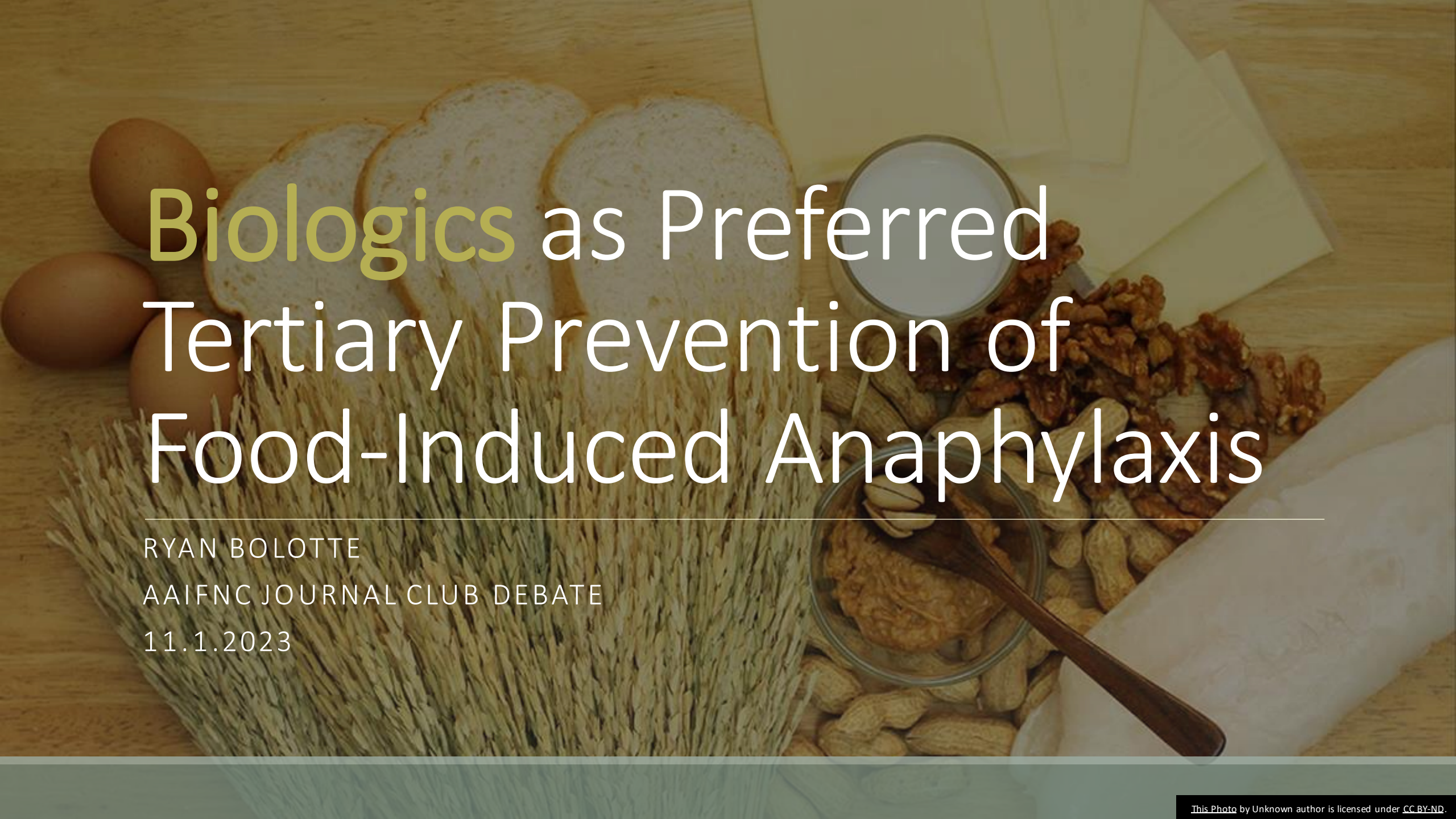


Biologics as Preferred Tertiary Prevention of Food-Induced Anaphylaxis

RYAN BOLOTTE

AAIFNC JOURNAL CLUB DEBATE

11.1.2023

This Photo by Unknown author is licensed under CC BY-ND.

Overview

I. Food Allergy Burden
II. Tertiary Prevention
III. Options for Tertiary Prevention
IV. Biologic Therapies vs Oral Immunotherapy

Reflection

For patients with confirmed IgE-mediated food allergy, which treatment option(s) do you offer?

How does your practice change with respect to certain patient-specific factors?

- Adolescents and adults
- Barriers to clinic visits (transportation, time off school/work, etc.)
- Patients/families who frequently move or plan to move
- Other chronic atopic conditions

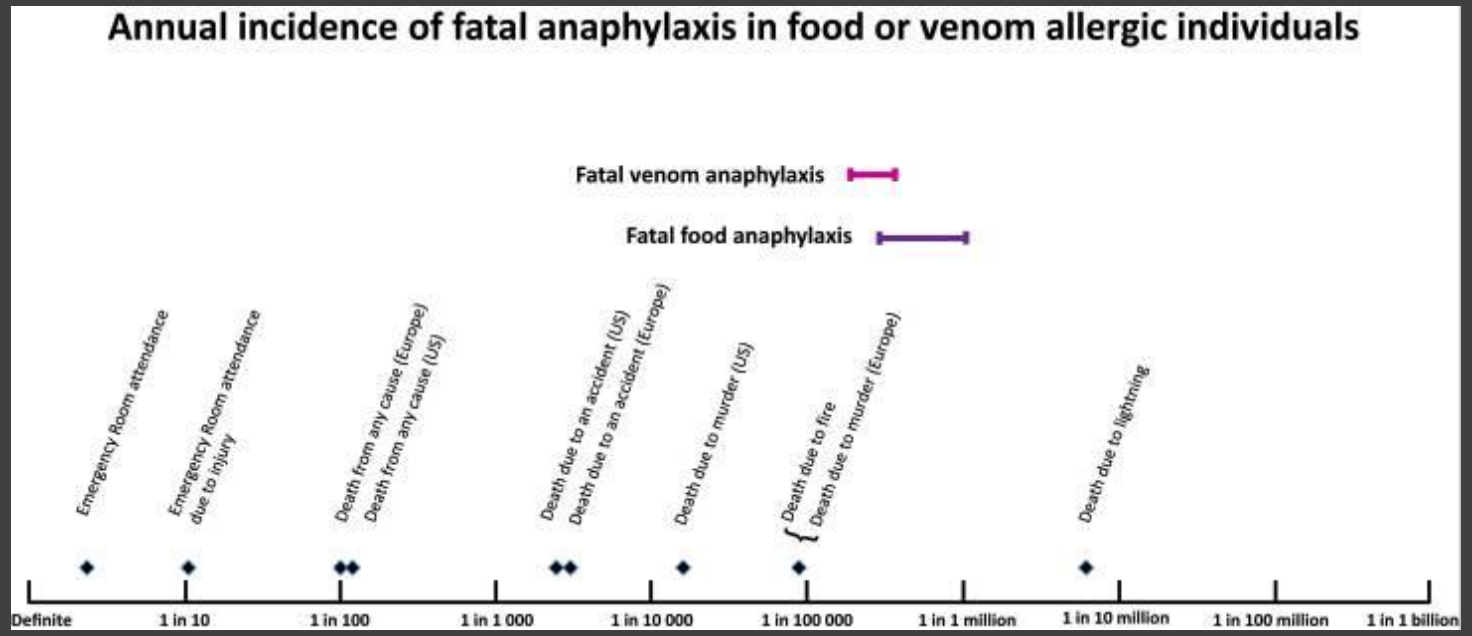
Food Allergy Burden


THE FOOD ALLERGY EPIDEMIC
33 million
Americans have food allergies
1 in 10
adults
1 in 13
children
51%
More than half of adults with food allergies have experienced a severe reaction.
42%
More than 40 percent of children with food allergies have experienced a severe reaction.
377%
Claim lines with diagnoses of anaphylactic food reactions increased 377 percent between 2007 and 2016.

Food Allergy Statistics

Each year in the U.S., 200,000 people require emergency medical care for allergic reactions to food

Every three minutes, a food allergy (FA) reaction sends someone to the emergency room



"Fatal Anaphylaxis: Mortality Rate and Risk Factors" (Turner, et al.)

Turner PJ, Jerschow E, Umasunthar T, Lin R, Campbell DE, Boyle RJ. Fatal Anaphylaxis: Mortality Rate and Risk Factors. J Allergy Clin Immunol Pract. 2017 Sep-Oct;5(5):1169-1178. doi: 10.1016/j.jaip.2017.06.031.

Psychological Burden

The psychosocial impact of food allergy and food hypersensitivity in children, adolescents and their families: a review (Cummings, et al.)

- Constant vigilance needed to avoid allergens
- Impacts on daily family activities and social events
- Detrimental effect on emotional QoL, physical functioning, and quality of school life

Quality of life (QoL) in food allergic children: Results from 174 quality-of-life patient questionnaires (Miller, et al.)

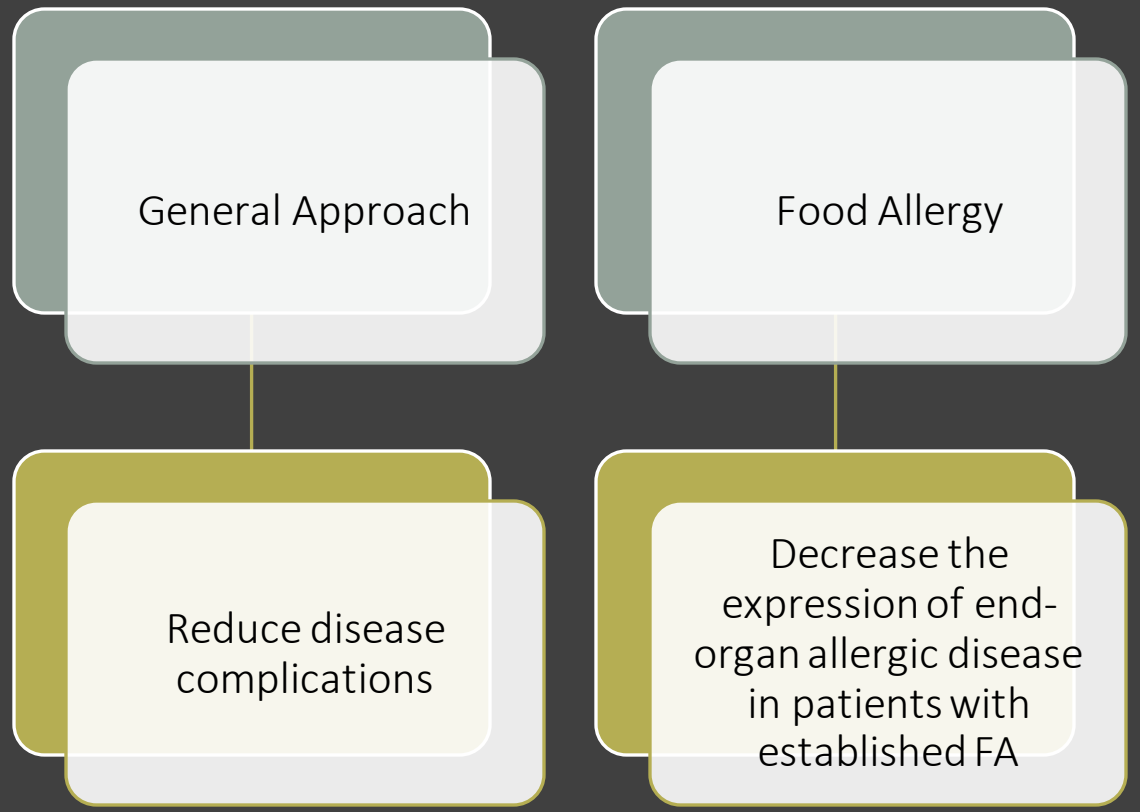
- Lower QoL in adolescents compared with children
- Limitations in family activities

Cummings AJ, Knibb RC, King RM, Lucas JS. The psychosocial impact of food allergy and food hypersensitivity in children, adolescents and their families: a review. Allergy. 2010 Aug;65(8):933-45. doi: 10.1111/j.1398-9995.2010.02342.x.

Miller J, Blackman AC, Wang HT, Anvari S, Joseph M, Davis CM, Staggers KA, Anagnostou A. Quality of life in food allergic children: Results from 174 quality-of-life patient questionnaires. Ann Allergy Asthma Immunol. 2020 Apr;124(4):379-384. doi: 10.1016/j.anai.2019.12.021.

Tertiary Prevention

Tertiary Prevention



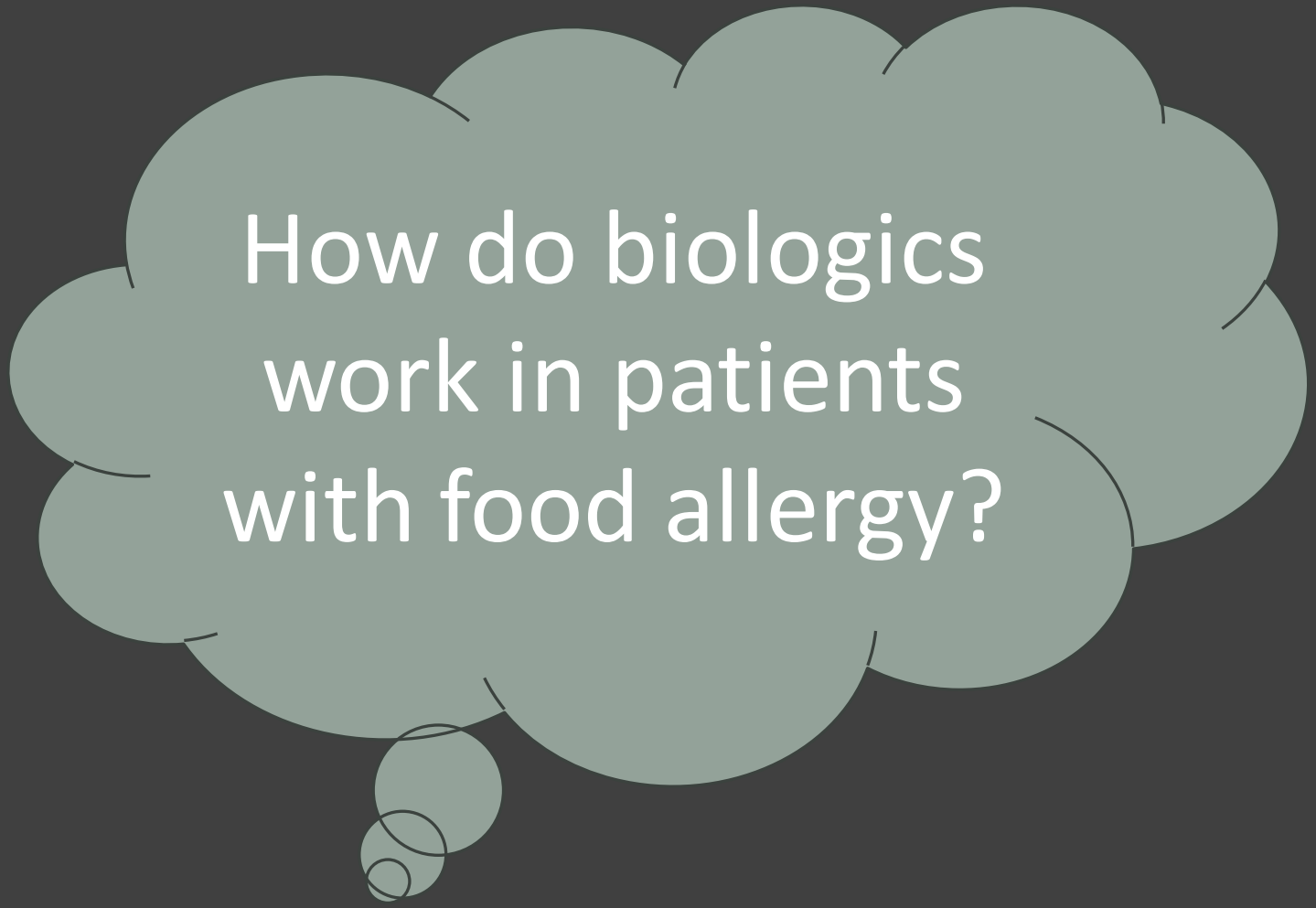
Du Toit, George, et al. "Prevention of Food Allergy." *Journal of Allergy and Clinical Immunology* 137, no. 4 (April 2016): 998–1010. https://doi.org/10.1016/j.jaci.2016.02.005.

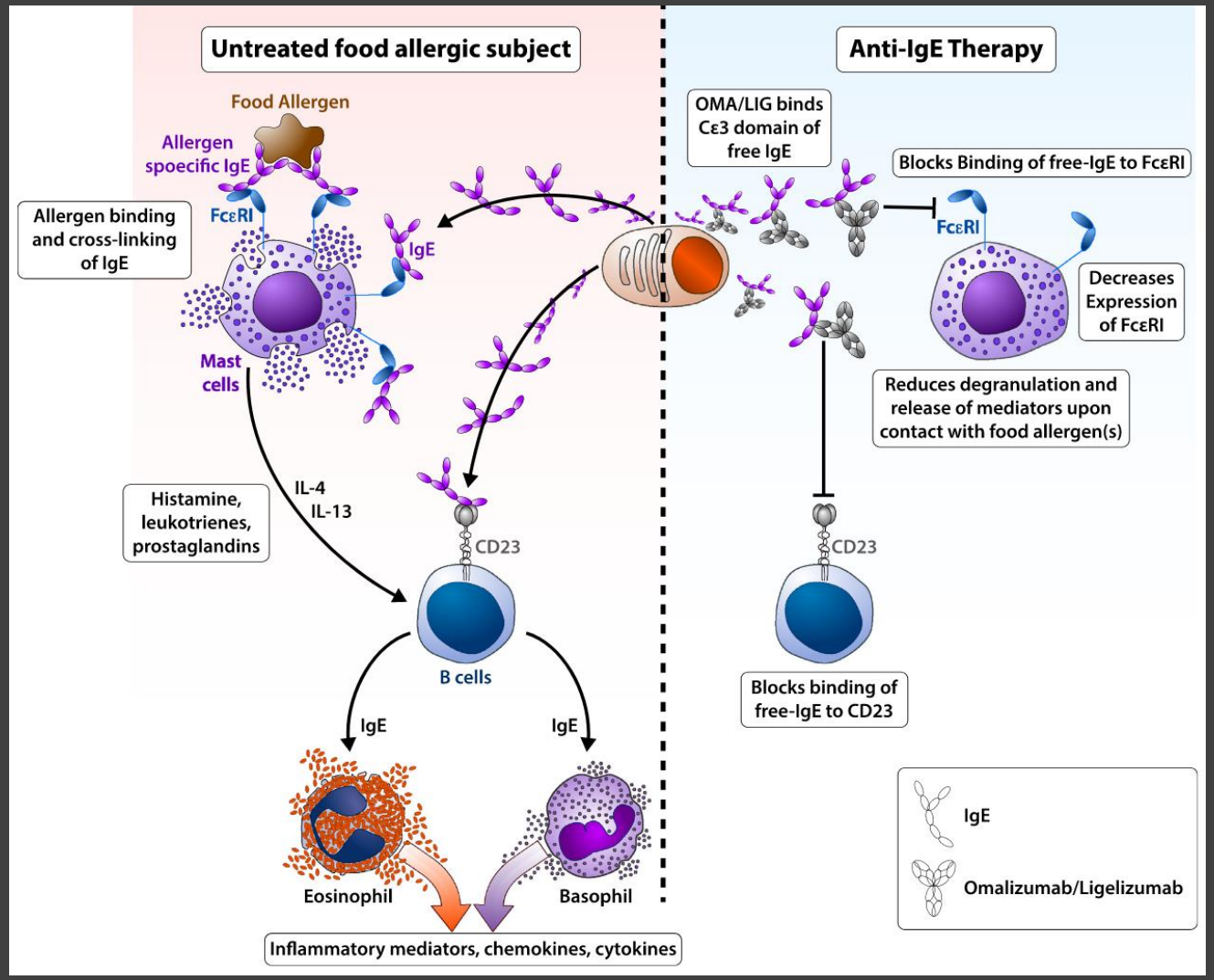
Biologics are the Preferred Tertiary Prevention Option

- Not age or food-specific
- Low hassle
- Improves quality of life
- Treats comorbidities
- Safe

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

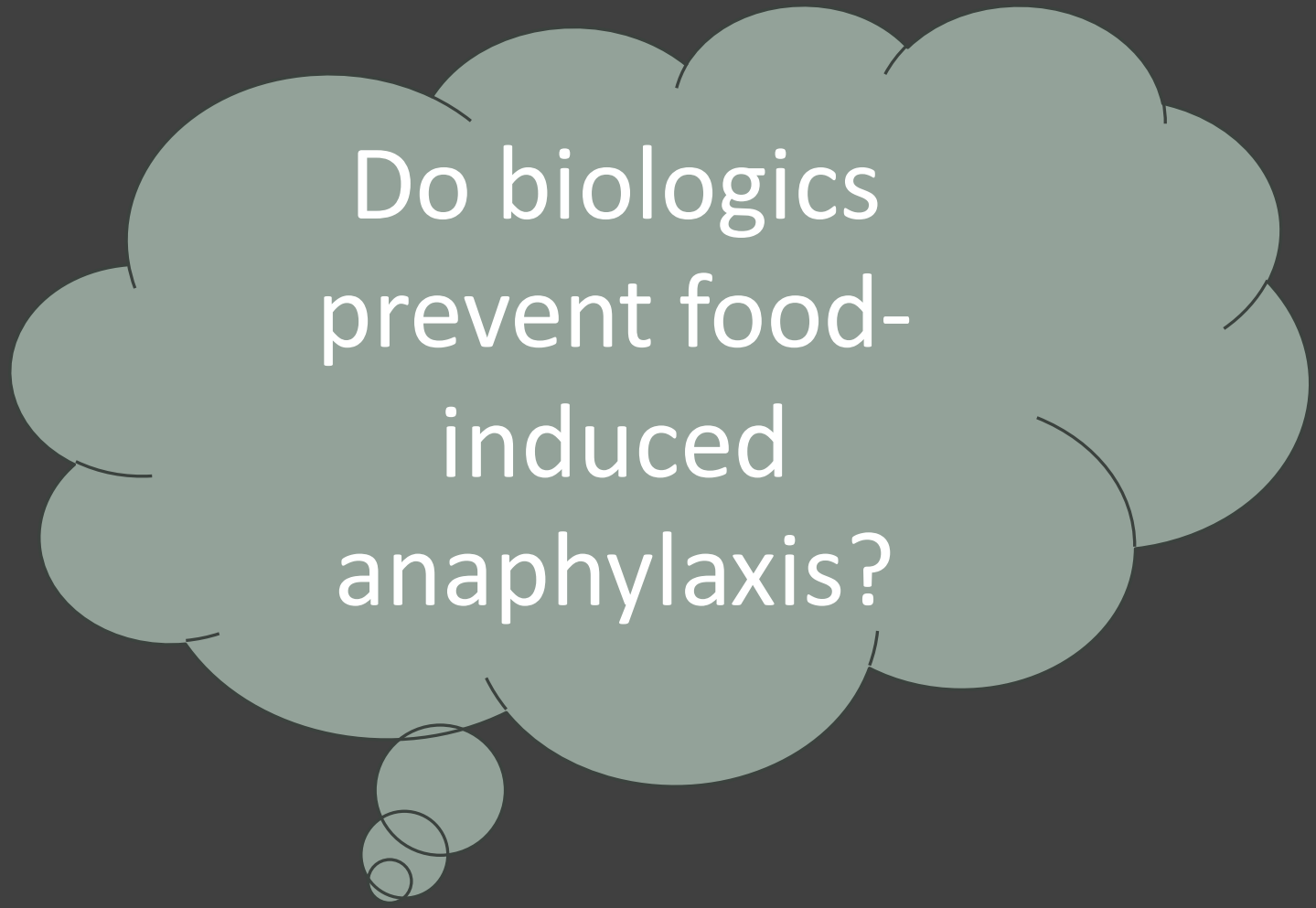
De Silva, Debra, Pablo Rodríguez Del Río, Nicolette W. De Jong, Ekaterina Khaleva, Chris Singh, Anna Nowak-Wegrzyn, Antonella Muraro, et al. "Allergen Immunotherapy and/or Biologicals for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 77, no. 6 (June 2022): 1852–62. https://doi.org/10.1111/all.15211.


How do biologics work in patients with food allergy?



"Anti-Immunoglobulin E for Food Allergy" (Dantzer & Wood)

Dantzer, Jennifer A., and Robert A. Wood. "Anti–Immunoglobulin E for Food Allergy." *Annals of Allergy, Asthma & Immunology* 131, no. 1 (July 2023): 11–22. https://doi.org/10.1016/j.anai.2023.03.030.


Do biologics prevent food-induced anaphylaxis?

"Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis" (Zuberbier)

Significantly reduced the risk of food-induced allergic reactions and anaphylaxis in patients with multiple FA after 1 year on omalizumab

Significantly reduced allergic reactions in patients with peanut allergy after 18 weeks on omalizumab

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

"Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis" (Zuberbier)

Meta-analysis of 4 studies (n = 210) showed that omalizumab significantly increased the tolerated dose of multiple foods versus pre-omalizumab over a period of 17-22 weeks

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

Other Biologic Therapies

LIGELIZUMAB: ANTI-IGE

Ongoing phase 3 clinical trial as monotherapy for patients with peanut allergy

DUPILUMAB: ANTI-IL-4RA

Studies in patients with atopic dermatitis and food allergy have shown:

- Decrease in serum IgE levels of food allergens
- Decrease in severity of allergic reactions due to accidental food ingestion

Berin, M. Cecilia. "Targeting Type 2 Immunity and the Future of Food Allergy Treatment." *Journal of Experimental Medicine* 220, no. 4 (April 3, 2023): e20221104. https://doi.org/10.1084/jem.20221104.
Spekhorst, Lotte S., Lisa P. Van Der Rijst, Marlies De Graaf, Maxime Van Megen, Nicolaas P. A. Zuithoff, André C. Knulst, Marjolein S. De Bruin-Weller, and Thuy-My Le. "Dupilumab Has a Profound Effect on specific-IgE Levels of Several Food Allergens in Atopic Dermatitis Patients." *Allergy* 78, no. 3 (March 2023): 875–78. https://doi.org/10.1111/all.15591.
Rial MJ, Barroso B, Sastre J. Dupilumab for treatment of food allergy. J Allergy Clin Immunol Pract. 2019 Feb;7(2):673-674. doi: 10.1016/j.jaip.2018.07.027.

Biologic Therapies vs Oral Immunotherapy

Biologics are the Preferred Tertiary Prevention Option

	Biologics	Oral Immunotherapy
Eligibility	Not food-specific Better efficacy in adolescents and adults	Food-specific Less efficacy in adolescents and adults
Logistics	Less frequent dosing Less dosing changes	More frequent dosing Requires buildup phase
Quality of Life	Improved	Mixed results
Additional Benefits	Treatment of comorbidities	Does not treat comorbidities
Safety	Less adverse events	More adverse events

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

De Silva, Debra, Pablo Rodríguez Del Río, Nicolette W. De Jong, Ekaterina Khaleva, Chris Singh, Anna Nowak-Wegrzyn, Antonella Muraro, et al. "Allergen Immunotherapy and/or Biologicals for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 77, no. 6 (June 2022): 1852–62. https://doi.org/10.1111/all.15211.

Fiocchi, Alessandro, Maria Cristina Artesani, Vincenzo Fierro, Carla Riccardi, Lamia Dahdah, and Maurizio Mennini. "Oral Immunotherapy for Peanut Allergy: The Con Argument." *World Allergy Organization Journal* 13, no. 8 (August 2020): 100445. https://doi.org/10.1016/j.waojou.2020.100445.

Biologics are not specific to age

BIOLOGIC THERAPIES

Anti-IgE Therapy for Peanut Allergy

- Leung (TNX-901, talizumab): 84 patients (age 12-64 years) with peanut allergy; increased mean dose of peanut eliciting symptoms in a dose-responsive manner
- Savage (omalizumab): 14 adult patients with peanut allergy; increased median dose of peanut required to induce allergic symptoms
- Brandstrom (omalizumab): 23 adolescents (age 12-19 years) with peanut allergy; patients completed an open peanut challenge to a maximum of 2800 mg peanut protein with no (18/23) or mild (5/23) symptoms

ORAL IMMUNOTHERAPY

AR101 Oral Immunotherapy for Peanut Allergy (PALISADE)

- Efficacy was not shown in the participants 18 years of age or older

Allergen Immunotherapy for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis (Nurmatov, et al.)

- Substantial average risk reduction only for children but not for adults

Dantzer, Jennifer A., and Robert A. Wood. "Anti–Immunoglobulin E for Food Allergy." *Annals of Allergy, Asthma & Immunology* 131, no. 1 (July 2023): 11–22. https://doi.org/10.1016/j.anai.2023.03.030.
The PALISADE Group of Clinical Investigators. "AR101 Oral Immunotherapy for Peanut Allergy." *New England Journal of Medicine* 379, no. 21 (November 22, 2018): 1991–2001. https://doi.org/10.1056/NEJMoa1812856.
Nurmatov, U., S. Dhami, S. Arasi, G. B. Pajno, M. Fernandez-Rivas, A. Muraro, G. Roberts, et al. "Allergen Immunotherapy for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 72, no. 8 (August 2017): 1133–47. https://doi.org/10.1111/all.13124.

Biologics are not specific to foods

BIOLOGIC THERAPIES

Effects of omalizumab in patients with food allergy (Rafi, et al.)

- Fish, shellfish, peanut, tree nuts, egg, soybean, and wheat
- Decrease/lack of clinical symptoms on re-exposure to sensitized foods

Impact of Omalizumab on Food Allergy in Patients Treated for Asthma: A Real-Life Study (Fiocchi, et al.)

- Increase in the allergen threshold for milk, egg, wheat, and hazelnut

ORAL IMMUNOTHERAPY

EAACI Guidelines on Allergen Immunotherapy: IgE-mediated Food Allergy (Pajno, et al.)

- Insufficient evidence for foods other than cow's milk, egg, and peanut

Palforzia is only FDA-approved food oral immunotherapy

Effect limited to food included in OIT dose

Rafi A, et al. Effects of omalizumab in patients with food allergy. Allergy Asthma Proc. 2010 Jan-Feb;31(1):76-83. doi:10.2500/aap.2010.31.3304.
Fiocchi, et al, Impact of Omalizumab on Food Allergy in Patients Treated for Asthma: A Real-Life Study, The Journal of Allergy and Clinical Immunology: In Practice, Volume 7, Issue 6, 2019, Pages 1901-1909.e5, ISSN 2213-2198, https://doi.org/10.1016/j.jaip.2019.01.023.
Pajno, G. B., M. Fernandez-Rivas, S. Arasi, G. Roberts, C. A. Akdis, M. Alvaro-Lozano, K. Beyer, et al. "EAACI Guidelines on Allergen Immunotherapy: IgE-mediated Food Allergy." *Allergy* 73, no. 4 (April 2018): 799–815. https://doi.org/10.1111/all.13319.

Biologics are less of a hassle than OIT

BIOLOGIC THERAPIES

- Training for preparation and administration
- Injections administered every 4 weeks (option for home administration)
- Clear dosing guidelines

ORAL IMMUNOTHERAPY

- Initial and up-dosing clinic visits every 2 weeks for ~9 months
- Daily dosing during up-dosing and maintenance phases
- Dose adjustments/pauses required for reactions, illnesses, etc.

Impact of Omalizumab on Food Allergy in Patients Treated for Asthma: A Real-Life Study (Fiocchi, et al.)

Omalizumab monotherapy for 17 weeks significantly **improved QoL** from **both the parents' and the patients'** perspective compared with pre-omalizumab

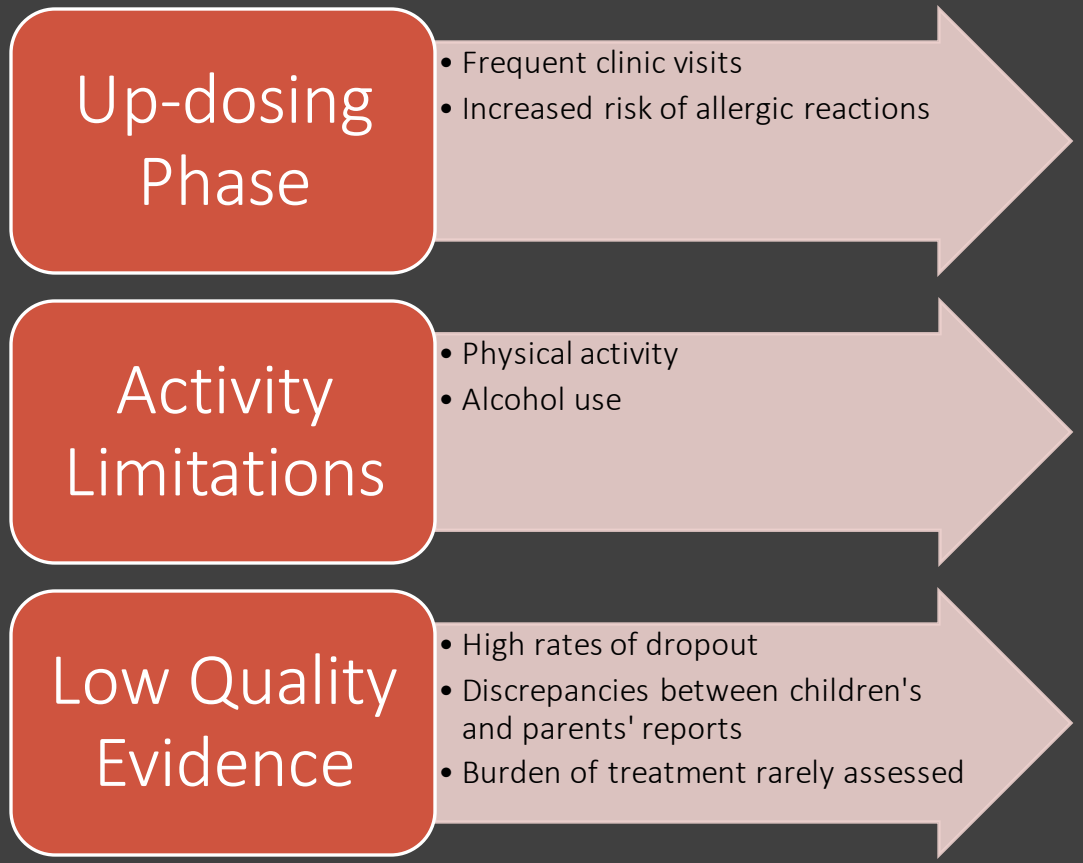
Fiocchi, et al, Impact of Omalizumab on Food Allergy in Patients Treated for Asthma: A Real-Life Study, The Journal of Allergy and Clinical Immunology: In Practice, Volume 7, Issue 6, 2019, Pages 1901-1909.e5, ISSN 2213-2198, https://doi.org/10.1016/j.jaip.2019.01.023.

Oral immunotherapy for peanut allergy (PACE): a systematic review and meta-analysis of efficacy and safety (Chu, et al.)

QUALITY OF LIFE WAS NOT DIFFERENT BETWEEN OIT VERSUS NON-OIT GROUPS

Chu DK, Wood RA, French S, Fiocchi A, Jordana M, Waserman S, Brożek JL, Schünemann HJ. Oral immunotherapy for peanut allergy (PACE): a systematic review and meta-analysis of efficacy and safety. Lancet. 2019 Jun 1;393(10187):2222-2232. doi: 10.1016/S0140-6736(19)30420-9.

OIT is burdensome and may negatively affect QoL



Mori, Francesca, Mattia Giovannini, Simona Barni, Rodrigo Jiménez-Saiz, Daniel Munblit, Benedetta Biagioni, Giulia Liccioli, et al. "Oral Immunotherapy for Food-Allergic Children: A Pro-Con Debate." *Frontiers in Immunology* 12 (September 28, 2021): 636612. https://doi.org/10.3389/fimmu.2021.636612.

Biologics treat conditions besides FA

BIOLOGIC THERAPIES

Omalizumab FDA-approved indications

- Asthma
- Chronic urticaria
- Chronic rhinosinusitis with nasal polyposis

Dupilumab FDA-approved indications

- Asthma
- Atopic dermatitis
- Eosinophilic esophagitis
- Chronic rhinosinusitis with nasal polyposis

ORAL IMMUNOTHERAPY

No data supporting treatment of comorbidities

Xolair
Dupixent

Biologics are safer than OIT

BIOLOGIC THERAPIES

Lower risk of anaphylaxis than OIT

Omalizumab has undergone 10 phase 3 clinical trials for safety

ORAL IMMUNOTHERAPY

Frequent adverse reactions

- Allergic reactions including anaphylaxis
- Gastrointestinal symptoms
- Eosinophilic esophagitis

Lack of standardized products and protocols

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

Xolair

Mori, Francesca, Mattia Giovannini, Simona Barni, Rodrigo Jiménez-Saiz, Daniel Munblit, Benedetta Biagioni, Giulia Liccioli, et al. "Oral Immunotherapy for Food-Allergic Children: A Pro-Con Debate." *Frontiers in Immunology* 12 (September 28, 2021): 636612. https://doi.org/10.3389/fimmu.2021.636612.

Oral immunotherapy for peanut allergy (PACE): a systematic review and meta-analysis of efficacy and safety (Chu, et al.)

OIT VERSUS NO OIT

- INCREASED ANAPHYLAXIS RISK & FREQUENCY
- INCREASED EPINEPHRINE USE
- INCREASED SERIOUS ADVERSE EVENTS
- INCREASED NON-ANAPHYLACTIC REACTIONS

Chu DK, Wood RA, French S, Fiocchi A, Jordana M, Waserman S, Brożek JL, Schünemann HJ. Oral immunotherapy for peanut allergy (PACE): a systematic review and meta-analysis of efficacy and safety. Lancet. 2019 Jun 1;393(10187):2222-2232. doi: 10.1016/S0140-6736(19)30420-9.

High rates of anaphylaxis in OIT

Peanut OIT	Cashew OIT	Cow's milk OIT
• IMPACT: 22% • PALISADE: 14%	• NUT CRACKER: 18%	• Longo: 10%

Jones, Stacie M, Edwin H Kim, Kari C Nadeau, Anna Nowak-Wegrzyn, Robert A Wood, Hugh A Sampson, Amy M Scurlock, et al. "Efficacy and Safety of Oral Immunotherapy in Children Aged 1–3 Years with Peanut Allergy (the Immune Tolerance Network IMPACT Trial): A Randomised Placebo-Controlled Study." *The Lancet* 399, no. 10322 (January 2022): 359–71. https://doi.org/10.1016/S0140-6736(21)02390-4.

The PALISADE Group of Clinical Investigators. "AR101 Oral Immunotherapy for Peanut Allergy." *New England Journal of Medicine* 379, no. 21 (November 22, 2018): 1991–2001. https://doi.org/10.1056/NEJMoa1812856.

Longo, Giorgio, Egidio Barbi, Irene Berti, Rosanna Meneghetti, Angela Pittalis, Luca Ronfani, and Alessandro Ventura. "Specific Oral Tolerance Induction in Children with Very Severe Cow's Milk–Induced Reactions." *Journal of Allergy and Clinical Immunology* 121, no. 2 (February 2008): 343–47. https://doi.org/10.1016/j.jaci.2007.10.029.

Elizur A, Appel MY, Nachshon L, Levy MB, Epstein-Rigbi N, Koren Y, Holmqvist M, Porsch H, Lidholm J, Goldberg MR. Cashew oral immunotherapy for desensitizing cashew-pistachio allergy (NUT CRACKER study). Allergy. 2022 Jun;77(6):1863-1872. doi: 10.1111/all.15212.

Safety of Food Oral Immunotherapy: What We Know, and What We Need to Learn (Vazquez-Cortes, et al.)

A meta-analysis of 9 studies on peanut, milk, and egg OIT published by March 2014 estimated that **2.7% of patients newly developed eosinophilic esophagitis**

Vázquez-Cortés, Sonia, Paloma Jaqueti, Stefania Arasi, Adrianna Machinena, Montserrat Alvaro-Lozano, and Montserrat Fernández-Rivas. "Safety of Food Oral Immunotherapy." *Immunology and Allergy Clinics of North America* 40, no. 1 (February 2020): 111–33. https://doi.org/10.1016/j.iac.2019.09.013

Biologics are the Preferred Tertiary Prevention Option

- Not age or food-specific
- Less hassle
- Improves quality of life
- Treats comorbidities
- Safer

Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

De Silva, Debra, Pablo Rodríguez Del Río, Nicolette W. De Jong, Ekaterina Khaleva, Chris Singh, Anna Nowak-Wegrzyn, Antonella Muraro, et al. "Allergen Immunotherapy and/or Biologicals for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 77, no. 6 (June 2022): 1852–62. https://doi.org/10.1111/all.15211.

Reflection

For patients with confirmed IgE-mediated food allergy, which treatment option(s) do you offer?

How does your practice change with respect to certain patient-specific factors?

- Adolescents and adults
- Barriers to clinic visits (transportation, time off school/work, etc.)
- Patients/families who frequently move or plan to move
- Other chronic atopic conditions

Rebuttal & Conclusion

OIT is not cheap!

Palforzia costs almost **$1,000** per month which comes out to more than **$10,000** per year

OIT is not cheap!

Economic burden of food-induced allergic reactions and anaphylaxis

- Estimated **$500 million per year**
- Clinic visits account for >50% of total cost

Clinic visits required for OIT

- Transportation
- Time off work/school

Adverse events due to OIT

- Clinic/ER visits
- Medication use
- Time off work/school

Bilaver, Lucy A., Avneet S. Chadha, Priyam Doshi, Linda O'Dwyer, and Ruchi S. Gupta. "Economic Burden of Food Allergy." *Annals of Allergy, Asthma & Immunology* 122, no. 4 (April 2019): 373-380.e1. https://doi.org/10.1016/j.anai.2019.01.014.

Omalizumab is the more equitable treatment option

- Widely available and easy to access
- Insurance coverage
- Financial assistance programs

Omalizumab is Safe!

As of 2021, over **60,000 patients** had been treated in the US since its initial approval in 2003

Novartis

Omalizumab is Safe!

ANAPHYLAXIS

Pre-marketing clinical trials: reported in 0.1% of patients

Post-marketing spontaneous reports: estimated frequency of 0.2%

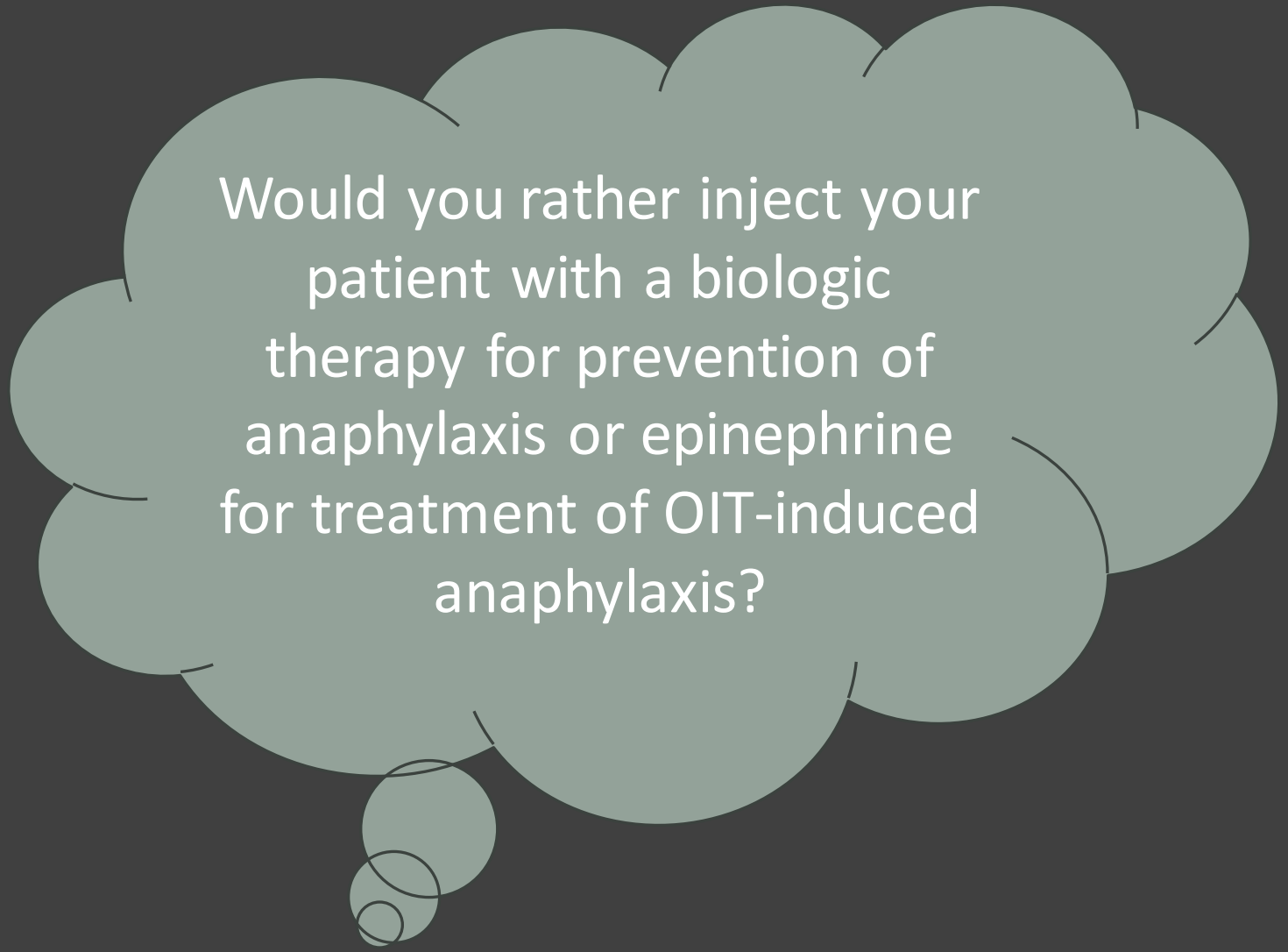
MALIGNANCY

Post-marketing studies: no difference in incidence rates of primary malignancies between treated and non-treated patients

- 5-year observational cohort study was conducted in patients ≥12 years of age
- 5007 XOLAIR-treated and 2829 non-XOLAIR treated patients

Studies for patients ages 6-11 years old: no cases of malignancy were reported

FDA


Would you rather inject your patient with a biologic therapy for prevention of anaphylaxis or epinephrine for treatment of OIT-induced anaphylaxis?

Anti-IgE Therapies Help Patient on OIT

Anti-IgE Treatment with Oral Immunotherapy in Multifood Allergic Participants: A Double-Blind, Randomised, Controlled Trial (Andorf, et al.)

- In multifood allergic patients, omalizumab improves the efficacy of multifood OIT and enables safe and rapid desensitization

Omalizumab Facilitates Rapid Oral Desensitization for Peanut Allergy (MacGinnitie, et al.)

- Omalizumab allows subjects with peanut allergy to be rapidly desensitized over as little as 8 weeks of peanut OIT

Andorf, Sandra, Natasha Purington, Whitney M Block, Andrew J Long, Dana Tupa, Erica Brittain, Amanda Rudman Spergel, et al. "Anti-IgE Treatment with Oral Immunotherapy in Multifood Allergic Participants: A Double-Blind, Randomised, Controlled Trial." *The Lancet Gastroenterology & Hepatology* 3, no. 2 (February 2018): 85–94. https://doi.org/10.1016/S2468-1253(17)30392-8.
MacGinnitie, Andrew J., Rima Rachid, Hana Gragg, Sara V. Little, Paul Lakin, Antonella Cianferoni, Jennifer Heimall, et al. "Omalizumab Facilitates Rapid Oral Desensitization for Peanut Allergy." *Journal of Allergy and Clinical Immunology* 139, no. 3 (March 2017): 873-881.e8. https://doi.org/10.1016/j.jaci.2016.08.010.

Resources

- Andorf, Sandra, Natasha Purington, Whitney M Block, Andrew J Long, Dana Tupa, Erica Brittain, Amanda Rudman Spergel, et al. "Anti-IgE Treatment with Oral Immunotherapy in Multifood Allergic Participants: A Double-Blind, Randomised, Controlled Trial." *The Lancet Gastroenterology & Hepatology* 3, no. 2 (February 2018): 85–94. https://doi.org/10.1016/S2468-1253(17)30392-8.
- Berin, M. Cecilia. "Targeting Type 2 Immunity and the Future of Food Allergy Treatment." *Journal of Experimental Medicine* 220, no. 4 (April 3, 2023): e20221104. https://doi.org/10.1084/jem.20221104.
- Bilaver, Lucy A., Avneet S. Chadha, Priyam Doshi, Linda O'Dwyer, and Ruchi S. Gupta. "Economic Burden of Food Allergy." *Annals of Allergy, Asthma & Immunology* 122, no. 4 (April 2019): 373-380.e1. https://doi.org/10.1016/j.anai.2019.01.014.
- Chu DK, Wood RA, French S, Fiocchi A, Jordana M, Waserman S, Brożek JL, Schünemann HJ. Oral immunotherapy for peanut allergy (PACE): a systematic review and meta-analysis of efficacy and safety. Lancet. 2019 Jun 1;393(10187):2222-2232. doi: 10.1016/S0140-6736(19)30420-9.
- Cummings AJ, Knibb RC, King RM, Lucas JS. The psychosocial impact of food allergy and food hypersensitivity in children, adolescents and their families: a review. Allergy. 2010 Aug;65(8):933-45. doi: 10.1111/j.1398-9995.2010.02342.x.
- Dantzer, Jennifer A., and Robert A. Wood. "Anti–Immunoglobulin E for Food Allergy." *Annals of Allergy, Asthma & Immunology* 131, no. 1 (July 2023): 11–22. https://doi.org/10.1016/j.anai.2023.03.030.
- De Silva, Debra, Pablo Rodríguez Del Río, Nicolette W. De Jong, Ekaterina Khaleva, Chris Singh, Anna Nowak-Wegrzyn, Antonella Muraro, et al. "Allergen Immunotherapy and/or Biologicals for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 77, no. 6 (June 2022): 1852–62. https://doi.org/10.1111/all.15211.
- Du Toit, George, et al. "Prevention of Food Allergy." *Journal of Allergy and Clinical Immunology* 137, no. 4 (April 2016): 998–1010. https://doi.org/10.1016/j.jaci.2016.02.005.
- Elizur A, Appel MY, Nachshon L, Levy MB, Epstein-Rigbi N, Koren Y, Holmqvist M, Porsch H, Lidholm J, Goldberg MR. Cashew oral immunotherapy for desensitizing cashew-pistachio allergy (NUT CRACKER study). Allergy. 2022 Jun;77(6):1863-1872. doi: 10.1111/all.15212.
- Fiocchi, Alessandro, Maria Cristina Artesani, Vincenzo Fierro, Carla Riccardi, Lamia Dahdah, and Maurizio Mennini. "Oral Immunotherapy for Peanut Allergy: The Con Argument." *World Allergy Organization Journal* 13, no. 8 (August 2020): 100445. https://doi.org/10.1016/j.waojou.2020.100445.
- Fiocchi, et al, Impact of Omalizumab on Food Allergy in Patients Treated for Asthma: A Real-Life Study, The Journal of Allergy and Clinical Immunology: In Practice, Volume 7, Issue 6, 2019, Pages 1901-1909.e5, ISSN 2213-2198, https://doi.org/10.1016/j.jaip.2019.01.023.
- Jones, Stacie M, Edwin H Kim, Kari C Nadeau, Anna Nowak-Wegrzyn, Robert A Wood, Hugh A Sampson, Amy M Scurlock, et al. "Efficacy and Safety of Oral Immunotherapy in Children Aged 1–3 Years with Peanut Allergy (the Immune Tolerance Network IMPACT Trial): A Randomised Placebo-Controlled Study." *The Lancet* 399, no. 10322 (January 2022): 359–71. https://doi.org/10.1016/S0140-6736(21)02390-4.

Resources

- Longo, Giorgio, Egidio Barbi, Irene Berti, Rosanna Meneghetti, Angela Pittalis, Luca Ronfani, and Alessandro Ventura. "Specific Oral Tolerance Induction in Children with Very Severe Cow's Milk–Induced Reactions." *Journal of Allergy and Clinical Immunology* 121, no. 2 (February 2008): 343–47. https://doi.org/10.1016/j.jaci.2007.10.029.
- MacGinnitie, Andrew J., Rima Rachid, Hana Gragg, Sara V. Little, Paul Lakin, Antonella Cianferoni, Jennifer Heimall, et al. "Omalizumab Facilitates Rapid Oral Desensitization for Peanut Allergy." *Journal of Allergy and Clinical Immunology* 139, no. 3 (March 2017): 873-881.e8. https://doi.org/10.1016/j.jaci.2016.08.010.
- Miller J, Blackman AC, Wang HT, Anvari S, Joseph M, Davis CM, Staggers KA, Anagnostou A. Quality of life in food allergic children: Results from 174 quality-of-life patient questionnaires. Ann Allergy Asthma Immunol. 2020 Apr;124(4):379-384. doi: 10.1016/j.anai.2019.12.021.
- Mori, Francesca, Mattia Giovannini, Simona Barni, Rodrigo Jiménez-Saiz, Daniel Munblit, Benedetta Biagioni, Giulia Liccioli, et al. "Oral Immunotherapy for Food-Allergic Children: A Pro-Con Debate." *Frontiers in Immunology* 12 (September 28, 2021): 636612. https://doi.org/10.3389/fimmu.2021.636612
- Nurmatov, U., S. Dhami, S. Arasi, G. B. Pajno, M. Fernandez-Rivas, A. Muraro, G. Roberts, et al. "Allergen Immunotherapy for IgE-mediated Food Allergy: A Systematic Review and Meta-analysis." *Allergy* 72, no. 8 (August 2017): 1133–47. https://doi.org/10.1111/all.13124.
- Pajno, G. B., M. Fernandez-Rivas, S. Arasi, G. Roberts, C. A. Akdis, M. Alvaro-Lozano, K. Beyer, et al. "EAACI Guidelines on Allergen Immunotherapy: IgE-mediated Food Allergy." *Allergy* 73, no. 4 (April 2018): 799–815. https://doi.org/10.1111/all.13319.
- The PALISADE Group of Clinical Investigators. "AR101 Oral Immunotherapy for Peanut Allergy." *New England Journal of Medicine* 379, no. 21 (November 22, 2018): 1991–2001. https://doi.org/10.1056/NEJMoa1812856.
- Rafi A, et al. Effects of omalizumab in patients with food allergy. Allergy Asthma Proc. 2010 Jan-Feb;31(1):76-83. doi: 10.2500/aap.2010.31.3304. Rial MJ, Barroso B, Sastre J. Dupilumab for treatment of food allergy. J Allergy Clin Immunol Pract. 2019 Feb;7(2):673-674. doi: 10.1016/j.jaip.2018.07.027.
- Spekhorst, Lotte S., Lisa P. Van Der Rijst, Marlies De Graaf, Maxime Van Megen, Nicolaas P. A. Zuithoff, André C. Knulst, Marjolein S. De Bruin-Weller, and Thuy-My Le. "Dupilumab Has a Profound Effect on specific-IgE Levels of Several Food Allergens in Atopic Dermatitis Patients." *Allergy* 78, no. 3 (March 2023): 875–78. https://doi.org/10.1111/all.15591.
- Turner PJ, Jerschow E, Umasunthar T, Lin R, Campbell DE, Boyle RJ. Fatal Anaphylaxis: Mortality Rate and Risk Factors. J Allergy Clin Immunol Pract. 2017 Sep-Oct;5(5):1169-1178. doi: 10.1016/j.jaip.2017.06.031.
- Vázquez-Cortés, Sonia, Paloma Jaqueti, Stefania Arasi, Adrianna Machinena, Montserrat Alvaro-Lozano, and Montserrat Fernández-Rivas. "Safety of Food Oral Immunotherapy." *Immunology and Allergy Clinics of North America* 40, no. 1 (February 2020): 111–33. https://doi.org/10.1016/j.iac.2019.09.013
- Zuberbier, Torsten, Robert A. Wood, Carsten Bindslev-Jensen, Alessandro Fiocchi, R. Sharon Chinthrajah, Margitta Worm, Antoine Deschildre, et al. "Omalizumab in IgE-Mediated Food Allergy: A Systematic Review and Meta-Analysis." *The Journal of Allergy and Clinical Immunology: In Practice* 11, no. 4 (April 2023): 1134–46. https://doi.org/10.1016/j.jaip.2022.11.036.

Resources

- Dupixent
- FARE
- FDA
- Novartis
- Today
- Xolair