

An economic evaluation of immediate vs non-immediate activation of emergency medical services after epinephrine use for peanut-induced anaphylaxis



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ABSTRACT

Background: Layperson food allergy management plans commonly stipulate that if epinephrine is used to immediately call 911 and seek care in the nearest medical facility for observation.

Objective: To evaluate the cost-effectiveness of this strategy, vs a watchful waiting approach before activating emergency medical services (EMS).

Methods: We performed a cost-effectiveness analysis using Markov modeling simulated over a 20-year horizon comparing activating EMS immediately after epinephrine use for allergic reactions to peanut vs a “wait and see” approach in which EMS was only activated if symptoms of the reaction did not promptly resolve after treatment. The base-case model assumed a 10-fold increased fatality risk with delayed EMS activation.

Results: The fatality risk associated with early EMS use was minimal, with a per-patient fatality rate over a 20-year horizon of 1.2×10^{-6} , vs 1.9×10^{-6} for a wait and see approach. The incremental cost per life-year saved was \$142,943,447 for early EMS vs wait and see, with the cost per death prevented reaching \$1,349,335,651 as the simulation concluded. Cost of early EMS activation rose to \$321,625,534 per life-year saved (\$3,035,454,848 per death prevented) if a 5-fold increase in fatality risk was assumed, and was \$12,997,173 per life-year saved (\$122,689,936 per death prevented) if a 100-fold increase in fatality risk was assumed.

Conclusion: Medical observation of a treated and promptly resolved peanut allergic reaction has minimal benefit and excessive costs. Immediately activating EMS after using epinephrine for a peanut allergic reaction in this context is not cost-effective.

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Introduction

Anaphylaxis is a multi-organ system, severe allergic reaction that is a medical emergency, with an estimated lifetime prevalence of 0.05% to 2%.^{1–3} Current World Allergy Organization anaphylaxis guidelines endorse epinephrine as first-line (and only) treatment for anaphylaxis.^{4,5} No randomized controlled trials of any therapeutic intervention have been performed in acute anaphylaxis, because of ethical concerns; therefore, management is heavily influenced by expert opinion based on best available observational evidence, which supports intramuscular epinephrine as the drug of choice.⁶ The current model of anaphylaxis treatment is predicated on prompt symptom recognition for multi-organ system involvement (or single severe cardiac/respiratory symptom), early intramuscular epinephrine treatment once symptoms emerge, careful postreaction observation for symptom recurrence requiring additional treatment, provision of an auto-injectable epinephrine prescription and written anaphylaxis management plan, and specialist referral if the patient is not already receiving such care.^{4–6}

In children, food allergy is a frequent trigger of anaphylaxis, although this can be provoked by any allergen.^{1,3,5–7} Food allergy management plans recommend that when epinephrine is administered in the non-hospital/office setting, emergency medical services should be activated to provide further observation for possible biphasic reactions or decompensation requiring escalation of care (“immediately call 911 and seek care in the nearest medical facility”).^{5,6} However, biphasic reactions are unlikely to occur in most pediatric patients experiencing an allergic reaction treated with epinephrine, and additional epinephrine doses are infrequently required. In most instances, the initial dose of epinephrine is usually adequate in completely treating the episode.^{8,9}

Despite these instructions, caregivers are often reluctant to administer the injection, and the close linkage of emergency services (EMS) activation with home epinephrine use may contribute to the tendency to simply seek expert guidance of management instead of using epinephrine early.⁶ In a recent study of factors associated with epinephrine use for anaphylaxis before emergency department (ED) arrival, only 36.3% of patients received epinephrine before presentation to the ED or urgent care center, and reactions were less likely to be treated with epinephrine at home compared with school.¹⁰ Of note, patients are often empowered to make the decision of when to use an epinephrine auto-injector without any encouragement of decision autonomy in the subsequent activation of EMS and transport to the ED, given most home food allergy action plans instruct this.¹¹ This advice is intended to afford timely access to additional care in the event of a recrudescence of symptoms or emergence of significant cardiorespiratory symptoms.⁶ However, most families presenting for observation in the ED after initial epinephrine use are discharged after a few hours, with minimal medical intervention, and are often already stable on presentation.^{8,10,12}

The purpose of this analysis was to evaluate the cost-effectiveness of reflexive EMS activation after non-medical setting epinephrine use after an allergic reaction to peanut (a common childhood allergen that is associated with severe reactions), compared with a “wait and see” approach in which EMS was only activated if symptoms of the allergic reaction did not promptly resolve without recurrence. Neither strategy has been studied nor compared previously.

Methods

A Markov model simulation was used to investigate the cost-effectiveness of a routine recommendation advising patients to activate EMS, defined by calling 911 for ambulance transport and undergoing subsequent ED evaluation, after home epinephrine use in peanut-allergic children. Using a computer-based mathematical model (TreeAge Pro, Williamstown, Massachusetts), cohorts of children were randomized to a patient preference-sensitive management strategy in which EMS was activated only if symptoms of anaphylaxis did not immediately improve or a strategy in which EMS was activated immediately irrespective of improvement (Fig 1). Markov modeling is useful in situations characterized by recurrent probabilistic risk, such as the longitudinal history of a peanut-allergic individual, because it allows transitions between health states over a predetermined time horizon.¹³ In a Markov simulation, cohorts of hypothetical patients experience real-life risks, costs, and benefits of management under different paradigms of care. These types of models are very commonly used to understand economic consequences of health care decisions because they allow for evaluation of costs and benefits over a specified period. This study was exempt from institutional review board review.

Subjects entered the simulation at 1 year of age, and the model continued through childhood, with the simulation concluding at 20 years of age. All cause age-adjusted mortality was incorporated

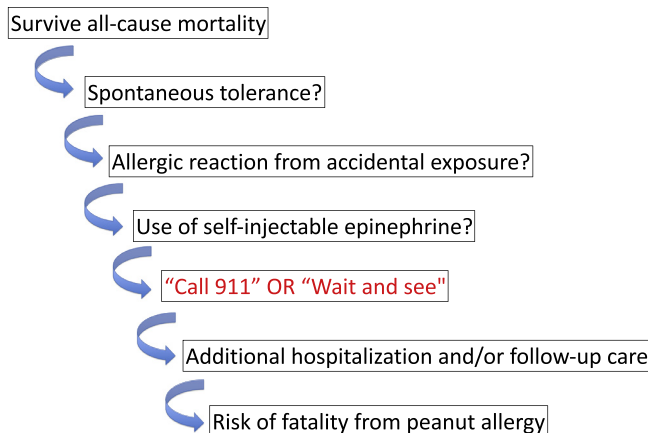


Figure 1. Markov model health state assumptions. Markov transitional health states simulated to evaluate cost-effectiveness of a patient-preference-sensitive approach toward additional medical care after epinephrine injection at home.

into the simulation, using the 2013 life table.¹⁴ Risks of accidental reactions, fatal reactions, and costs associated with treatment and living with a peanut allergy diagnosis were applied to each cohort as previously described.^{15–20} The health state utility of living with food allergy was derived from research by Carroll and Downs.^{21,22} Future costs were discounted at a rate of 3% per annum to reflect the average consumer price index for all goods and services.²³ The probability of home allergic reactions responding adequately to treatment with 1 dose of epinephrine was assumed to be 88%, following the data reported by Rudders and colleagues⁸ that 12% of children received a second dose of epinephrine according to a study using a multicenter medical chart review of food-related allergic reactions presenting between January 1, 2001 and December 31, 2006.⁸ This is in range of the upper end of more recent estimates of biphasic reaction occurrence (14.6%).²⁴ Higher rates of subsequent care were modeled in extended sensitivity analyses to an upper limit of 50% to account for reported rates of second-dose epinephrine usage.²⁵

Because the risk reduction associated with early EMS use after nonhospital setting epinephrine administration is unknown, we assumed a 10-fold increase in peanut allergy fatality as the base-case comparison (with a priori planned sensitivity analyses applied to 100-fold and 1,000-fold increase in risk), as well as modeled EMS activation of parent transport of the child without an ambulance to the ED. Costs in US dollars, fatality rates, admission rates, and quality of life adjusted years were the main outcome measures to determine the cost-effectiveness between the 2 strategies studied (Table 1).

Results

Early EMS access costs an average of \$910.95 per patient over the model horizon, with the overall model-horizon cost of living with a peanut allergy reaching \$52,832.29 for patients using a strategy of early EMS access after epinephrine use, vs \$51,921.34 for those using a “wait and see” approach. We noted a minimal decrease in absolute fatality risk associated with early EMS use, with a per-patient fatality rate over the model horizon of 1.2×10^{-6} and 1.9×10^{-6} for early EMS vs a wait and see approach after home (or other nonmedical setting) epinephrine use. On average, subjects accessing EMS early only gained 6.4×10^{-6} life years over the model horizon. The incremental cost per life year saved in the simulation was \$142,943,447 for early EMS vs “wait and see,” with the cost per death prevented reaching \$1,349,335,651 as the simulation concluded.

To evaluate patients who may be at lower or higher risk (eg, patients with a prior past severe reaction or history of anaphylaxis-related hospitalization) from a wait and see approach, sensitivity

Table 1
Simulation Model Inputs

Variable	Model reference	Source
US Life Table	National Vital Statistics Reports, April 2017	Arias et al. ¹⁴
Probabilities		
Fatality from peanut allergic reaction	5.77×10^{-7}	Shaker ¹⁷
Accidental peanut exposure if allergic	11.7% per year	Vander Leek et al. ¹⁹
Moderate to severe reaction following peanut exposure	52%	Vander Leek et al. ¹⁹
Hospitalization following severe food allergic reaction	0.18% per year after reaction	Shaker ¹⁷
Outpatient visits for food allergy after reaction	20.4% per year after allergic reaction	Shaker ¹⁷
Spontaneous peanut tolerance	1.1% per year	Skolnik et al. ²⁰
Additional medical care needed for allergic reaction	12%	Rudders et al. ⁸
Costs		
Epinephrine auto-injector (annual cost per twin pack)	\$635	Shaker et al. ¹⁸
Hospitalization (mean cost per patient per year in 2017 dollars)	\$5,638.26	Patel et al. ¹⁶ ; US Department of Labor, Bureau of Labor Statistics ²³
ED visit	\$660.72	Patel et al. ¹⁶ ; US Department of Labor, Bureau of Labor Statistics ²³
Outpatient visit for food allergic reactions	\$230.60	Patel et al. ¹⁶ ; US Department of Labor, Bureau of Labor Statistics ²³
Ambulance runs for allergic reactions	\$561.00	Patel et al. ¹⁶ ; US Department of Labor, Bureau of Labor Statistics ²³
Pediatrician visits (mean incremental annual cost for food allergy diagnosis)	\$97.60	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Allergist visits for food allergy (mean incremental annual cost for food allergy diagnosis)	\$146.26	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Nutritionist visits for food allergy (per year)	\$16.97	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Alternative provider visits for food allergy (per year)	\$24.40	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Incremental annual grocery costs (living with food allergy)	\$303.85	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Job-related opportunity costs from food allergy (per year)	\$2,544.19	Gupta et al. ¹⁵ ; US Department of Labor, Bureau of Labor Statistics ²³
Additional assumptions		
Start age	1 year	
Annual discount rate	0.03	US Department of Labor, Bureau of Labor Statistics ²³
Negative health state influence for food allergy	-0.09	Carroll and Downs ²¹ ; Mittmann et al. ²²

analyses evaluating a 5-fold to 100-fold increase in fatality risk were performed. Cost of early EMS activation rose to \$321,625,534 per life year saved (\$3,035,454,848 per death prevented) if a 5-fold increase in fatality risk was assumed. If a 100-fold increase in fatality risk was assumed, the cost of early EMS activation was \$12,997,173 per life year saved (\$122,689,936 per death prevented) for early EMS activation. This increased risk range would incorporate multiple potential co-factors that could potentially worsen anaphylaxis severity and potentially increase the risk of a biphasic reaction.¹² Because the probability of needing additional care in the wait and see cohort ranged from 5% to 25%, the incremental cost was \$370,353,632 per life year saved (\$3,495,911,838 per death prevented)—\$58,477,946 per life year saved (\$552,008,532 per death prevented). With a starting age modeled at 6 years, the cost of early EMS activation was \$143,045,172 per life year saved (\$1,349,444,362 per death prevented). Assuming private vehicle transport after epinephrine use (ambulance costs excluded), seeking immediate ED care cost \$77,932,777 per life year saved (\$737,668,790 per death prevented) compared with the wait and see approach (Table 2).

We also modeled the cost of provision of additional epinephrine auto-injectors in the early EMS group, because many families receive multiple auto-injectors annually. This sensitivity analysis provided a cost ceiling for most conservative (and common) practices in which families assume costs of both early EMS activation for epinephrine use as well as costs of multiple (unused) epinephrine auto-injectors. When (high utilization) prescription of 6 epinephrine auto-injectors (3 twin-packs in the early EMS group) was compared with (low utilization) prescription of 2 devices (single twin-pack) in the wait and

see cohort, the cost in the early EMS group reached \$2,871,682,776 per life year saved (\$27,108,072,878 per death prevented).

A minimal increase in hospitalization rates was noted for a wait and see approach assuming a 10-fold increased risk. Admission rates were 0.00195 vs 0.00234 per subject over the model horizon in the early vs delayed activation cohorts. With cost-effective care defined as less than \$100,000 per life year saved,²⁶ early EMS activation was cost-effective when the risk of fatality increased 500-fold over a wait and see approach when combined with eventual care being required in the wait and see cohort 75% of the time (2-way sensitivity analysis, Fig 2). When the need for subsequent care was modeled at 50%, reflex EMS activation only became cost-effective when the risk of fatality from waiting exceeded a 1,000-fold increase.

Discussion

Modeling care for the treatment of acute anaphylaxis is difficult because of a high reliance on observational studies, case series, and expert opinion given limited existence of randomized controlled trials for ethical reasons.^{5,6} This can complicate evaluating best-practices strategies and potentially allow more emotional considerations and judgments to influence care provision. Few other areas within allergy are as vulnerable to such constraints as anaphylaxis care, in particular the care of a food-allergic child. Still, placing risk in context is important to avoid unnecessary care and cost burdens on both families and medical systems. Indeed, medical precedent exists for critical risk analysis in such circumstances. In anaphylaxis, patient preference-sensitive risk-averse decision making is

Table 2
Simulated Outputs for the Cost-Effectiveness of Automatic EMS Activation

Variable	Baseline value	Plausible range	Base case cost-effectiveness	Cost-effectiveness Range
Fatality risk from "wait and see" approach	10 ×	5 × -100 ×	\$142,943,447 per life year saved (\$1,349,335,651 per death prevented)	\$321,625,534 per life year saved (\$3,035,454,848 per death prevented) - \$12,997,173 per life year saved (\$122,689,936 per death prevented)
Probability of needing additional care	12%	5%-25%		\$370,353,632 per life year saved (\$3,495,911,838 per death prevented) - \$58,477,946 per life year saved (\$552,008,532 per death prevented)
Number of devices^b	2 devices in each approach	2 vs 6 devices		\$142,943,447 per life year saved (\$1,349,335,651 per death prevented) - \$2,871,682,776 per life year saved (\$27,108,072,878 per death prevented)
Ambulance cost (per transport)	\$561	\$0-\$561		\$77,932,777 per life year saved (\$737,668,790 per death prevented) - \$142,943,447 per life year saved (\$1,349,335,651 per death prevented)
Start age	1 year	6 years		\$142,943,447 per life year saved (\$1,349,335,651 per death prevented) - \$143,045,172 per life year saved (\$1,349,444,362 per death prevented)

^aLife year saved over model horizon.

^bIn the baseline model, 2 epinephrine auto-injectors are prescribed for both wait-and-see and immediate medical care following epinephrine use. In the sensitivity analysis, 2 devices in wait-and-see is compared with 6 devices in immediate care.

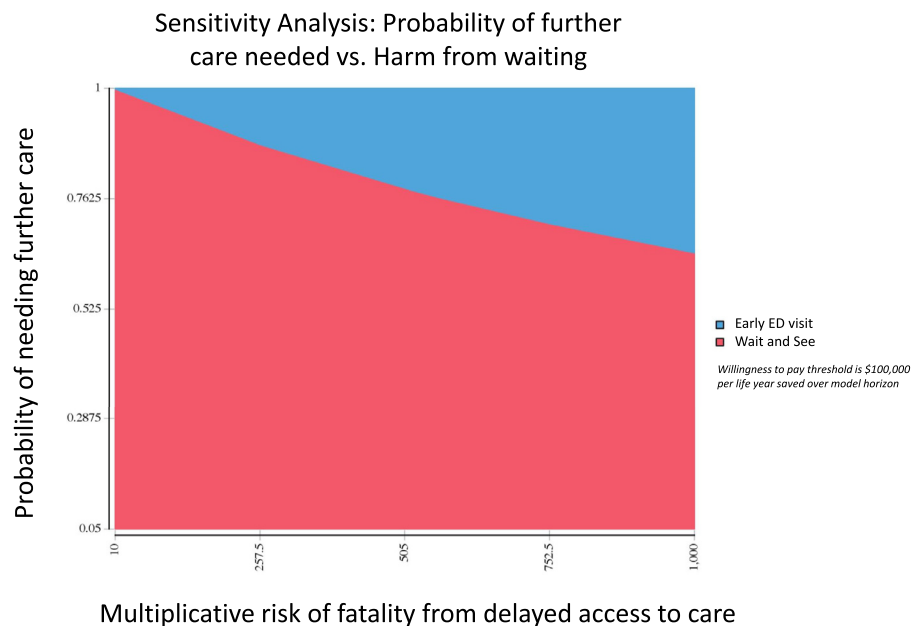


Figure 2. Sensitivity analysis of the probability of further care needed vs harm from waiting. Sensitivity analysis denotes that early EMS care after epinephrine use becomes cost-effective when the risk of fatality from the “wait and see” approach exceeds a 500-fold increase together with a likely probability that care would be needed exceeding 75%. Cost-effective care is considered to cost less than \$100,000 per life-year saved. EMS, emergency medical services.

incorporated into many clinical situations, such as some decisions about venom immunotherapy, as well as epinephrine auto-injector prescribing choices in lower-risk situations, including oral allergy syndrome, allergen immunotherapy, and isolated cutaneous and large local reactions from Hymenoptera stings.^{18,27–29}

In this simulation and cost-effectiveness analysis, immediate activation of EMS services after use of epinephrine (for additional observation, after symptoms were treated and have resolved) for a peanut-allergic reaction is associated with costs on the order of hundreds of millions of dollars to save a single life year over the model horizon (or costs of billions to prevent 1 fatality), evaluating fatal anaphylaxis as the study outcome of interest. Negligible incremental absolute difference has been found in the risk of fatality between reflex EMS

activation when epinephrine is used, vs having the caregiver carefully monitor the child at home and not contact EMS unless symptoms do not immediately improve and promptly resolve. This is heavily influenced by an exceedingly low rate of food-related anaphylaxis fatality, even to high-risk allergens such as peanut, tree nut, seed, and shellfish. This argument is bolstered by data from national registries in 2 countries that suggest fatality from food allergy (in particular) and other allergy-related causes in children is, thankfully, quite rare, with approximately 150 cases in the United States over a 10-year period.^{30–32} The perceived risk of food-allergy-related fatality may be presumed to be greater than it is when events are extrapolated from case series, where reporting is not centralized or systematic and has relied on selective self-report or contact with a family willing to

report these details.^{33,34} Furthermore, overall rates of biphasic reactions are also believed to be low (0.6%–14.7%), with the specific risk of a biphasic reaction from a food trigger even lower—a recent meta-analysis of biphasic reactions has suggested that food triggers are associated with a lower risk of a biphasic reaction (odds ratio, 0.62; confidence interval, 0.4–0.94; 2,667 total subjects analyzed).^{12,24}

Importantly, a wait and see approach would not change current practices or absolve a caregiver of the responsibility to provide prompt and appropriate initial treatment with epinephrine, closely monitor, and seek care if symptoms do not promptly resolve. Such primary management would remain the hallmark of outpatient anaphylaxis management.^{4,11} Epinephrine devices in the United States are sold as 2-packs, and patients are instructed to carry 2 devices with them at all times, so an additional device should be available as a failsafe for the small percentage of reactions that may require additional management in a wait and see scenario. Of course, if a patient with a treated and initially resolved allergic reaction at home subsequently experiences a biphasic reaction, then subsequent activation of EMS would be appropriate. Although arguments could be made for recommending quicker activation of EMS (rather than wait and see) in those with a history of a prior severe reaction (which would require a tight definition) or poorly controlled asthma, our sensitivity analysis accounted for such incremental increased risk and still found this to not be cost-effective at base fatality rate estimates unless fatality risk increased 500-fold in the setting of likely eventual EMS activation.^{6,11} However, in certain higher-risk subgroups, the decision of reflex EMS activation may be preference-sensitive, and this could be a prime area for the development of a decision aid. This economic analysis takes a societal perspective, and an individual patient perspective may differ. In some circumstances, additional factors may drive the decision to seek immediate care for patients despite symptom resolution after epinephrine use, such as a perceived need for counseling, evaluation, reassurance, and support after an allergic reaction.

We compared the health and economic outcomes of alternative approaches of management after a symptomatic peanut-allergic individual is administered epinephrine and experiences prompt resolution of symptoms, and the value of the default practice of every patient going to the ED after using epinephrine, even if they are stable, compared with a watchful waiting approach. This assumed that the patient had filled a prescription for an epinephrine auto-injector twinpack and had promptly administered the epinephrine treatment as indicated, per recommended guidelines. Many other situations

could be modeled, but these would be distinct analyses. We did not model outcomes of symptomatic persons who were never administered epinephrine as an initial treatment (because of either lack of a device or not using an available device), or an individual initially administered epinephrine but who require a second injection, which is not administered (because of either lack of a device or not using an available device). These situations deal with failing to administer necessary treatment (potentially from not having recommended treatment available), and such situations would not have feasible alternatives except to use EMS and ED care. These would fall outside our model. More specifically, these situations would model whether a person having a severe reaction (including anaphylaxis) would benefit from epinephrine treatment. We stipulate that it is both cost-effective to treat a severe reaction with epinephrine and that such treatment would be associated with beneficial health outcomes.²⁵ We would also presume that this strategy dominates, and minimal feasibility in additional cost-effective modeling of epinephrine administration to a symptomatic patient. We strongly advocate that patients fill their epinephrine prescriptions and note ample literature describing the dangers of a severe allergic reaction without epinephrine available for treatment. However, despite increased awareness and education, patients may not adhere to such advice, follow guidelines, or fill their prescriptions. In a recent survey by Song et al,²⁵ most respondents reported not carrying 2 epinephrine autoinjectors; however, half reported needing a second epinephrine dose at least once.²⁵ Oren et al³⁵ reported that 16% of food-induced anaphylaxis required a second epinephrine dose, and Jarvinen et al³⁶ reported that 19% of children required multiple doses to treat reactions.^{35,36} To account for a higher usage rate of a second epinephrine dose, we modeled higher rates of subsequent care in sensitivity analyses, but even at higher rates reflex EMS activation in patients with resolved symptoms was not cost-effective under model assumptions.

This study has additional limitations. The approach strictly investigated activating emergency services after a reaction to peanut in the home setting, requiring epinephrine, with such services defined as calling 911 for ambulance transport of a patient to an ED for further assessment and possible hospital admission. We did not explicitly model activation of EMS after a similar reaction in the school/child care setting, and we only considered peanut as a provoking source. Foods are the most common cause of anaphylaxis in children, and peanut is widely considered an allergen associated with potential fatal anaphylaxis and severe reactions, which helps justify this choice

Annual incidence of fatal anaphylaxis in an unselected population

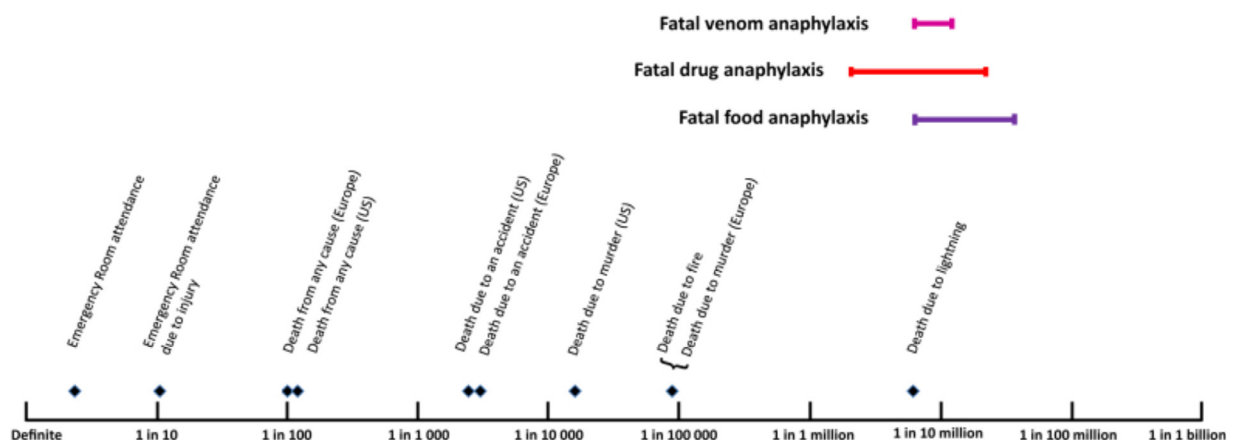


Figure 3. Comparison of fatality risk. Comparison of the odds of fatality through different mechanisms. Risk of fatality from food allergy is comparable to that of a lightning strike, and lower than multiple other common risks. Reprinted with permission from Turner PJ, Jerschow E, Umasunthar T, Lin R, Campbell DE, Boyle RJ. Fatal anaphylaxis: mortality rate and risk factors. *J Allergy Clin Immunol Pract.* 2017;5:1169–1178.³¹

for the model.⁶ We assumed that all treatment was given promptly and appropriately, and that a caregiver or person who was present with the individual at the time of the reaction could adequately assess the child for a wait and see response, neither of which may always be the case in reality. The analysis was also limited to only children and excluded peanut-allergic adults, because the epidemiology of peanut allergy in adults is not well known, and peanut-allergic adults may have different considerations based on co-morbidities more commonly seen at older ages. We did not directly model the effect of co-factors such as concurrent illness or concomitant medication, exercise, improper body positioning post-epinephrine (upright), poorly controlled asthma, the presence of a systemic mast cell disorder, a prior severe reaction, prior biphasic reaction, or specific symptoms that necessitated epinephrine use, although sensitivity analysis was deliberately broad to expand the potential increase in risk of fatality to incorporate these variables.^{10,12,37} The opportunity costs of the ambulance and emergency facility time and resources being used for other health care services were not factored into this model. Lastly, poor data inform the precise nature of the difference in risk of the approaches modeled. We believed a 10-fold assumption of risk was reasonable and conservative estimate for the base case. In comparison, the US Food and Drug Administration recently accepted a standard of between a 2- and 3-fold increased risk of fatality associated with combined long-acting beta-agonist/inhaled steroid use as sufficient in deciding to recommend removal of a box warning from such products.^{38,39} We had an a priori plan for both low- and high-risk sensitivity analyses to make the model as robust as possible, given the absence of well-established data to inform us of the incremental risk between these approaches.

Food allergy fatalities are viewed as imminently preventable and tragic when they occur, given that these events have a disconcerting association with failure to either promptly use epinephrine or to have self-carried a device.^{33,34} However these are still uncommon, and that the calculated odds of a food allergy fatality are similar to those of being killed by lightning strike, murder, or fire, and significantly lower than the risk of accidental death, is a rarely considered perspective³¹ (Fig 3). Moreover, the context of fatality is often misconstrued, in that most reported fatalities appear to be the result of compounded risk—lack of allergen avoidance (either by intent or mistake) combined with not using appropriate treatment when symptoms arose, or not having emergency medication available when it was needed.^{7,33,34,40,41} The rate of fatality after “appropriate” treatment, meaning that the symptoms were promptly recognized and medication commensurate to symptom severity was administered in a timely manner, is completely unknown. Further research to more clearly define root causes of fatal anaphylaxis in such instances are needed.

Most guidance for postreaction anaphylaxis management is level D evidence, and dominated by expert opinion given that randomized controlled trials may not be ethical.^{5,6} The true risk of a biphasic reaction or failure of the primary epinephrine dose to adequately control all symptoms arising in such a reaction is poorly understood.⁴ For this reason, expert consensus recommends that after epinephrine is used in the nonmedical setting, recipients should seek emergency care (often explicitly stated as “call 911”) and observation by a trained medical provider.^{4,6,11} This guidance aims to afford immediate access in case escalation of care is needed, in theory, but is poorly studied and without evidence that such actions are either necessary or associated with better outcomes. Activating EMS is expensive, and it may not be covered by all insurance plans (or it may be part of a deductible). The risk of fatality at baseline is exceedingly low, and rates of biphasic anaphylaxis occurring in the community setting are largely unknown.^{8,24,31} This is an example of where expert opinion has dominated actual evidenced-based demonstration of medical necessity, and a practice with little ability to influence health outcomes has become ingrained in anaphylaxis management. Alternatively, the requirement to activate EMS

may actually serve as a barrier to prompt epinephrine use by some families.

In conclusion, we show that the currently recommended strategy of immediately activating EMS regardless of symptom response for an allergic reaction to peanut necessitating epinephrine treatment is a cost-ineffective recommendation compared with a wait and see response strategy, which allows patients with prompt resolution of symptoms to be monitored at home and seek care if needed. Food allergy is associated with both very low rates of fatality as well as low rates (relative to other triggers) of biphasic anaphylaxis. An approach incorporating patient preferences may lead to more value-based decisions in anaphylaxis management, in which a routine recommendation for reflex EMS activation after treatment of childhood food allergic reactions can be nuanced with situational awareness together with caregiver preferences and judgments. Further studies evaluating a wait and see strategy seem warranted, and future anaphylaxis and food allergy practice parameters may consider incorporating such an approach in formulating recommendations.

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