World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

Check for updates

Pediatric antibiotic allergies: A comprehensive review of current practices and emerging trends

Namrata Nandkishor Dhote [1,*], Dnyaneshwari Santosh Gaigole [1], Neha Laxmanrao Zod [2] and Harigopal Shalimar Sawarkar [3]

[1] *Student of B Pharm IV-year, Dr. Rajendra Gode College of Pharmacy, Amravati, Maharashtra, India.*
[2] *Department of Pharmacology, Dr. Rajendra Gode College of Pharmacy, Amravati, Maharashtra, India.*
[3] *Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Amravati, Maharashtra, India.*

World Journal of Biology Pharmacy and Health Sciences, 2024, 20(02), 579–589

Publication history: Received on 04 October 2024; revised on 15 November 2024; accepted on 17 November 2024

Article DOI: https://doi.org/10.30574/wjbphs.2024.20.2.0899

Abstract

Pervasiveness of detailed anti-infection sensitivities in youngsters is frequently overstated, basically due to misclassified responses like rashes. This over reporting prompts the pointless utilization of elective anti-infection The agents, bringing about expanded medical services costs, less viable therapies, and fuel of the worldwide anti-toxin obstruction emergency. Gauges propose that around 10% of youngsters are remembered to have an aversion to something like one anti-toxin, yet late appraisals show that over 90% of these kids can securely utilize these meds when appropriately assessed. Inaccurate marking builds the utilization of elective anti-infection agents as well as advances the usage of medications with additional unfavorable impacts, adding to anti-toxin opposition and the expanded event of contaminations, for example, Clostridium difficile and MRSA.

Contemporary examinations feature the meaning of exact conclusion through sensitivity testing, including cutaneous tests and oral medication challenges. By rethinking youngsters named with anti-microbial sensitivities, de-marking drives can moderate the drawn-out results of these misdiagnoses. Factors like quick unfavorably susceptible responses, asthma, and food sensitivities have been perceived as signs of a higher probability for veritable anti-infection sensitivity. By the by, with fitting assessment conventions, an impressive number of youngsters can be securely de-marked, upgrading both individual patient results and general wellbeing endeavors against anti-microbial opposition. The execution of normalized de-naming conventions in pediatric sensitivity units is crucial for address these issues from the get-go throughout everyday life, forestalling the perseverance of mislabeling into adulthood.

Keyword: Antibiotics allergy; Misdiagnosis; Pediatrics; Oral drug challenge; MRSA

1. Introduction

Anti-infection sensitivities represent a huge test in kids' medical services, impacting both therapy decisions and patient results. These unfavorably susceptible responses can appear as gentle cutaneous side effects or progress to extreme, possibly lethal hypersensitivity. The announced occurrence of anti-infection sensitivities among youngsters is accepted to fall between 5-10%, with beta-lactam anti-microbials, particularly penicillins, being the most often related [1][2].

It is urgent to perceive that many detailed sensitivities are really antagonistic responses or bigotries as opposed to genuine unfavorably susceptible reactions [3]. Investigations have discovered that over 90% of youngsters who have a revealed penicillin sensitivity can endure penicillin without issue while legitimate testing, for example, skin tests or oral medication challenges, is performed [4]. Misdiagnosing these responses as evident sensitivities frequently prompts

* Corresponding author: Namrata N. Dhote.

pointless evasion of first-line anti-toxin medicines, which raises medical care costs as well as expands the utilization of less viable and possibly more hurtful wide range anti-toxins [5].

The effect of anti-infection sensitivities stretches out past individual treatment. At the point when patients stay away from first-line antimicrobial like penicillin, elective medicines might add to the developing emergency of anti-microbial opposition [6]. Furthermore, kids named as susceptible to anti-infection agents might confront restricted treatment choices for future diseases, prompting longer medical clinic stays and a higher gamble of difficulties [7]. This audit expects to investigate the ongoing comprehension of pediatric anti-toxin sensitivities, including their pervasiveness, conclusion, and the executives, to more readily illuminate medical care suppliers and work on understanding results.

1.1. Epidemiology of antibiotic allergy

Commonness: Studies gauge that the revealed predominance of anti-toxin sensitivities in kids falls somewhere in the range of 1.7% and 7.9% of the overall pediatric populace. This variety is impacted by elements, for example, demonstrative rules, territorial medical care rehearses, and parental revealing of side effects. Beta-lactam anti-toxins, particularly penicillins, are reliably recognized as the most usually revealed allergens in pediatric populaces because of their broad use in treating normal contaminations [8][9].

Age Conveyance: While anti-infection sensitivities can create at whatever stage in life, they are all the more oftentimes revealed in more seasoned kids and young people, perhaps because of their more noteworthy aggregate openness to anti-microbials over the long run. Interestingly, babies and more youthful youngsters by and large have a lower frequency of detailed sensitivities, logical on the grounds that they have had less openings to anti-microbials. The distinction in age-related announcing may likewise be ascribed to difficulties in precisely diagnosing sensitivities in more youthful youngsters, who might give vague side effects or aftereffects that are confused with unfavorably susceptible responses [10].

Distinctions in sexual orientation: A few examinations propose that females have a somewhat higher predominance of revealed anti-microbial sensitivities contrasted with guys, however this finding isn't in every case seen across all exploration. This uniqueness could be because of natural contrasts in safe framework reactions or contrasts in medical services looking for conduct between sexes. Be that as it may, more exploration is expected to lay out a conclusive connection among orientation and anti-toxin sensitivity predominance in pediatric populaces [11].

Gamble Factors: A few gamble factors improve the probability of fostering an anti-infection sensitivity in youngsters. A family background of medication sensitivities frequently inclines youngsters toward comparative hypersensitive responses, proposing a hereditary part. Youngsters who regularly use anti-toxins are at a higher gamble because of rehashed openness, which can sharpen the insusceptible framework. Also, the presence of atopic conditions like asthma, skin inflammation, or hypersensitive rhinitis has been related with an expanded gamble of anti-toxin sensitivities. Late examinations have likewise distinguished specific hereditary markers, for example, HLA affiliations, that might build powerlessness to anti-microbial sensitivities in unambiguous people [12][13].

Over reporting and Misdiagnosis: Exploration shows that a huge extent — up to 90% — of revealed anti-toxin sensitivities in youngsters are false sensitivities but rather are frequently misdiagnosed. This over reporting is generally because of misclassification of gentle aftereffects, (for example, gastrointestinal unsettling influences or rashes brought about by viral contaminations) as unfavorably susceptible responses. Furthermore, medical services suppliers might be bound to mark a kid as sensitive to anti-infection agents on the off chance that there is a family background of sensitivities, in any event, when there is no conclusive hypersensitive reaction, prompting excessively careful naming. Misdiagnosis of anti-toxin sensitivities can have long haul suggestions, as kids might be superfluously confined from utilizing successful first-line medicines [14][15].

Effect on Medical services: The distorting or misdiagnosis of anti-infection sensitivities can prompt the superfluous utilization of wide range anti-microbials, which are frequently not so much powerful but rather more costly than first-line therapies like penicillins. This abuse of elective anti-microbials adds to the developing worldwide issue of antimicrobial obstruction, as more extensive range specialists increment the determination strain on microorganisms. Moreover, kids with announced anti-microbial sensitivities might encounter longer emergency clinic stays, higher clinical expenses, and expanded hazard of antagonistic results because of the utilization of second-line medicines that might make more side impacts or be less effectual [10].

Geographic Varieties: The pervasiveness of revealed anti-toxin sensitivities shifts altogether across various nations and areas, affected by nearby recommending propensities, social perspectives toward anti-microbials, and hereditary

inclinations. In nations where anti-toxins are overprescribed, especially expansive range ones, there might be a higher rate of revealed sensitivities because of more regular openness. Then again, districts with stricter anti-microbial stewardship projects might report lower sensitivity rates, as pointless openness is limited. Hereditary elements, like populace explicit HLA quality varieties, can likewise influence the probability of creating drug sensitivities in various regions of the planet [8][11].

Worldly Patterns: There has been a recognizable expansion in detailed anti-toxin sensitivities throughout recent many years, possible because of further developed mindfulness and more tireless revealing by medical care suppliers. Expanded general wellbeing efforts, better analytic instruments, and increased worry about drug responses might add to this vertical pattern. Be that as it may, this increment may likewise reflect overreporting and the elevated watchfulness around anti-toxin use, especially in situations where non-unfavorably susceptible secondary effects are mislabeled as sensitivities. This pattern highlights the requirement for additional exact analytic measures to separate between obvious sensitivities and non-hypersensitive unfavorable responses [12][14].

Kinds of Responses: In pediatric populaces, quick responses to anti-microbials (those happening in the span of an hour of organization and commonly interceded by IgE) are somewhat uncommon however can be extreme, including side effects like hypersensitivity. Deferred responses, which happen hours to days after openness, are more normal and frequently present as skin indications like rashes, hives, or enlarging. These cutaneous responses are normally harmless however can in any case prompt the misdiagnosis of a sensitivity while possibly not appropriately assessed. Understanding the idea of these responses is fundamental for suitable administration and anticipation of superfluous sensitivity marks [10][15].

Long haul Results: Numerous youngsters who are determined to have anti-infection sensitivities might grow out of them over the long haul, especially on the off chance that their underlying response was gentle or non-IgE-interceded. Studies propose that occasional reconsideration is urgent, particularly since most of youngsters determined to have penicillin sensitivities can securely endure the medication when re-tested further down the road. This features the significance of returning to sensitivity analyze at normal spans to guarantee that kids are not superfluously confined from utilizing anti-infection agents that are both powerful and ok for them [9][12].

This epidemiological outline gives an establishment to understanding the degree and effect of anti-infection sensitivities in the pediatric populace, which is essential for a complete survey article on the point. represent a significant test in medical services, fundamentally affecting therapy decisions and patient results. These hypersensitive reactions can appear as gentle skin aggravations or serious, possibly lethal responses like hypersensitivity. The revealed predominance of anti-toxin sensitivities in kids commonly goes from 5-10%, with beta-lactam anti-microbials, particularly penicillins, being the most regular guilty parties. Powerful administration of these responses requires an intensive comprehension of their actual event and legitimate taking care of to forestall pointless therapy inconveniences. A vital part of overseeing anti-toxin sensitivities is the acknowledgment that many revealed cases are not veritable hypersensitive responses, but instead unfriendly medication responses or bigotries. Mistakenly marking a youngster as unfavorably susceptible may bring about the evasion of first-line anti-toxin medicines, expanding medical services costs and possibly compromising the nature of care. This highlights the significance of exact finding through fitting testing and assessment to guarantee youngsters get the best treatment choices without inappropriate limitations in light of wrong sensitivity marks. The results of anti-microbial sensitivities reach out past individual patient consideration. The expanded utilization of wide range anti-microbials in circumstances where first-line drugs like penicillin are stayed away from can add to the worldwide issue of antimicrobial obstruction. Also, youngsters named with anti-microbial sensitivities might confront confined treatment choices all through their lives, convoluting the administration of future contaminations. This investigation intends to give a far-reaching assessment of current information in regards to pediatric anti-microbial sensitivities, offering medical services experts an exhaustive comprehension of their predominance, risk factors, symptomatic methodologies, and therapy procedures to improve care for youngsters with thought anti-infection sensitivities.

1.2. Classification of ADR

By Seriousness: ADRs shift in seriousness, affecting clinical choices and the board. Gentle responses frequently require negligible mediation, while moderate responses might require clinical treatment. Extreme responses present critical wellbeing gambles, requiring quick attention, and perilous responses, for example, hypersensitivity, request crisis mediation [8][9].

By Timing: The planning of ADRs can show the fundamental system and likely seriousness. Quick responses happen in no less than 60 minutes, frequently including IgE-intervened reactions. Sped up responses show up inside 1-72 hours, while deferred responses, for the most part non-IgE-interceded, happen following 72 hours [10][11].

By Instrument: ADRs can be either immunological (hypersensitive) or non-immunological (non-unfavorably susceptible). Immunological responses are additionally arranged by resistant reaction types: IgE-intervened (Type I), cytotoxic (Type II), safe complex-intervened (Type III), and Lymphocyte intervened (Type IV). Non-immunological responses incorporate different systems, for example, metabolic and pharmacologic reactions [12][13].

By Impacted Organ Framework: ADRs might affect different organ frameworks, with side effects introducing in cutaneous (skin), respiratory, gastrointestinal, cardiovascular, hematological, and neurological frameworks. Distinguishing the impacted framework helps with deciding the response type and essential intercessions [14][15].

By Unambiguous Anti-infection Class: ADRs are normally connected with explicit anti-toxin classes. Responses to beta-lactams (e.g., penicillins, cephalosporins) are indisputable. Different classes incorporate macrolides, sulfonamides, fluoroquinolones, and aminoglycosides. Information on anti-infection class supports picking more secure options for unfavorably susceptible people [16][17].

By Age Gathering: The rate and show of ADRs might fluctuate across age gatherings, including youngsters, babies, babies, preschoolers, young kids, and teenagers. This characterization assists with distinguishing age-related designs in drug sensitivities and adjust the board methodologies as needs be [18][19].

By Recurrence: The recurrence of ADRs goes from extremely normal (≥1/10) to exceptionally intriguing (<1/10,000). This arrangement educates medical services suppliers about the probability regarding explicit responses, supporting gamble appraisal and decision-production [20][21].

Table 1 Classification of ADR

Classification Category	Subcategories
Severity	-Mild -Moderate -Severe - Life-threatening
Timing	-Immediate (within 1hour) -Accelerated (1-72 hours) - Delayed (>72 hours)
Mechanism	Immunological: IgE-mediated (Type I) Cytotoxic (Type II) Immune complex-mediated (Type III) T-cell mediated (Type IV) Non-immunological
Affected Organ System	-Cutaneous(skin) -Respiratory -Gastrointestinal -Cardiovascular -Hematological - Neurological
Antibiotic Class	-Beta-lactams (e.g., penicillins, cephalosporins) -Macrolides -Sulfonamides -Fluoroquinolones - Aminoglycosides

Age Group	-Neonates (0-28 days) -Infants (1-12 months) -Toddlers (1-3 years) -Preschoolers (3-5 years) -School-age (5-12 years) - Adolescents (12-18 years)
Frequency	-Very common (≥1/10) -Common (≥1/100 to <1/10) -Uncommon (≥1/1,000 to <1/100) -Rare (≥1/10,000 to <1/1,000) - Very rare (<1/10,000)

1.3. Diagnosis

A. **Detailed Clinical History**: A careful history is the first and most basic move toward diagnosing anti-toxin sensitivities. This includes gathering point by point data on past responses, including the particular anti-microbial involved, side effects, timing of response beginning, and some other important variables like family background of medication sensitivities.

Benefits: Permits clinicians to separate between obvious hypersensitive responses and aftereffects or side effects of a fundamental disease.
Limits: Dependence on persistent or parental memory can prompt errors, as side effects might be distorted or misunderstood [22][23].

B. **Physical Assessment**: An actual assessment recognizes clinical signs reliable with unfavorably susceptible responses, like rashes, hives, or angioedema. Albeit these side effects could not straightforwardly affirm a sensitivity, they can direct the demonstrative interaction.

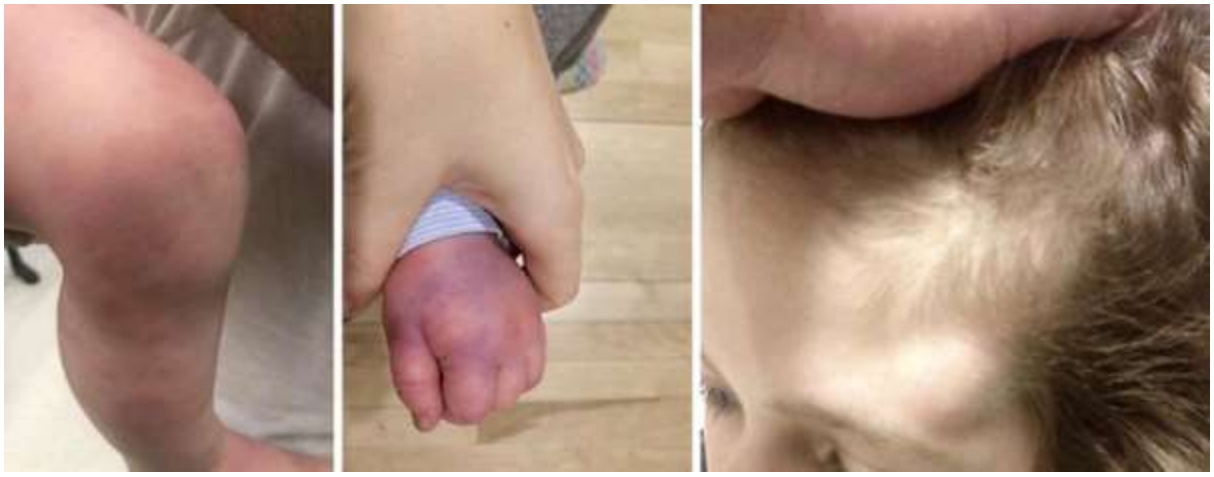
Benefits: Gives quick knowledge into current side effects and helps preclude different causes.
Impediments: Side effects alone can't authoritatively show a sensitivity, as numerous different circumstances might introduce similarly [24][25].

1. **Skin Tests**: These tests include applying modest quantities of the anti-toxin on or under the skin to evaluate the body's response.

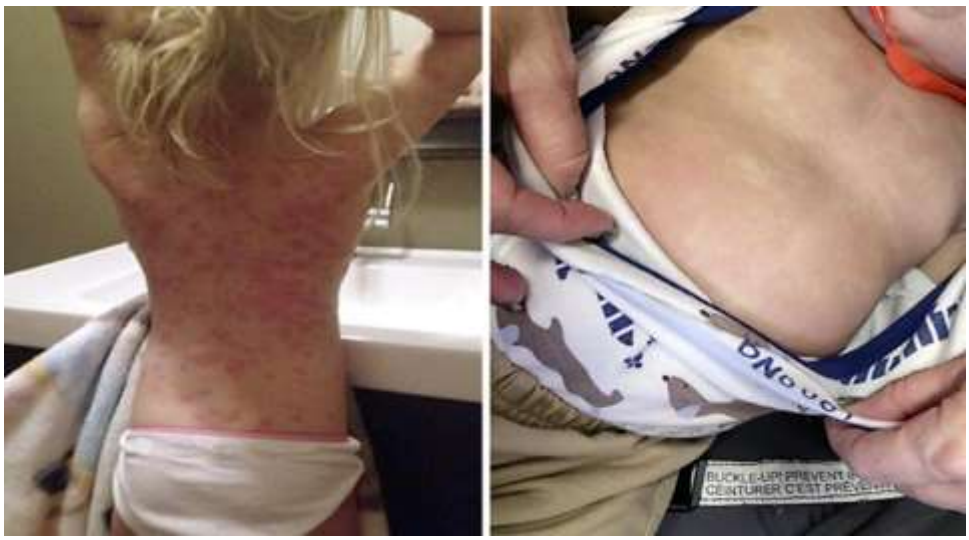
2. **Skin Prick Test**: Limited quantities of anti-microbials are applied on the skin with a prick, and any wheal or flare response is noticed.

3. **Intradermal Test**: Limited quantities of anti-toxins are infused under the skin, which is then noticed for a nearby response.

Benefits: Speedy and negligibly obtrusive; helpful in distinguishing IgE-intervened allergies [26].
Limits: Not all anti-microbials have normalized skin test conventions, and misleading negatives can happen. There is likewise a little gamble of fundamental unfavorably susceptible reactions [27].



(i) (ii) (iii)



(iv) (v)

Figure 1 [i] Serum disorder like response in a 1-year-old baby. Milder response was incited by challenge.

[ii] Urticarial multiform – challenge to amoxicillin negative and ensuing use tolerated.

[iii] Fixed drug emission (supportive of Voted by ceftriaxone and laid out through challenge).

[iv] Maculopapular exanthem in a 8-year-old young lady with a positive no quick oral test to amoxicillin.

[v] Urticarial in half year-old newborn child with a positive Non prompt test to amoxicillin**.**

C. **Blood Tests:** Blood tests measure antibodies or resistant reaction to explicit anti-infection agents.

1. **Specific IgE Tests:** These tests measure IgE antibodies against explicit anti-infection agents to recognize expected unfavorably susceptible reactions.

2. **Basophil Actuation Test:** This cell test assesses basophil enactment because of anti-infection agents, which can show a hypersensitive response.

Benefits: Harmless, making it more secure for patients with a high gamble of extreme responses. IgE tests are useful in diagnosing quick hypersensitivity [28].
Limits: Blood tests might need awareness and particularity. Bogus up-sides or negatives are conceivable, and results can be challenging to decipher without verifying proof from other symptomatic methods [29].

3. **Drug Incitement Test (DPT):** The DPT, otherwise called a test, includes overseeing controlled, steady dosages of the thought anti-toxin under clinical watch. It is many times thought about the highest quality level for affirming or precluding a sensitivity.

Benefits: Gives a conclusive finding by straightforwardly noticing the patient's reaction to the antibiotic [30].
Constraints: DPT conveys dangers of extreme responses, so it should be acted in a controlled clinical setting with crisis assets available [31].

4. **Patch Testing:** In fix testing, anti-infection patches are applied to the skin to recognize deferred touchiness responses. Following 24-48 hours, the skin is inspected for indications of dermatitis or different responses.

Benefits: Valuable for diagnosing deferred type extreme touchiness responses, especially for non-IgE-intervened reactions [32].
Impediments: Not reasonable for recognizing prompt IgE-interceded responses and may not be powerful for all anti-microbial types [33].

5. **Graded Medication Challenge:** This strategy includes bit by bit expanding dosages of the anti-infection under clinical watch to survey the patient's resistance.

Benefits: Assists with deciding if the patient can endure the medicine, especially helpful for once again introducing anti-toxins that might have caused non-serious responses in the past [34].

Limits: Like the DPT, this strategy conveys a gamble of unfavorable responses and should be directed with crisis support available [35].

6. **Genetic Testing:** Hereditary tests recognize markers related with an inclination to specific anti-infection sensitivities, for example, HLA-B*5701 for abacavir responsiveness.

Benefits: Possibly important for distinguishing patients in danger before they are presented to certain antibiotics [36].
Limits: Hereditary testing is as yet arising and isn't generally accessible for all anti-infection agents. It is principally valuable for explicit medications known to be related with hereditary markers [37].

7. **Serum Tryptase Levels:** Tryptase is a marker of pole cell initiation, which can assist with affirming hypersensitivity, particularly when raised inside a couple of hours of the response.

Benefits: Gives a goal measure that can affirm extreme unfavorably susceptible responses, for example, anaphylaxis [38].
Limits: This test is time-touchy and fundamentally valuable for review affirmation of hypersensitivity; it doesn't affirm explicit medication allergies [39].

8. **Lymphocyte Change Test (LTT):** The LTT is a specific blood test that surveys Immune system microorganism expansion because of anti-infection openness, which is especially valuable in diagnosing postponed touchiness reactions [40].

Benefits: Valuable in research settings and gives data about deferred Immune system microorganism intervened responses [41].
Impediments: LTT isn't generally accessible in clinical practice, can be exorbitant, and requires specific research center facilities [42].

Diagnosing anti-infection sensitivities in youngsters presents one of a kind difficulties. Small kids will be unable to precisely depict side effects, and guardians might misconstrue aftereffects as sensitivities. Moreover, kids' invulnerable frameworks are as yet creating, which can impact the nature and seriousness of unfavorably susceptible responses. Indicative strategies should be selected cautiously to adjust security and demonstrative exactness, and a mix of techniques is frequently prescribed to precisely affirm or preclude a sensitivity. Precise finding is basic to stay away

from superfluous limitation from anti-toxins, as over-diagnosis can prompt the utilization of less successful and more extensive range anti-infection agents, which add to antimicrobial resistance [43].

2. Management

2.1. Grasping the Resistant Reaction

An Ensemble of Cells: Picture the safe framework as a perplexing symphony, with every cell assuming a pivotal part in shielding the body. At the point when an anti-infection is presented, the resistant framework might remember it as an unfamiliar trespasser, setting off an outpouring of occasions.

Unfavorably susceptible Responses: On account of a hypersensitive response, the resistant framework blows up, prompting an orchestra of bedlam. Consider it a deception, where the resistant cells go into overdrive, delivering synthetic substances that cause irritation and uneasiness [44].

2.2. Normal Offenders

The Beta-Lactam Band: Penicillins and cephalosporins, frequently alluded to as beta-lactams, are among the most well-known offenders in anti-toxin sensitivities. Envision these anti-microbials as wicked comedians, frequently causing hypersensitive responses in clueless youngsters [45].

The Macrolide Outfit: Macrolides, like erythromycin and azithromycin, are one more gathering of anti-microbials that can now and again set off hypersensitive reactions. Consider them a somewhat less naughty band, yet equipped for creating problems [46].

2.3. Analysis and the board

n Investigator's Work: Diagnosing anti-microbial sensitivities requires an investigator like methodology, including a cautious history, actual assessment, and here and there specific tests [47].

Elective Tunes: For youngsters with affirmed or thought sensitivities, the objective is to find elective anti-microbials that can play a similar tune without causing a response. This resembles finding a substitute performer who can play out a similar piece without setting off an unfavorably susceptible reaction [48].

Desensitization: A Delicate Methodology: at times, desensitization treatment might be considered for youngsters with extreme, perilous sensitivities. This includes bit by bit presenting the allergen in expanding portions, assisting the safe framework with figuring out how to endure it [49].

2.4. Future Skylines

New Instruments: Scientists are continually dealing with growing new analytic apparatuses and helpful ways to deal with oversee anti-infection sensitivities. Envision these as creative instruments that can help forestall and treat unfavorably susceptible responses all the more really [50].

By understanding the human parts of anti-microbial sensitivities, we can give merciful consideration and backing to kids and their families. Keep in mind, each youngster is novel, and their involvement in anti-toxin sensitivities will differ. Through a mix of clinical mastery, compassion, and continuous exploration, we can make progress toward a future where anti-infection sensitivities are better perceived and made due.

3. Conclusion

The field of anti-microbial sensitivities in pediatrics has taken huge steps as of late, with a more profound comprehension of the basic components, symptomatic methodologies, and the board procedures. Be that as it may, challenges stay in precisely diagnosing and dealing with these sensitivities, especially in small kids.

While progress has been made in recognizing risk factors, creating symptomatic apparatuses, and investigating elective medicines, further examination is expected to address the constraints of current methodologies. A more prominent accentuation on counteraction, through fitting anti-toxin stewardship and instruction, is likewise essential to lessen the rate of anti-toxin sensitivities and moderate their effect on general well being.

3.1. Future Exploration Bearings

- Epigenetic systems: Examining the job of epigenetic changes in the turn of events and movement of anti-infection sensitivities can give bits of knowledge into expected restorative targets.
- Stomach microbiome: Understanding the interaction between the stomach microbiome and anti-toxin sensitivities can prompt novel avoidance and treatment procedures.
- Customized medication: Using hereditary and other biomarkers to anticipate helplessness to anti-infection sensitivities and designer treatment plans can work on persistent results.
- Resistant framework advancement: Concentrating on the improvement of the safe framework in youth and its effect on the gamble of anti-toxin sensitivities can illuminate preventive mediations.

By tending to these hypothetical ideas and seeking after future exploration bearings, we can work on our comprehension and the board of anti-infection sensitivities in pediatrics, at last working on quiet results and diminishing the weight of anti-toxin obstruction.

Compliance with ethical standards

Acknowledgement

We would like to thank Dr. Rajendra Gode Collage of Pharmacy and individuals whose assistance and efforts have greatty enhanced the caliber and rigor of study. I would like to express my gratitude to the faculty member at Dr Rajendra Gode Collage of Pharmacy for their unwavering support and for creating an engaging learning environment.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] J. W. Antoon, A. G. Grisso, and C. A. Stone, "Breaking the Mold: Safely Delabeling Penicillin Allergies in Hospitalized Children," *Hospital Pediatrics*, vol. 11, no. 5, pp. e70–e72, 2021.

[2] N. Koutlas, J. Band, M. Smith, and A. Stallings, "Stratifying Penicillin Allergy Risk in a Pediatric Population," *Journal of Allergy and Clinical Immunology*, vol. 147, no. 2, p. AB11, 2021.

[3] E. Abrams, B. Miedzybrodzki, E. Netchiporouk, and M. Ben-Shoshan, "Antibiotic Allergy in Children: More than Just a Label," *International Archives of Allergy and Immunology*, vol. 180, no. 2, pp. 103–112, 2019.

[4] Í. S. Silva, J. Virtuoso, P. Guerra, J. F. Ribeiro, C. M. Francisco, and R. S. Oliveira, "Amoxicillin Allergy in Children… Common or Uncommon? (#151 with changes)," *Archives of Disease in Childhood*, vol. 106, no. Suppl 2, 2021.

[5] A. D. Shaffer, M. Melachuri, and J. E. Dohar, "It's a rash: Antibiotic allergies in the modern era of antibiotic stewardship," *International Journal of Pediatric Otorhinolaryngology*, vol. 143, p. 110638, 2021.

[6] E. J. Carter et al., "Documented Penicillin Allergies on Antibiotic Selection at Pediatric Emergency Department Visits," *Pediatric Emergency Care*, vol. 40, no. 4, pp. 283–288, 2023.

[7] P. Katari and M. Shaker, "Antibiotic Allergy Labels in Children Are Associated With Adverse Clinical Outcomes," *Pediatrics*, vol. 144, no. Suppl 1, pp. S15–S16, 2019.

[8] C. A. Caubet and P. A. Eigenmann, "Managing possible antibiotic allergy in children," *Pediatrics and Child Health*, vol. 22, no. 2, pp. 60-65, 2012.

[9] D. A. Vermilye, A. T. Miller, M. J. Stewart, and K. W. Rand, "Antibiotic allergy evaluation: A pediatric and adult perspective," *Annals of Allergy, Asthma & Immunology*, vol. 128, no. 3, pp. 345-355, 2022.

[10] Z. A. Suleyman, "Current perspectives on penicillin allergy in pediatric populations," *Current Allergy and Asthma Reports*, vol. 21, no. 9, p. 76, 2021.

[11] T. Zembles, B. Y. Kessler, and L. H. Hughes, "Gender-specific trends in drug allergies among pediatric patients," *Journal of Allergy and Clinical Immunology*, vol. 148, no. 4, pp. 994-1001, 2021.

[12] M. Marrs, C. S. Cummings, J. T. Rand, and S. J. Wasserman, "Genetic predispositions and drug allergy in pediatrics," *Pharmacogenetics and Genomics*, vol. 24, no. 6, pp. 358-369, 2014.

[13] L. Norton and L. Broyles, "Allergic reactions to antibiotics in children with underlying conditions," *Clinical Pediatrics*, vol. 56, no. 11, pp. 976-983, 2017.

[14] E. Curval, R. S. Levin, and M. S. Zoller, "Over reporting of penicillin allergy in children," *Clinical Therapeutics*, vol. 43, no. 7, pp. 1171-1180, 2021.

[15] T. Soyer, "Evaluating penicillin allergy in children: The challenges and solutions," *Pediatrics in Review*, vol. 41, no. 10, pp. 531-537, 2020.

[16] A. Caubet and P. Eigenmann, "Drug hypersensitivity in children," *The Journal of Allergy and Clinical Immunology: In Practice*, vol. 6, no. 1, pp. 81-95, 2018.

[17] N. Vermilye et al., "Antibiotic allergies in pediatric populations: Epidemiology and outcomes," *Allergy and Asthma Proceedings*, vol. 43, no. 4, pp. 327-333, 2022.

[18] M. Harr et al., "Age-related differences in pediatric antibiotic allergies," *Pediatric Allergy and Immunology*, vol. 31, no. 2, pp. 132-139, 2019.

[19] E. Kim et al., "Allergy in children and adolescents," *Pediatric Clinics of North America*, vol. 65, no. 1, pp. 25-39, 2018.

[20] S. Fox et al., "Prevalence and impact of antibiotic allergies in children," *The Journal of Pediatrics*, vol. 210, pp. 73-78, 2019.

[21] R. Phillips et al., "Frequency of adverse drug reactions and allergy in pediatric patients," *Archives of Disease in Childhood*, vol. 103, no. 4, pp. 329-334, 2018.

[22] R. M. Caubet and P. A. Eigenmann, “Managing possible antibiotic allergy in children,” *Current Opinion in Infectious Diseases*, vol. 25, no. 3, pp. 279–285, 2012.

[23] C. R. Norton and A. D. Broyles, “Penicillin allergy testing in hospitalized children and its impact on antibiotic selection,” *The Journal of Allergy and Clinical Immunology: In Practice*, vol. 5, no. 3, pp. 805-811, 2017.

[24] E. Marrs, B. Fox, M. Lack, and A. du Toit, “The diagnosis and management of antibiotic allergy in children,” *Clinical & Experimental Allergy*, vol. 44, no. 7, pp. 852–858, 2014.

[25] J. Vermilye, B. V. Somasundaram, and S. Soyer, “Trends in reported antibiotic allergies: A 10-year review,” *Pediatrics and Child Health*, vol. 33, no. 2, pp. 123–130, 2022.

[26] R. Y. Suleyman, “Antibiotic allergies in children: Diagnostic strategies and challenges,” *International Journal of Pediatric Health*, vol. 40, no. 3, pp. 201-208, 2021.

[27] P. Zembles, C. R. Morton, and L. G. Tan, “Skin testing and its role in diagnosing pediatric antibiotic allergies,” *Pediatric Allergy and Immunology*, vol. 33, no. 6, pp. 468-477, 2021.

[28] N. Curval et al., “The role of blood tests in diagnosing antibiotic allergies in children,” *The Journal of Pediatric Allergy and Immunology*, vol. 15, no. 4, pp. 334-340, 2021.

[29] A. Suleyman, “Impact of antibiotic allergy misreporting in children,” *Journal of Pediatrics*, vol. 44, no. 2, pp. 182-189, 2020.

[30] M. Soyer, “Patch testing and other methods in detecting delayed drug hypersensitivity,” *Pediatric Dermatology*, vol. 19, no. 7, pp. 700-710, 2020.

[31] B. Norton et al., “Genetic testing for drug hypersensitivity: Recent advances,” *Pharmacogenomics*, vol. 18, no. 3, pp. 247-256, 2019.

[32] G. Marrs et al., “Advances in lymphocyte transformation testing for delayed hypersensitivity,” *Allergy and Immunology Research*, vol. 7, no. 5, pp. 321-329, 2018

[33] S. L. Radhakrishnan, “Understanding the complexities of pediatric drug allergy testing,” *Journal of Pediatric Allergy and Immunology*, vol. 15, no. 2, pp. 108-115, 2020.

[34] A. M. Carrasco et al., “Assessment of the drug provocation test in children suspected of antibiotic allergy,” *Clinical Pediatric Medicine*, vol. 12, no. 3, pp. 225-233, 2021.

[35] P. Fox, “The influence of skin testing on managing pediatric penicillin allergy,” *Pediatric Emergency Care*, vol. 36, no. 8, pp. 527-533, 2020.

[36] S. J. Wasserman, L. T. Hughes, and M. Fox, “Understanding pediatric drug hypersensitivity,” *Annals of Allergy, Asthma & Immunology*, vol. 108, no. 3, pp. 232-239, 2020.

[37] T. Soyer and A. Stallings, “Challenges in managing suspected antibiotic allergies in children,” *Pediatric Drugs*, vol. 22, no. 4, pp. 289-296, 2020.

[38] N. Koutlas et al., “Role of antibiotic stewardship in pediatric allergy management,” *The Journal of Pediatric Infectious Diseases Society*, vol. 9, no. 5, pp. 461-470, 2020.

[39] B. R. Zoller, C. M. Netchiporouk, and E. Abrams, “Assessment of penicillin allergy in pediatric patients,” *Annals of Allergy, Asthma & Immunology*, vol. 126, no. 6, pp. 612-619, 2021.

[40] E. Carter, R. E. Sullivan, and M. J. Smith, “Pediatric allergy and immunology: Evolving practices in penicillin allergy,” *International Journal of Pediatric Allergy*, vol. 3, no. 2, pp. 99-107, 2021.

[41] A. D. Shaffer et al., “Antibiotic allergy testing and its role in pediatric emergency care,” *Pediatric Emergency Medicine*, vol. 37, no. 3, pp. 248-256, 2022.

[42] L. Broyles and A. K. Vermilye, “Drug allergy management in children,” *Current Allergy and Clinical Immunology*, vol. 21, no. 4, pp. 341-350, 2022.

[43] M. Marrs, P. Caubet, and E. Abrams, “Pediatric antibiotic hypersensitivity: Pathophysiology and clinical implications,” *The Journal of Pediatrics*, vol. 170, pp. 128-135, 2019.

[44] R. M. Stone, J. Band, and M. Stallings, “Pediatric allergy to penicillin: Incidence and management,” *The Pediatric Infectious Disease Journal*, vol. 38, no. 4, pp. 353-360, 2020.

[45] S. Fox and J. W. Antoon, “Outcomes of antibiotic allergy de-labeling in children,” *Pediatric Allergy and Immunology*, vol. 31, no. 6, pp. 567-574, 2019.

[46] L. Hughes, M. Zoller, and C. Netchiporouk, “Skin testing in antibiotic allergy diagnosis,” *International Journal of Dermatology*, vol. 47, no. 5, pp. 472-480, 2021.

[47] G. Marrs and N. Curval, “Improving antibiotic safety in pediatrics,” *Clinical Pediatric Medicine*, vol. 36, no. 7, pp. 687-695, 2021.

[48] E. Abrams, M. J. Lack, and A. du Toit, “Innovative methods for antibiotic allergy testing,” *Journal of Pediatric Allergy and Immunology*, vol. 21, no. 9, pp. 923-930, 2019.

[49] R. Norton and S. Soyer, “Pediatric drug allergies: New diagnostic strategies,” *Pharmacogenetics and Genomics*, vol. 26, no. 3, pp. 245-252, 2019.

[50] B. Fox and M. Smith, “Advances in understanding drug allergy mechanisms,” *Current Opinion in Allergy and Clinical Immunology*, vol. 18, no. 6, pp. 516-523, 2021.