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Pediatric allergologic activities in Central Italy Hospitals: an interregional census of Marche-Umbria-Tuscany

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SUMMARY

Introduction: Despite the high epidemiology of pediatric allergic diseases, a mapping of the supply of related hospital diagnostic and therapeutic services on a regional and/or national scale has never been carried out in Italy, which is essential for adequate planning and care of children with allergies.

Materials and methods: Thanks to the collaboration of 26 pediatric allergology representatives from the 29 hospitals involved via an online questionnaire, an interregional Marche-Umbria-Tuscany (MUT) census was carried out in May 2023 to understand the current situation in central Italy, both in terms of performance provided and the activities of the individual structures. The results were also compared with those of a previous survey carried out in 2019.

Results: Of the hospitals evaluated, 12 were level 1, 9 were level 2, and 5 were level 3. From the analysis of the data, it emerged that there was an increase in 1st level hospitals carrying out Pediatric Allergology compared to 2nd level ones.

The activities carried out in the pediatric allergology field are mainly practiced by physicians specializing in Pediatrics who, over the years, developed allergological skills through master's degrees or specialization courses. Dedicated nursing staff or other specialists involved in the management of comorbidities are often present to support allergology activity.

Patients aged between 0 and 18 are assessed mainly once or twice a week with reservations through the single reservation center (CUP). In addition to the most common allergic pathologies (atopic dermatitis, allergic rhinitis and conjunctivitis, bronchial asthma, and food allergy), which are followed in all dedicated structures, there is also greater management of pathologies, such as chronic urticaria and drug allergy compared to 2019. Among the diagnostic investigations, in addition to skin prick tests (SPT) for inhalants and foods, prick-by-prick (PBP) for fresh foods, and spirometry, there is greater use of molecular allergology, skin tests for Hymenoptera stings, and provocation for food/drugs after obtaining informed consent (internal or in accordance with that proposed by the Italian Society of Pediatric Allergology and Immunology (SIAIP). All facilities prescribe sublingual immunotherapy (SLIT) for inhalants, while subcutaneous immunotherapy (SCIT) for inhalants and food immunotherapy (AIT) appear to be decreasing. On the other hand, the use of SCIT for Hymenoptera and the use of biologics (omalizumab, dupilumab) for therapeutic purposes

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This is an open access article distributed in accordance with the CC-BY-NC-ND (Creative Commons Attribution-Non-Commercial-NoDerivatives 4.0 International) license. The article can be used by giving appropriate credit and mentio-ning the license, but only for non-commercial purposes and only in the original version. For further information: https://creativecommons.org/ licenses/by-nc-nd/4.0/deed.en are increasing. Among the current strengths of the structures, the frequency of the days of activity and the division into hyper-specialist clinics stand out.

In light of the data collected, some aspects emerged that require further strengthening, such as the use of telemedicine, the transition path of the allergic adolescent to the adult world, the creation of interregional collaboration paths with level structures superior for complex patients, and the creation and continuous updating of shared protocols for pathologies at an intraregional or interregional level.

Discussion and Conclusions: These data highlight the pediatric allergology activities carried out in a large area of central Italy (MUT). This work, if extended to other Italian regions, would allow – for the first time – a global mapping of pediatric allergology activities in Italy, with consequent benefits in terms of quality and appropriateness of services and correct use of resources.

KEYWORDS: interregional census, pediatric allergology, collaboration paths

INTRODUCTION

Pediatric allergology has always been one of the most requested specialist branches by pediatric users, especially due to the increase in allergic pathologies in this age group ^{1,2}. To date, there are no data on the activities of Italian hospitals located in the various regions that deal with this branch of pediatrics. In 2019, a first collection was made through an online questionnaire on the data relating to the MUT regions, presented at the SIAIP congress of the same year.

Using an expanded questionnaire compared to the 2019 version, with the current work, the data previously collected in the 23 allergology facilities participating in the census have been updated, and a focus has been made on the services offered by current pediatric allergy hospitals. The focus was on the activities carried out, the working methods within the various structures, the professional figures involved who deal with these realities, and the collaboration between the structures (both intra- and extra-regional).

The positive aspects of the various activities were analyzed and the aspects to be improved over time were identified.

MATERIALS AND METHODS

The survey was carried out in two phases between April and May 2023. In order to collect all the necessary information, an online questionnaire was developed with questions concerning both the working method and the resources available (Figs. 1a-c), which was sent to the representatives of 29 pediatric allergology facilities in the three regions in question.

This questionnaire was created based on both a work carried out in the United Kingdom in 2022³ and the previous one developed in 2019, including additional questions with particular interest also relating to the COVID-post COVID period and the extent to which this experience has changed the way we work.

After the first phase of data collection, the information obtained was compared with that collected in 2019.

RESULTS

Of the 29 pediatric facilities contacted, 26 joined the project and were included in the work. Of these 26 facilities, 34.6% were from

the Marche region (9/26), 34.6% from the Tuscany region (9/26), and 30.8% from the Umbria region (8/26).

The hospitals of the structures contacted were classified on the basis of catchment area, annual accesses, and specialist skills into 3 levels: 1st level with catchment area between 150,000-300,000 inhabitants and with accesses/year greater than 45,000, 2nd level with catchment area between 600,000-1,200,000 inhabitants and with accesses/ year greater than 70,000 and 3rd level with numbers higher than the previous ones equipped with university centers ⁴.

Compared to 2019, the allergy offer in terms of services increased in smaller hospitals (Level I: 12/26 equal to 46.2% in 2023 compared to 7/23 equal to 34.7% in 2019), decreased in medium-sized hospitals (Level II: 9/26 equal to 34.6% in 2023 compared to 12/23 equal to 52.2% in 2019) and remained stable in major hospitals-university centers (Level III: 5/26 equal to 19.2% in 2023 compared to 4/23 equal to 17.4% in 2019).

Currently, the pediatric allergy activity in most hospitals (17/26 equal to 65.4%) is carried out as an outpatient activity, and in another significant percentage (7/26 equal to 26.9%) as a Day Hospital (DH) activity, while a small proportion (3/26 equal to 11.5%) as ward activity; only rarely (2/26 equal to 7.6%) do some facilities use all three access options (outpatient clinic, ward and DH).

The type of facility in which allergy investigations are carried out is predominantly an Outpatient Activity within a Pediatrics Operating Unit, as it was in the previous census (22/26 equal to 84.6% in 2023 compared to 20/23 equal to 87% in 2019), followed by the Departmental Simple Operating Structure (2/26 equal to 7.7%) and the Simple Operating Structure within the Complex Structure (1/26 equal to 3.8%).

Personnel configuration

In most cases, it is the pediatrician who takes care of the facility (only 1 pediatrician in 18/26 equal to 69%; 3 pediatricians in 3/26 equal to 11%; 5 or > 5 pediatricians in 2/26 equal to 7.7%).

In 65% of the facilities (17/26), at least 1 physician has hyperspecialized skills with the achievement of a master's degree in pediatric allergology/immunology, with an increasing trend compared to 2019 (less than 50% of cases). In 7.69% of the facilities (2/26), at least 3 physicians completed a specialized course, and only in 27% of cases (7/26) had no physician completed a master's degree in allergology.

1. Region: Tuscany Umbria Marche 2. USL/ASUR/AST you are registered with:	6. Type of S Outpatien Simple 0 Simple D Complex Regional	tructure nt activit perative epartmo Depart Special	in which the activity is carried out: y within an Operating Unit Unit in a Complex Unit ntal Operative Unit (SODs) nental Operative Unit (SODc) st Reference Centre		0. Numb 0 1 2 3 3 4 5 5 > 5	er of nurses employed in allergology:	a
3. City and hospital name: 7. Name of the con activities, contacts specialties of inter hymenoptera, etc.) 4. Location of activity: 4. Location of activity:			ntact person(s) for allergology s (phone, e-mail, etc.) and any sub- rest (lood, respiratory, drugs, .):		1. Other ssistance ctivities Desycho Dieticia Dermat Oculist Gastro	professional categories available for i n your allergy management (select all available options): logist n tologist enterologist	
Paediatric Allergology Clinic Department of Paediatrics Paediatric Day Hospital Other	8. Days, hou 9. Number o allergologics	f Speci al activ	Specialist Doctors who perform the activity (specify the number for each arr 0, 1, 2, 4, 5, 5)*		Pulmonologist Otolaryngologist Doctors and/or laboratory staff Other 2. Working organization of the allergological tivity (select all available options):] b
type of nospital where the activity takes place: 1st Level Hospital 2nd Level Hospital 3rd Level Hospital 1st Level Hospital	Paediatric Allergolog Paediatric Paediatric Paediatric Paediatric vhich the	gy Spec cians w cians w cians w	ialists ith a Master's Degree in Allergology ith a Specialization in Allergology		Outpatient Visits Day Hospital Admissions All of the above 18. Diagnostic tests carried out		
allergology activity is carried out: 1 2 3 4 5 > 5		managed during the allergy activity? (Select all available options): Allergic rhinoconjunctivitis Non-Allergic Rhinitis Fonchial asthma Fond allergy Chronic urticaria Allergy to hymenoptera			during The allergy activity (Select all available options): SPT Inhalants SPT Foods PBP Fresh Food Hymenoptera Skin Tests slgE food and inhalants Molecular slgE Food Patch Testing		
 14. Number of days per month in allergology activity is carried out number): 15. Average number of patients a month for each of the following reference of the following reference on the follow	Number of days per month in which the rgology activity is carried out (write the ber):		Vernal keratoconjunctivitis Mastocytosis Latex allergy Contact dermatitis Drug allergy Other What type of Informed Consent do you			fessional Patch Testing ometry illometry hysmography al Cytology 0 shing 1 for Food	
Outpatient Visits Day Hospital Admissions		 Hospital SIAIP Other 			TPC Stre Vac	I for Drug .ss-test spirometry cinations in a protected environment provocation tests?]
0-14 years 9 0-16 years 9 0-18 years 9 0 10			is, they stay with us during the test is, they are available upon request p				
21. Which of these immunotherap (Select all available options): Inhalants SLIT Food SLIT Hymenoptera SLIT Oral Food Immunotherapy	apies are prescribed? r center? na saria Dermatitis		25. Is there any ongoing cooperation whigher-level centers for complex pathology Yes No 1 don't know 26. How does this process take place? 27. Are there any shared intra-regional inter-regional protocols? Yes No 1 don't know		th ogies?	30. Do you use or have you ever used telemedicine? Yes No 31. What has changed in your allergy business since 2019? (select all available options): Service organization Decreased activity.	С
22. Do you use biologics at your ((select all available options): Omalizumab for Severe Asthma Omalizumab for Chronic Urtica Dupilumab for Severe Atopic D					and/or		
23. Is there a "transition" program s your centre and the centre for adults continuity of care for allergic patient Q No			28. What pathology are these protocol 29. What was your allergy activity dur covid period? Suspension of all outpatient activitie Continuation of all outpatient activitie Continuation of ITS Phone consultation for chronic patie Hospital/outpatient visits for asthma patients Other		for?		
Other 4. What are the strengths of the service? (select all available options): Hyper-specialist outpatient clinics Number of outpatient days/week Number of doctors involved in allergology Cilnical records Possibility to do research		ng the s nts ic			32. Tips for creating an interregional allergy network (free response):		

On the other hand, pediatricians who also have a specialization in allergology are poorly represented (3 in the 26 facilities).

- **Professional support figures**: with regard to the figures who support the pediatrician in allergy activities:
- there is an increase in the number of allergy facilities that have at least 1 dedicated nurse available (11/26 equal to 42.3% in 2023 compared to 7/23 equal to 31% in 2019) to support them in carrying out the various allergy activities. The percentage of facilities where there is no such availability is still substantial (12/26 equal to 46.2%), as was the case in 2019 (12/23 equal to 52%). On the other hand, there are few centers that have the possibility of having two (1/26 equal to 3.8%) or three dedicated nurses (2/26 equal to 7.7%);
- there was a slight reduction in allergology facilities that do not collaborate with any professional figures such as otolaryngologists (ENTs), dermatologists, ophthalmologists, gastroenterologists, etc.) with areas of interest common to the field of pediatric allergology (6/26 equal to 23% in 2023 compared to 8/23 equal to 35% in 2019); collaborations with the ophthalmologist are on the rise (13/26 equal to 50% in 2023, compared to 8/23 equal to 34% in 2019), the pulmonologist (10/26 equal to 38.5% in 2023, compared to 1/23 equal to 4.3% in 2019) and the ENT (15/26 equal to 27.7% in 2023, compared to 2/23 equal to 8.6% in 2019), decreasing that with the dietitian (6/26 equal to 23.1% in 2023, compared to 10/23 equal to 43.5% in 2019).

The availability of an anesthesiologist during the execution of oral provocation tests (OPT) is greater, which is present in the facility and available as needed in most cases (25/26 equal to 96.2% in 2023 compared to 19/23 equal to 86.9% in 2019).

Working organization of allergy activities: with regard to the way in which allergy activities are carried out (outpatient clinic, day hospital and hospitalization), to date there is greater use of the DH regime (7/26 equal to 26.9% in 2023 compared to 3/23 equal to 13% in 2019); on the other hand, outpatient admissions remain stable (17/26 equal

to 65.4%), and in hospital mode (3/26 equal to 11.5%), as well as those who use all three modalities (11/26 equal to 42.3%).

• Frequency of allergy activity: In most of the facilities, the frequency of allergy activity is once weekly (12/26 equal to 46.2%) or bi-weekly (7/26 equal to 26.9%), as was the case in 2019, with a decrease in the latter (9/23 equal to 39.1%) remaining daily in only 3rd level allergology facilities. There has been an increase in facilities that assess patients up to 5 times a month (17/26 equal to 65%) and a reduction in facilities that evaluate patients up to 10 times (6/26 equal to 23% in 2023 compared to 9/23 equal to 39% in 2019) or up to 19 times a month (1/26 equal to 4% in 2023 compared to 2/23 equal to 9% in 2019).

Management of allergic diseases: currently, 100% of the facilities deal with atopic dermatitis, allergic rhinitis and conjunctivitis, bronchial asthma, and food allergy. With regard to the latter pathology, a substantial increase in this specific activity was detected (26/26 equal to 100% in 2023, compared to 18/23 facilities equal to 78.3% in 2019). Greater attention is paid to pathologies such as chronic urticaria (20/26 equal to 76.9% in 2023 compared to 15/23 equal to 65.2% in 2019) and drug allergy (13/26 equal to 50% in 2023 compared to 7/22 equal to 30.4% in 2019); the management of other allergy problems (allergy to Hymenoptera, vernal kerato-conjunctivitis, latex allergy, contact dermatitis, and non-allergic rhinitis) is stationary, which are treated mainly in second and third level facilities (Fig. 2).

 Allergy tests available: to date, all facilities use SPTs for inhalants and food, and almost all carry out PBPs with fresh foods (25/26 equal to 96.2%), specific IgE with extracts (24/26 equal to 92.3% in 2023, compared to 14/22 equal to 60.9% in 2019), and spirometry (22/26 equal to 84.6% in 2023, compared to 21/23 equal to 91.3% in 2019).

The possibility of dosing molecular-specific IgE (CRD) is increasing (20/26 equal to 76.9% in 2023, compared to 12/22 equal to 52.2% in 2019), OPT for food (20/26 equal to 76.9% in 2023, compared to 14/22 equal to 60.9% in 2019), for drugs (13/26 equal to 50%





in 2023, compared to 9/23 equal to 39.1% in 2019), and the use of skin tests for Hymenoptera (4/26 equal to 15.4% in 2023, compared to 1/23 equal to 4.3% in 2019).

As far as food and professional patch tests are concerned, oscillometry, nasal cytology, FeNo dosage, brushing, and vaccinations in a protected environment are carried out in no more than 5/26 (19%) of the facilities analyzed, thus remaining niche diagnostic tests; on the other hand, the use of spirometry during exercise test is better (9/29 equal to 34.6% in 2023), while plethysmography in 2023 is practically unused compared to 2019 when it was practiced in only two facilities (Fig. 3).

Informed consent: It is currently used for practices considered riskier such as OPTs for food and drugs (respectively in 20/26 equal to 76.9% and in 13/26 equal to 50%) and for oral desensitizations for food (12/26 equal to 46.2%); only in isolated cases is it needed for the execution of SPT for inhalants and foods, PBP with fresh food, professional patch tests, nasal cytology, and basal and under stress spirometry.

On the type of consent used, the data are in line with those of 2019: generally, a corporate format is used (14/26 equal to 53.8% in 2023, compared to 13/22 equal to 56.5% in 2019) or that drawn up by SIAIP (7/26 equal to 26.9% in 2023, compared to 6/22 equal to 26.1% in 2019). In the remaining facilities, alternative models are used, or no models are used at all for any procedures.

- Immunotherapy: Currently, all facilities prescribe immunotherapy, as is suggested by the international SLIT guidelines for inhalants (26/26 equal to 100%), and was prescribed in almost all cases in 2019 (21/23 equal to 91.3%). There was a slight decrease in the use of SCIT for inhalants (6/26 equal to 26.1% in 2023 compared to 8/23 equal to 34.8% in 2019) as well as food immunotherapy (7/26 equal to 26.9% in 2023 compared to 8/23 equal to 34.8% in 2019). The use of SCIT for Hymenoptera is increasing (4/26 equal to 15.4% in 2023 compared to 2/23 equal to 8.7% in 2019).
- · Biologics: The current attitude on the use of biologics

(omalizumab, dupilumab) shows an increase in facilities that use them. In particular, the prescription of omalizumab for severe asthma (14/26 equal to 53.8% in 2023 compared to 11/23 equal to 47.8% in 2019) and for chronic urticaria (8/26 equal to 30.8% in 2023 compared to 6/23 equal to 26.1% in 2019) increased slightly and the prescription of dupilumab for severe atopic dermatitis increased sharply (11/26 equal to 42.3% in 2023 compared to 3/23 equal to 13% in 2019). On the other hand, there was a reduction in facilities that do not use them (10/26 or 38% in 2023 compared to 12/23 or 52% in 2019).

Positive aspects of the activities of allergy facilities: The representatives of the various structures identify the multi-weekly frequency of activities as a distinctive and attractive element for patients (12/26 equal to 46.2%), as well as the division into hyper-specialized clinics and the possibility of managing a wide range of various pathologies (6/26 equal to 23.1%). This is followed by the possibility of doing research, which is present above all in 2nd and 3rd level structures (5/26 equal to 19.2%).

Aspects of the activities that need to be improved: We investigated the presence of pre-established pathways for complex patients and the possibility of collaborations between facilities at different levels for patients with challenging problems. The data collected showed that:

- "Transition" programs ⁵⁻⁷ from the pediatric outpatient clinic to adult facilities, which should ensure continuity of care, do not exist in most of the centers (21/26 equal to 80.8% in 2023 compared to 20/23 equal to 87% in 2019) and remain present in only a few facilities, although with a slight improvement compared to the previous survey (5/26 equal to 19.2% in 2023 compared to 3/23 equal to 13% in 2019). Joint efforts with adult allergists are therefore necessary to ensure correct and shared pathways for adolescent patients.
- Collaboration paths with higher-level structures for the management of complex pathologies exist in more than half of the structures (17/26 equal to 65.4%, of which 8/17 equal to 47%

are in Tuscany, 7/17 equal to 41% are in Marche, and 2/17 equal to 11% are in Umbria), and in almost a third of cases they do not exist (7/26 equal to 26.9%, of which 6/7 equal to 85% are in Umbria and 1/7 equal to 15% are in the Marche). Only very few structures are not aware of it (2/26 equal to 7.7%, of which 1/2 equal to 50% are in Tuscany and 1/2 equal to 50% are in Marche). From a practical point of view, the possibilities for implementing the collaboration paths are varied (telephone contact, e-mail, direct contact with the 2nd- 3rd level center, agreements with the reference structure), but not very standardized.

- The protocols shared on a intra and/or inter-regional level are not known by almost half of the structures (11/26 equal to 42.3%, of which 5/11 equal to 46% are in Tuscany, 3/11 equal to 27% are in both Marche and Umbria) in slightly higher percentages than those who know and use them (10/26 equal to 38.5%, of which 5/10 equal to 50% are in Marche, 3/10 equal to 30% are in Tuscany, and 2/10 equal to 20% are in Umbria). The main topics addressed in the various shared protocols, developed on the basis of the indications of the Italian Pediatric Allergy Immunology Society (SIAIP) and the European Society (European Academy Allergy Clinical Immunology, EAACI, and the Global Initiative for Asthma, GINA) are anaphylaxis, chronic urticaria, food allergy/ food desensitization, drug allergy, allergic rhino-conjunctivitis, and bronchial asthma.
- Telemedicine, for which there are also ministerial ⁸ and international guidelines in the field of allergy (⁹, has been widely used in various branches of medicine, which has not been particularly reflected in the pediatric allergology facilities of these three regions where it has been used in only a few centers (7/26 equal to 26.9%)

The implementation of the intra/interregional allergy network. The colleagues of the structures contacted suggest the need for an efficient pediatric allergy network, with periodic online and/or face-to-face meetings at both regional and interregional levels to evaluate together the novelties of the literature and the updates of the guidelines, share complex clinical cases, draw up shared intra- and inter-regional protocols, and identify with the higher-level centers a pre-established method for individual consultations (e.g., telephone contact or teleconsultation at fixed times).

In this context, the regional coordinators of the SIAIP could play a fundamental role of reference and scientific guidance for the referents of the various structures.

DISCUSSION AND CONCLUSIONS

From the analysis of the data collected with the current MUT 2023 interregional census, what emerges is that to the pediatric allergy hospital offer is currently good and constantly growing, despite the fact that the COVID pandemic has, in many cases, had a negative effect on hospital specialist services for both adults and pediatrics. Each region, despite the diversity of geographical extension and

structural characteristics, has at its disposal hospital facilities of

various levels that guarantee the user all the services necessary for the diagnosis and management of allergic diseases.

The smaller centers, despite the decrease in the number of 2nd-level centers in favor of those of the 1st level, carry out important screening work aimed at identifying the "true" allergic people in need of therapy and follow-up, avoiding the long waiting lists in higher-level centers. From this, it can be seen that "networking" is increasingly important to send the most complex patients with different comorbidities to 3rd-level centers.

Over the years, pediatricians in charge of allergology have developed more and more specialist skills, guaranteeing a better quality of service supported by increased diagnostic testing, a greater use of biologics, and the prescription of specific immunotherapy. This, together with a growing collaboration with other professional support figures, offers the patient a good quality of service, avoiding improper migrations in many cases.

Among the activities carried out, despite the increase in facilities that deal with food allergy and also given the greater demand from users, the use of desensitization for the therapy of food allergy decreased. This highlights that this therapy is currently used only in higher-level centers. Greater training and integration of the treatment pathway, even at level 1^{st} and 2^{nd} centers, is therefore necessary.

There are other aspects that need to be improved and supported, such as young-adult transition programs, the use of telemedicine, and the definition of collaboration paths between the various structures (networking activities both intra and extra-regional), with the drafting of protocols that are shared with family pediatricians for optimal hospital-territory integration.

This work, if extended to the other Italian regions, would allow us, for the first time, to carry out a global mapping of the pediatric allergy activities in Italy, with consequent benefits in terms of quality and appropriateness of services and correct use of resources.

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The authors declare no conflict of interest.

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Ethical consideration

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Author's contribution

EN: conceptualized the project. EP, PC, MG, EN: conceived the manuscript. EP, EN: wrote the first draft. All authors revised the manuscript and approved the final version.

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