

3. Discussion

Pertussis cases reported by the French Sentinelles network decreased from the beginning of the Covid-19 pandemic [3], and increased from the beginning of 2024, peaking in July 2024. Observations from other French and international pertussis surveillance systems confirmed the low circulation of pertussis during the Covid-19 pandemic [2,4] and its resurgence in 2024 [2,7–10]. Compared with French surveillance data from 2017 to 2020, cases appear to be younger, with a median age of 13 years in 2024 compared with 31.5 in 2017–2020, while data from the last three decades suggest that vaccination programmes shift cases towards older children and adults [11,12]. The social distancing and hygiene measures implemented to control the spread of Covid-19 may have disrupted the cycles of pertussis, resulting in a long period of low circulation without immunity boost by natural infection, perhaps leading to this late and unprecedentedly large outbreak [13]. This situation may also have had an impact on the duration of this new cycle, intensifying the outbreak and making it more rapid. The observed age structure could be related to delays in vaccination boosters observed in pandemic years [13], or to post-pandemic changes in healthcare behaviours.

The representativeness of the French Sentinelles network raises important questions. Variations in patient demographics and

Table 1
Demographic and laboratory description of 689 pertussis cases, French Sentinelles network, France, 2024w1 to 2024w52.

Characteristics	Available data	Number with the characteristic (percentage)	2017–2020 pertussis data: number with the characteristic/ available data (percentage)
Laboratory-confirmed case	685	597 (87 %)	109/132 (83 %)
Epidemiologically-confirmed case	685	88 (13 %)	23/132 (17 %)
Median age (min–max; IQR)	685	13 years (1 month– 92 years; 34 years)	31.5 years (2 months-87 years; 39 years)
Sex: Female	681	417 (61 %)	83/132 (63 %)
Vaccinated	552	477 (86 %)	58/112 (52 %)
Known number of doses	477	316 (66 %)	37/58 (64 %)
1 dose	316	4 (1 %)	1/37 (3 %)
2 doses	316	5 (2 %)	1/37 (3 %)
3 doses	316	165 (52 %)	8/37 (22 %)
4 doses	316	76 (24 %)	13/37 (35 %)
> 4 doses	316	66 (21 %)	14/37 (38 %)
Laboratory criteria			
Culture prescribed	569	2 (0 %)	6/127 (5 %)
Culture performed	2	2 (100 %)	6/6 (100 %)
Culture positive	2	2 (100 %)	6/6 (100 %)
PCR prescribed	673	620 (92 %)	112/131 (85 %)
PCR performed	620	610 (98 %)	110/112 (99 %)
PCR positive	610	595 (98 %)	103/110 (94 %)
Cluster information			
Presence of coughing cases in the surroundings	602	380 (63 %)	Unpublished data
One coughing case	380	254 (67 %)	Unpublished data
Two coughing cases	380	97 (26 %)	Unpublished data
More than two coughing cases	380	29 (8 %)	Unpublished data

GP: general practitioner; IQR: interquartile range; max: maximum; min: minimum.

Table 2
Estimated incidence rates of confirmed pertussis cases diagnosed in general practice by age group and sex, French Sentinelles network, France, 2024w1 to 2024w52.

	N	%	Incidence rate per 100,000 inh. [IC 95 %]
Age groups			
< 1 year	8	1	291 [74–508]
1–6 years	206	30	1,173 [996–1,350]
7–13 years	136	20	546 [444–648]
14–25 years	116	17	270 [216–324]
26–45 years	76	11	112 [84–140]
46–64 years	91	13	127 [98–156]
≥ 65 years	52	8	83 [58–108]
Sex			
Male	264	39	191 [166–216]
Female	417	61	282 [252–312]

consultation volumes among participating physicians may introduce bias when extrapolating data to estimate the incidence in general practice of infectious diseases such as pertussis. Currently, the network lacks detailed information on the composition of its patient population and the volume of consultations specific to participating GPs. Sentinelles GPs are not fully representative of all French GPs, particularly in terms of gender distribution and geographical coverage [14]. Incidence rates are therefore adjusted by region and we assume that Sentinelles GPs represent the average patient load and case mix of a 'typical' regional GP. Although individual variation exists, it is expected to cancel out in a sufficiently large and geographically diverse network, mitigating local bias or case clustering. In addition, many children in large cities visit paediatricians rather than GPs, and French recommendations are to hospitalise infants under one year old with pertussis, which can skew comparisons between age groups in general practice. Consequently, the national incidence of pertussis in children (especially those under one year of age) is likely to be significantly underestimated by our calculated incidence rates in general practice. Therefore, the lower 2024 incidence rate we observed in infants under one year compared with children aged 1–6 and 7–13 years does not necessarily indicate lower overall national incidence rate in this youngest age group. However, this should not distort the comparison between years for a given age group.

Cases were more frequently fully or partially vaccinated in 2024 (86 %, 477/552, 20 % missing data on vaccination) than in 2017–2020 (52 %, 58/112, 15 % missing data on vaccination). In France, the national vaccination schedule includes a primary immunisation at 2 and 4 months, followed by boosters at 11 months, and 6, 11–13 and 25 years, plus boosters for pregnant women (from April 2022), relatives of infants, and healthcare and childcare professionals [3]. By definition, in a highly vaccinated population, most cases will be seen in vaccinated individuals, experiencing vaccine failure (sometimes linked to a delay in the last vaccination) or waning immunity [10,15]. The increase in the proportion of vaccinated cases may be due to the decreasing age of cases, as vaccination coverage in France is higher in children than in adults. Another explanation could be an increase in pertussis vaccination coverage in the French population. In fact, vaccination compliance and pertussis vaccination coverage in France have improved since the pre-pandemic years. For example, pertussis vaccination coverage at 24 months (three doses) improved from 95.1 % in 2016 to 96.3 % in 2022. Between 2022 and 2024, preliminary calculations suggest that this vaccine coverage has increased by 0.5 percentage point [16]. The proportion of women vaccinated during pregnancy also improved from 2 % in 2021 to 12 % in 2022, 41 % in 2023 and 63 % in 2024 [17]. Unfortunately, a high rate of missing data on vaccination status (20 % in 2024, 15 % in 2017–2020) and on the number of doses received by vaccinated persons (34 % in 2024, 36 % in 2017–2020), especially among adults (30 % and 64 % in 2024, respectively, for cases aged 15 years and older) makes it difficult to draw conclusions on this issue. The characteristics of persons with missing data on vaccination in 2024 and 2017–2020 may differ. Furthermore, we have calculated a raw vaccination rate, which shows the percentage of persons who received at least one injection of the vaccine, without considering whether the full vaccination schedule was completed.

Pertussis surveillance in primary care is essential in epidemic management, as most pertussis cases are now seen in primary care and not hospitalized. The documentation of cases is also crucial to study changes in the affected population and to assess vaccination programs. GPs were among the first witnesses of this outbreak, and an alert was promptly issued, enabling efficient sensibilisation of health professionals.

4. Conclusion

We report the increase in pertussis incidences seen in primary care in France since January 2024, reaching a peak in July 2024. Characteristics of cases appear to have shifted towards younger age and a higher proportion of people who have received at least one dose of pertussis vaccine in their lifetime, whether or not given according to the recommended schedule, compared to previous outbreaks. These results emphasize the importance of surveillance and case characterisation in primary care to enable rapid responses in epidemic management and evaluation of vaccination programmes. This study underlines the need for timely vaccination, especially in the young population.

Ethic statement

We performed an observational study on anonymous data. Under French law, this does not require approval by a regulatory structure or an ethics committee. The protocol was conducted in agreement with the

Table 3
Symptomatic description of 689 pertussis cases by age group, French Sentinelles network, France, 2024w1 to 2024w52.

Characteristics	Number with the characteristic/available data (percentage)							
	Total	< 1 year, %	1–6 years, %	7–13 years, %	14–25 years, %	26–45 years, %	46–64 years, %	≥ 65 years, %
Presence of fever (assessed by GP or reported by patient)	135/649 (21 %)	4/8 (50 %)	39/194 (20 %)	19/129 (15 %)	21/112 (19 %)	18/70 (26 %)	19/83 (23 %)	15/52 (29 %)
Hospitalisation	4/658 (1 %)	1/8 (12 %)	1/201 (0 %)	1/126 (1 %)	0/113 (0 %)	1/72 (1 %)	0/84 (0 %)	0/52 (0 %)
Cough	669/ 670 (100 %)	8/8 (100 %)	202/202 (100 %)	132/133 (99 %)	115/115 (100 %)	72/72 (100 %)	85/85 (100 %)	51/51 (100 %)
Predominantly nocturnal	438/607 (72 %)	6/6 (100 %)	149/184 (81 %)	84/118 (71 %)	65/105 (62 %)	48/69 (70 %)	48/75 (64 %)	38/50 (76 %)
Cough with paroxysms	565/630 (90 %)	8/8 (100 %)	175/191 (92 %)	103/118 (87 %)	98/112 (87 %)	62/69 (90 %)	74/81 (91 %)	45/51 (88 %)
Cough with frequent post-cough vomiting	166/615 (27 %)	2/7 (29 %)	66/187 (35 %)	21/117 (18 %)	37/107 (35 %)	15/69 (22 %)	18/79 (23 %)	7/49 (14 %)
Cough leading to difficult breathing	174/621 (28 %)	4/8 (50 %)	51/186 (27 %)	22/119 (18 %)	30/109 (28 %)	24/68 (35 %)	30/82 (37 %)	13/49 (27 %)
Cough with cyanosis	7/627 (1 %)	0/8 (0 %)	0/187 (0 %)	2/120 (2 %)	1/111 (1 %)	2/70 (3 %)	2/80 (2 %)	0/51 (0 %)
Cough with whooping	54/614 (9 %)	1/7 (14 %)	15/183 (8 %)	7/121 (6 %)	13/110 (12 %)	8/67 (12 %)	7/79 (9 %)	3/47 (6 %)
Apnoea	15/617 (2 %)	1/7 (14 %)	1/184 (1 %)	1/120 (1 %)	2/110 (2 %)	2/69 (3 %)	8/81 (10 %)	0/46 (0 %)
Time between beginning of cough and consultation								
Less than 7 days	202/641 (32 %)	5/8 (62 %)	60/194 (31 %)	44/124 (35 %)	24/112 (21 %)	25/70 (36 %)	31/83 (37 %)	13/49 (27 %)
7–14 days	286/641 (45 %)	2/8 (25 %)	98/194 (51 %)	55/124 (44 %)	49/112 (44 %)	26/70 (37 %)	28/83 (34 %)	28/49 (57 %)
15–21 days	106/641 (17 %)	1/8 (12 %)	23/194 (12 %)	16/124 (13 %)	28/112 (25 %)	14/70 (20 %)	19/83 (23 %)	5/49 (10 %)
>21 days	47/641 (7 %)	0/8 (0 %)	13/194 (7 %)	9/124 (7 %)	11/112 (10 %)	5/70 (7 %)	5/83 (6 %)	3/49 (6 %)

Helsinki Declaration and authorisation was obtained from the French Data Protection Agency (CNIL, registration 923,099).

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Authors' contribution

LR, FAEB, SB, NG, JT, TB, TH, MD designed and set up the surveillance. MD, TL analysed the data. TM, MD wrote the manuscript. TM, TL, LR, FAEB, SB, NG, LM, CR, IPC, AR, JT, TH, TB, OS, MD reviewed the manuscript.

CRediT authorship contribution statement

Thomas Monchausse: Writing – review & editing, Writing – original draft. **Titouan Launay:** Writing – review & editing, Formal analysis. **Louise Rossignol:** Writing – review & editing, Conceptualization. **Fatima Ait El Belghiti:** Writing – review & editing, Conceptualization. **Sylvain Brisse:** Writing – review & editing, Conceptualization. **Nicole Guiso:** Writing – review & editing, Conceptualization. **Lore Merdrignac:** Writing – review & editing. **Carla Rodrigues:** Writing – review & editing. **Isabelle Parent du Châtelet:** Writing – review & editing. **Aubane Renard:** Writing – review & editing. **Julie Toubiana:** Writing – review & editing, Conceptualization. **Thomas Hanslik:** Writing – review & editing, Conceptualization. **Thierry Blanchon:** Writing – review & editing, Conceptualization. **Olivier Steichen:** Writing – review & editing. **Marion Debin:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Guiso N has no conflict of interest for this surveillance, but has participated in the past years in expert meetings with Sanofi and Bionet Asia. For other authors, no conflict of interest declared. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The data that has been used is confidential.

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