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**Individual healthcare plan for allergic children at school:
lessons from a 2015-2016 school year survey.**

Running title Individual healthcare plan for allergy at school

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Abstract

The Individual Healthcare Plan (IHP) was implemented in schools in France in 2003 to improve management of allergic children. Our objectives were to assess the practical aspects of IHP (excluding asthma) and allergic reactions occurring at school.

Methods: Prospective study conducted in the North Department (France) during the 2015/2016 school-year. Two questionnaires were developed: one for the school doctors (n=67) and one for the school principals (n=2372).

Results: Data from 336 (25%) of the 1325 IHPs (0.24% of children) were collected [mean age: 8 years; food allergy (FA): 94% (peanut=44%, nuts=54%), venom: 4%]. Wide variations in emergency kit (EK) medications were observed: antihistamines (84%), oral corticosteroids (79%), adrenaline auto-injectors (70%), inhaled bronchodilators (65%). 670 (28%) school principals' responses, representing 81% of all IHPs, were analyzed. A total of 1935 EKs were stored (mean: 2.8/school), one or more with adrenaline, by 213 (32%) schools: in the class room (33%), the nursery (14%), or the principal's office (10%). Sixty, mainly mild to moderate allergic reactions (adrenaline injection: 2) occurred in 44 schools (0.09/school/y), in children with previously undocumented allergy in 50%. FA was highly suspected in 92%.

Conclusion: IHP is mainly implemented for FA. Anaphylaxis remains rare in the school setting and FA is often a suspected cause of reaction. Staff training should be improved. Application of the recommendations regarding the content and accessibility of EK and a widespread emergency action plan are needed.

Key words: allergy, anaphylaxis, child, individual healthcare plan, school.

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At least 25% of school-age children in Europe live with an allergic disease and food allergy affects from 4-7% of primary school children (1). Data from many countries suggest an increase in hospital admissions for anaphylaxis in both adults and children (2-4). This increase is particularly marked in children for food-related anaphylaxis (4, 5). A Canadian study of two pediatric emergency departments, recorded that 8% of 484 anaphylaxis cases occurred at school (6). The European Anaphylaxis Registry reported a similar percentage with 9% of anaphylaxis cases (7). In data extracted from English and Welsh national databases, 17% of the 48 fatalities in school-age children occurred within the educational environment (4). Prevention policies, legislation, and training to reduce the risk of severe allergic reactions and improve the quality of life of allergic children in the school setting vary between countries.

In France, prevention measures to improve the acceptance of children with allergic disease and reduce the risk of allergic reactions in a school setting were introduced into law in 2003. These measures are contained within an Individual Healthcare Plan (IHP) for each child. The IHP includes prevention measures to avoid exposure to a known allergen at school, indications for the school meal conditions and an individualized anaphylaxis emergency plan associated with an emergency kit (EK). The document is first filled in by an allergist (or another practitioner under the recommendations of an allergist) and then validated by a school doctor to ensure that the IHP is in accordance with the recommendations and the local

amenities. During the 2014-2015 school year, 12.8 million school-age children attended 64 000 schools in France and 46 700 IHPs were for allergy (excluding asthma). In 2002, there were only 7 482 IHPs for allergy indicating a 6-fold increase in 15 years (8).

The French Allergology Society provided a position statement in 2016 about the indications for an IHP for allergic children at school and the content of the EK taking into account the EAACI anaphylaxis recommendations (9, 10) (Table 1).

Nevertheless, real-life data about the implementation of IHPs in schools are lacking. The aim of our study was to assess the practical aspects of the implementation of an IHP for allergy in all school settings and to determine the number of suspected allergic reactions that occurred during the 2015-2016 school year in the North Department of France which has the highest number of school-age children in France and also the highest number of IHPs for allergy.

Methods

This survey was conducted in the North Department (France) during the 2015-2016 school year. The population of this department is of 2 628 000 people including 548 000 school-age children (www.insee.fr ; www.ac-mlille.fr/dsden59/presentation/chiffre.php.html). The study consisted of a two-part analysis:

Part 1. Each school doctor in the department was asked to complete a questionnaire for each IHP that had been validated for allergy, excluding those for asthma. This questionnaire was designed to describe the characteristics of the children covered by an IHP: allergen, age, sex,

stage of schooling, content of the EK (especially whether it contained an adrenaline auto-injector [AAI]) and school meal conditions.

Part 2. Each of the department's principals –from nursery- to high school – was asked to complete another questionnaire during the same period. This questionnaire was designed to detail the practical aspects of the IHP implementation and the occurrence of allergic reactions during the school year 2015-2016. It was sent electronically between June and July 2016 using the databases of the French Ministry of Education. Only one questionnaire was completed for each school. Three email reminders to complete the survey were sent after an initial introduction letter. Missing responses were excluded from the analysis.

Permission to carry out the survey was obtained from the local Education Authorities.

Statistical analysis was descriptive and exact Fisher's and Chi-square tests were used to perform comparisons of categorical data. A p-value<0.05 was considered significant.

Results

Part 1.

Description of the IHP validated by the school doctors

In all, 1 325 IHPs for allergy, of which 690 (52%) were introduced in 2015, were validated by the 67 school doctors in the department. This represents one IHP per 414 school-aged children (0.24%) in the North Department. We received completed questionnaires for 336 (25%) of the IHPs (girls: 64%; mean age: 8 years [SD: 4.2]). The description of the IHPs is given in the Table 2.

Prescriptions for the emergency kits and conditions of school meals

The IHP prescriptions included an EK with an AAI (n=211; 63%), an EK without an AAI (n=91; 27%), or merely specific instructions to avoid the allergen (n=34; 10%). Specific allergen avoidance or an EK without an AAI were more likely to be prescribed by a general practitioner than by another physician ($p < 10^{-3}$). Medications prescribed in the EK were: oral antihistamines (84%), oral corticosteroids (79%), AAI (70%) and inhaled β 2-agonists (65%) (Figs 1a/1b).

Prescriptions providing instructions for school meal conditions were the following: meal in the canteen with avoidance under child/family supervision (n=116; 37%), lunch box provided by the family (n=99; 31%), meal in the canteen with avoidance under staff supervision (n=63; 20%), strict removal of child from school for mealtimes (n=30; 9%).

Part 2. School principals' responses regarding IHP implementation and emergency kits

From the 2 372 schools in the department, 710 (30%) school principals completed the questionnaire but only 670 (28%) were included for analysis due to missing responses: data was lacking for 174 644 (32%) of registered pupils and 1 073 (81%) of the 1 325 IHP for allergy (1.6 IHP (range 0-19) for each school). The school stages were represented as follows: nursery (n=236; 35%), primary (n=301; 45%), middle (n=82; 12%) and high school (n=51; 8%). Of these, 1 073 IHP, 829 (77%) were food-related and the four most frequent food allergens were the following: peanut (19%), hazelnut (15%), cashew/pistachio (14%), hen egg (13%).

Non-food-related conditions were the following: insect venom (9%), idiopathic (7%), exercise-induced anaphylaxis (5%), latex (2%).

Emergency kits at school

A total of 1 935 EKs were stored in the 670 schools (mean: 2.8/school; range: 0-57). Of these, 353 (18%) included an AAI (mean: 0.08/school; range: 0-8). In all, 563 (84%) stored at least one EK: 213 (32%) stored at least one EK with adrenaline, 82 (11%) at least two, 32 (5%) at least three. The EKs were stored in the class room (33%), in the sick room (14%) or in the principal's office (10%). In 44% of the schools the EKs were kept under lock and key. In 56% of the schools, the canteen was located in the school itself or close to the EK storage place (at a distance of less than 200 meters in 92% of cases).

Allergic reactions in the school setting

Forty-four (7%) of school principals reported a total of 60 allergic reactions during the 1-year study period (0.09 reactions/school/year). These reactions occurred in nursery (n=14; 23%), primary (n=18; 30%), middle (n=17; 28%) and high schools (n=11; 18%). Thirty (4%) schools reported one allergic reaction, 10 (1.5 %) two allergic reactions and two schools three or more. The remaining schools (n= 626; 93%) reported no allergic reactions.

Of the 60 allergic reactions, 55 (92%) were highly suspected to be food-related although food allergen was recorded in only 35 (58%) of these cases: peanut (n=7), hazelnut (n=4), shellfish/crustaceans (n=4), kiwi (n=3), cashew/pistachio (n=2). The other triggers were insect venom (n=3) and exercise (n=2). Overall, 30 (50%) of the reactions occurred in children that were not known to be allergic to food. Of the 30 children known to have a food allergy, 29 (48%) had an EK, including an AAI in 13. The reactions triggered a call to a medical emergency service in 16 cases (27%) and an adrenaline injection by school staff in

two. The adrenaline utilization rate was 0.11/10 000 students per year. No deaths were reported in the department.

Discussion

This was the first study to evaluate IHPs from both the school doctor's and principal's perspective. It confirmed the large number of IHPs (1.6 IHP per school; 0.24% of school-age children), mainly for food-related allergy, validated in the North Department of France. We observed a wide variation of medications in the EK and difficulties related to the accessibility of the EK and AAI. Allergic reactions at school were not uncommon (0.09/school/year), even if they were mild to moderate in most cases. Most of them were food related and half were in children not known to be allergic.

The prevention and management of allergic reaction in a school setting is now recognized as a public health concern in many countries and recommendations from both the EAACI and American Academy of Pediatrics have been published (9, 11-14). We recorded that 0.24% of school-age children had an IHP, mainly for food allergy, which appears to be relatively low compared with the prevalence of children of school age with food allergies (up to 8% of children) (15, 16). The main food allergens for which an IHP was required were similar to those reported as anaphylaxis triggers in the European Anaphylaxis registry (7). We also found that the kiwi fruit accounted for around 10% of food allergens which is a higher rate than that reported in the European registry (7). The other usual anaphylaxis triggers such as insect venom, latex rubber or exercise were not a common cause (<10%) either of an IHP request or as elicitors of allergic reaction at school in our study. Our data also showed a wide

variety of EK medications. The EK contained an AAI in 70% of cases and oral corticosteroids, whose effectiveness has not been clearly demonstrated, in 79%. This would indicate that there is a lack of clear recommendations regarding the ideal content of the EK, except for the indications for an AAI (9). Important questions about the role of antihistamines, corticosteroids and the need for bronchodilators in an EK remain to be addressed.

We found that the number of declared allergic reactions was low and that they were mainly mild. Few epidemiological data are available regarding the number and characteristics of food allergy reactions and anaphylaxis at school. In North Carolina (U.S.), the number of self-reported severe allergic reactions rose from 1.3% of all students in 2004 to 3% in 2014 (17). In the same area, school officials saw a 3.4-fold increase in the number of EKs with adrenaline at school over the last 10 years giving a ratio 1:76 school-age children in 2015. A 2.2-fold increase of anaphylaxis cases was reported for the same period: from 1:9 381 students (2004) to 1:4 333 students (2014). A utilization rate of adrenaline at school has been reported at 0.58 doses/10 000 students per year (17). In the Epipen4Schools survey, data were collected from 6 019 participating US schools and 11% reported the occurrence of one or more anaphylactic events (18). In our study, this rate was lower (0.11) but difficult to interpret because our data were not exhaustive even if the school sample that responded to the questionnaire covered up to 80% of all IHPs.

In our study most of the allergic reactions were reported to occur in the classroom (43%). McIntyre et al. reported that up to 79% of allergic reactions occur in the classroom (19). On the contrary, Sabouraud et al. from the Allergyvigilance network analyzed 56 anaphylaxis

events occurring in a school setting over a 10-year period (2005-2015) and found that 80% of them occurred in the canteen (20). This is of some concern as we found that the canteen was outside of the school setting or at some distance from the storage place for the EKs in 44% of the schools indicating that an AAI is not readily available.

Interestingly, we observed that half of the reactions occurred in children without known allergy and that only one third of the schools had at least one EK with an AAI. This is higher than reported in other studies: 25 % of anaphylactic events in Massachusetts (2003 and 2010) and 22% in the United States (U.S.) (19, 21). In Chicago, district-issued AAIs were distributed to all public and charter schools prior to the start of the 2013-2013 school year (22). During this school year, AAIs were administered to 38 children and for a first-time anaphylactic event in 55% of the cases. This raises the question of introducing unassigned AAIs at school to treat any child experiencing a severe allergic reaction even out of the context of an IHP, a concept which deserves to be explored by a cost-benefit analysis. Steffens et al. performed a retrospective cohort study to evaluate the cost and utility of keeping unassigned AAIs in schools (23). Of the 631 cases that received a non-cardiac arrest dose of adrenaline, only 23 occurred in a public school and 52% of these reactions involved food allergens. The annual cost to stock AAI in these schools ranged from \$56 500 to \$484 6000 not including the staff's training costs.

Our study also raises the question of accessibility of the EK. We found that the EKs were stored in various places and that around half of them were kept under lock and key which may be a real problem if an emergency adrenaline injection is needed. It is also recognized that children and adolescents at risk often fail to carry their unexpired AAI with them or do

not have ready access to an AAI in case of anaphylaxis (9, 24, 25). In Ontario, an Act to protect Anaphylactic pupils (Sabrina's Law, 2006), ensures that all school boards have policies or procedures to address anaphylaxis in schools including instructions for school staff and guidance for treating an anaphylactic event. In the U.S., the Federal School Access to Emergency Epinephrine Act was signed into law in 2013. This legislation encourages states to adopt laws inciting schools to stock AAI and to train school staff in its use.

Our study has some limitations. Only 25% of the school doctors and 30% of the principals completed the questionnaires implying that our results may not be representative of all the IHPs and schools in our department. Nevertheless, principals who responded covered around 80% of the schools with an IHP in place. Another limitation is that the number of allergic reactions should be interpreted with caution because the events were recorded retrospectively and were not validated by a physician. Moreover, we did not assess if the treatment was appropriate to the clinical severity as this was not the aim of our study.

Conclusions

Our study highlights shortcomings concerning IHPs as a preventive approach to improve the management of allergy at school and reduce the risk of severe allergic reactions. These include: allergic reactions in children with previously undocumented allergy, a wide variety of EK medications, lack of easy access to the EK and the AAI, and poor staff skills for the treatment of allergic reactions. Further studies assessing the real rate of allergic reactions and anaphylaxis events in the school setting are required. The feasibility of unassigned AAI at school should be further explored. Furthermore, a unique emergency

action plan for children in the school setting and firm recommendations on the ideal EK content would be an important step forward.

Conflicts of interest: All authors declare to have no conflict of interest related to this subject.

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Table 1. Recommendations for the establishment of an Individual Healthcare Plan in allergic children at school from the French Allergology Society (10).

Group I: IHP with an emergency kit including adrenaline autoinjector	Previous anaphylaxis triggered by food, latex, or aeroallergens Previous exercise-induced anaphylaxis Previous idiopathic anaphylaxis Co-existing unstable or moderate to severe, persistent asthma and a food allergy* Venom allergy in adults with previous systemic reactions (not receiving maintenance VIT) and children with more than cutaneous/mucosal systemic reactions Underlying mast cell disorders or elevated baseline serum tryptase concentrations together with any previous systemic allergic reactions to insect stings, even in VIT-treated patients
Groupe II: IHP with an emergency kit the content of which relies on the expertise of the prescribing physician	Previous mild-to-moderate allergic reaction* to peanut and/or tree nut Teenager or young adult with a food allergy* Remote from medical help and previous mild-to-moderate allergic reaction to a food, venom, latex, or aeroallergens Previous mild-to-moderate allergic reaction to traces of food*
Groupe III: IHP designed exclusively for allergen avoidance (without any emergency kit)	Previous mild allergic reaction to food or latex (oral syndrome, dermatitis) or mild-to-moderate allergic reaction induced for significant intake (gastrointestinal symptoms par exemple)
Groupe IV: No need for an IHP	Allergen sensitization without any previous allergic reaction
	Chronic or recurring gastrointestinal symptoms without any proven food allergy
	Previous food allergy that healed
	Venom induced allergy with only local or locoregional symptoms
	History of a suspected food allergy without any medical confirmation.

*Excluding pollen food syndrome (oral allergy syndrome).

Individual Healthcare Plan: IHP

Table 2. Description of the individual healthcare plans (IHP) validated by the school doctors in the department North of France during the 2015-2016 school year.

	N (%)
Stage of schooling	
-nursery	119 (35)
-primary	109 (32)
-middle	69 (21)
-high school	39 (12)
Requested by...	
-allergists	137 (41)
-general practitioner	126 (38)
-pediatricians	52 (15)
pulmonologists	9 (3)
Allergens concerned by the IHP	
-food (top ten)	317 (94)
Peanut	140 (44)
Hazelnut	93 (29)
Cashew/pistachio	86 (27)
Egg	56 (18)
Kiwi fruit	28 (9)
Shrimp/sellfish	25 (8)
Cow's milk	14 (4)
Fish	13 (4)
Goat's and sheep's milk	6 (2)
Strawberry	6 (2)
-insect venom	12 (4)
-grass pollen	2 (<1)
-exercise induced	2 (<1)
-pencillin	1 (<1)

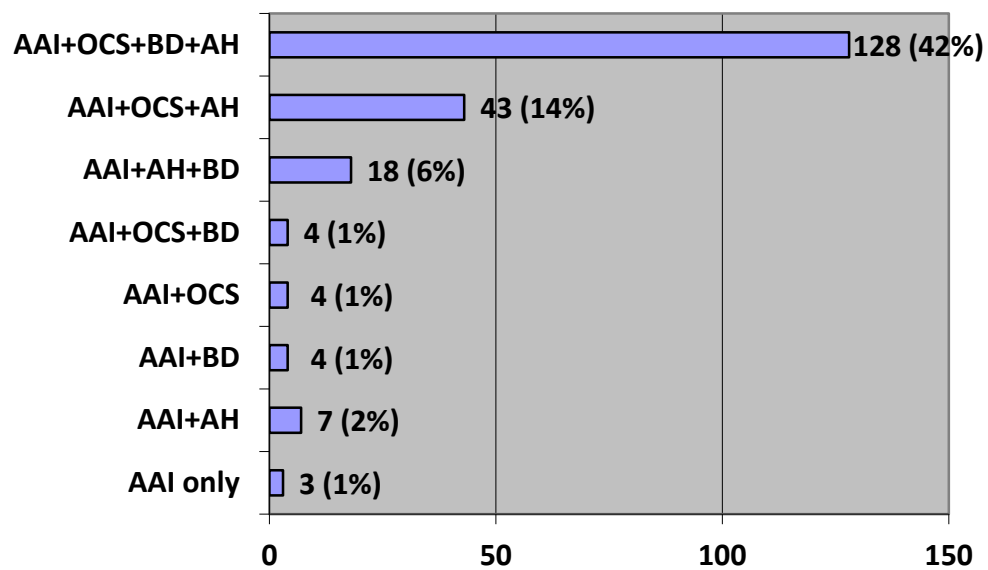


Figure 1a. Content of the emergency kit including an AAI (n=211) (absolute number and percentage of the 302 IHPs with an emergency kit).

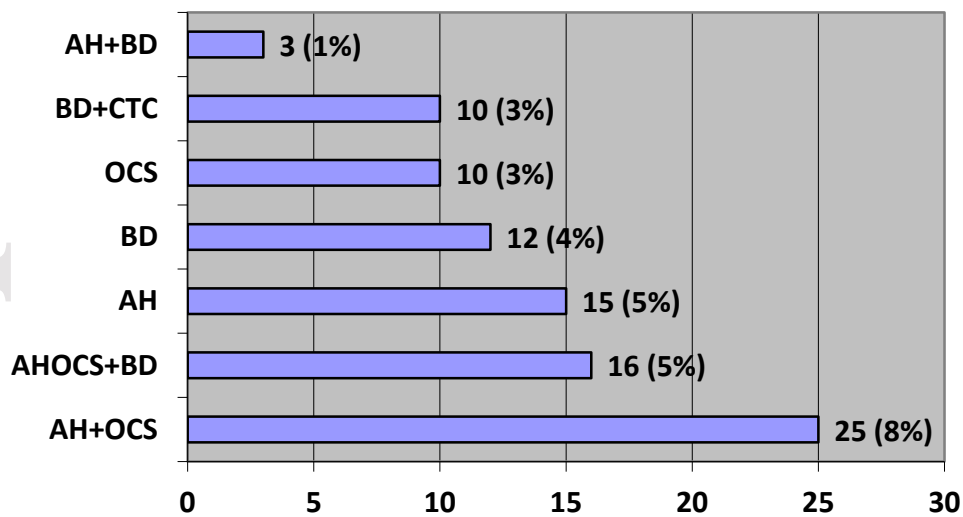


Figure 1b. Content of the emergency kit without AAI (n=91) (absolute number and percentage of the 302 IHPs with an emergency kit).

OCS : oral corticosteroids, AH : antihistamines BD : β 2-agonists, AAI : adrenaline autoinjector.