

Table 1
Characteristics of Patients Undergoing Home Peanut OIT

Patient number	Age (y)	Sex	Clinical history of reactions to peanut	SPT reaction (mm)	Total IgE/peanut IgE/Ara h 2 (kAU/L)	Physician-supervised peanut oral food challenge	Home peanut OIT program
1	17	Female	At 4 y ate peanuts and within 5 min developed urticaria, facial swelling, husky voice, cold, and clinginess; mild asthma: no steroid inhaler; grass-induced rhinitis: on grass SLIT	10	1,000/12.8/—	Did not achieve stage 5 at 14 y: ate peanut 5 g and developed urticaria, angioedema, vomiting; given antihistamine only	24 mo into home peanut OIT program; no acute allergic reactions; started with 1 and now tolerates 6 peanuts 3 times/wk
2	15	Female	At 2 y ate roasted peanut and within 5 min developed itchy mouth, cough listless, agitation; no asthma	18	340/8.1/5.1	Did not achieve stage 4 at 12 y: ate peanut 1 g and developed lip swelling; given antihistamine only	20 mo into home peanut OIT program; no acute allergic reactions; started with ¼ and now tolerates 4 shelled peanuts 3 times/wk
3	7	Male	At 1 y ate peanut butter and within 5 min developed facial angioedema only; mild asthma: no steroid inhaler	7	910/3.4/0.7	Did not achieve stage 5 at 6 y: ate peanut 5 g and had large vomit	13 mo into home peanut OIT program; no acute allergic reactions; started with 2 and now tolerates 9 peanuts 3 times/wk
4	8	Male	At 6 y ate a peanut-containing chocolate bar and within 30 min developed generalized urticaria only; mild asthma: no steroid inhaler; mild allergic rhinitis	10	903/1.1/1.3	Did not achieve stage 5 at 7 y: ate peanut 5 g and developed localized urticaria on torso	6 mo into home peanut OIT program; no acute allergic reactions; started with 1 and now tolerates 4 peanuts 3 times/wk
5	2	Female	At 1 y was given peanut butter and within 5 min developed facial urticaria and angioedema only; no asthma	3	25/0/0	Did not achieve stage 3 at 1 y: ate peanut butter 200 mg and developed localized urticaria	9 mo into home peanut OIT program; no acute allergic reactions; started with peanut butter 100 mg and now tolerates peanut butter 2.5 g 3 times/wk
6	13	Male	No history of peanut consumption before challenge	3	100/0/0	Did not achieve stage 3 at 11 y: ate peanut 200 mg and developed abdominal pain, vomiting, anxiety, itch, conjunctivitis	14 mo into home peanut OIT; no acute allergic reactions; describes stinging in his mouth when taking peanut after missed doses; started with ½ and now tolerates 1 peanut 4–7 times/wk

Abbreviations: IgE, immunoglobulin E; OIT, oral immunotherapy; SLIT, sublingual immunotherapy; SPT, skin prick test.

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Human factors study in untrained adolescents comparing a recently approved single-dose epinephrine prefilled syringe with an approved autoinjector



Self- or caregiver administration of epinephrine is considered the treatment of choice for acute anaphylaxis.¹ In June 2017, the US Food and Drug Administration approved Symjepi (Adamis Pharmaceuticals, San Diego, California), a prefilled syringe used for the administration of epinephrine.²

In this prospective study, we examined human factors that affect the usability of Symjepi, as compared with the market leader, the EpiPen (Mylan Pharmaceuticals Inc, Canonsburg, Pennsylvania), in untrained adolescents. This study was conducted in accordance with Food and Drug Administration Guidance³ and was conducted independently by Worrell Inc. Worrell randomly recruited subjects who fulfilled the inclusion and exclusion criteria for the study. The Worrell moderator participating in the study had been trained on the devices before the start of the study. During the

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Figure 1. Symjepi and EpiPen epinephrine devices.

study sessions, only the moderator and the participant were allowed in the study room. Research was conducted in Edina, Minnesota, at the Focus Pointe Minneapolis testing facility. All participants signed an informed consent form indicating that they were fully willing to participate in the study. Participants were untrained naïve adolescents aged 12 to 17 years. Subjects were studied in 2 cohorts. In cohort 1, half of the untrained naïve adolescents ($n = 17$) were randomized to use Symjepi first, and then the EpiPen second. In cohort 2, half of the untrained naïve adolescents ($n = 17$) were randomized to use the EpiPen first and then given Symjepi second. The evaluation sample size was 34. This included 17 male and 17 female subjects. The mean age of participant in this study was 14.7 years. A χ^2 test was used to compare the use failure events between the 2 groups. A Symjepi device filled with saline was used (Fig 1) and compared with an EpiPen trainer for the study. The critical tasks as described on the instructions for Symjepi in this cohort were: (1) open case; (2) retrieve Symjepi; (3) remove needle cap; (4) insert needle into thigh; (5) press plunger until it stops for the Symjepi device. For the EpiPen trainer, the critical tasks were defined as: (1) flip open cap; (2) retrieve EpiPen; (3) remove blue safety cap; (4) swing and firmly push orange tip against thigh so it “clicks.” Use error was defined as any user action or lack of action that was different from the use expected by the manufacturer and that caused a result that (1) was different from the result expected by the user and (2) was not caused solely by device failure and (3) did or could result in harm. Subjects were advised that the epinephrine devices had instructions on the outside on how and where to use them correctly. The subjects were then asked to imagine that they were having an allergic emergency and were experiencing symptoms that required epinephrine. To simulate an actual epinephrine injection, subjects were instructed to retrieve the epinephrine devices, place an injection pad on the site of the body where they were going to inject, and then proceed with the injection into the pad.

No use errors occurred for the Symjepi device (0/34). However, a total of 4 of 34 errors were observed for the EpiPen, which was significantly worse than the Symjepi device performance ($P < .05$). Three subjects were observed to inject the EpiPen with their thumb over the needle port (injected upside down), with the outcome of injecting the thumb. One subject did not hold the EpiPen in place on the injection site on the thigh for the required time for the proper

dosing of epinephrine. The ages of the subjects who displayed critical use errors were 12, 12, 14, and 15 years (mean age, 13.3; $P > .05$ compared with the complete study cohort).

In this prospective human factors study, we compared a recently approved prefilled syringe of epinephrine (Symjepi) with an auto injector (EpiPen) trainer in untrained adolescents. We examined use errors that could result in the improper administration of epinephrine and therefore could likely have a negative impact on the effective treatment of anaphylaxis. All 34 participants successfully completed all steps to simulate an epinephrine injection with the Symjepi device. Four use errors were committed in total throughout the course of the study, all occurring using the EpiPen. When tasked with administering an injection with the EpiPen trainer, 12% (4/34) critical use errors were observed. The results obtained in this study using EpiPen in untrained subjects (12% failure rate) was similar to the use error rate found in another study of untrained participants (11% failure rate).⁴ This study uniquely examined the use of epinephrine devices in adolescents. Adolescents and young adults make up the largest population of fatalities caused by anaphylaxis caused by foods.⁵ Food allergies have been noted to contribute to as many as 70% of all food-related deaths.⁶ Therefore, proper use of epinephrine is of paramount importance in this age group. A number of incorrect use injuries have been described for autoinjectors, including accidental digit injection⁷ as well as lacerations.⁸ This study demonstrated 4 use errors in subjects using EpiPen, including 3 that were incorrect injections into the thumb. Because EpiPen trainers were used, no clinical sequelae resulted from the simulated incorrect administration. No use errors were noted for Symjepi.

In summary, this simulated-use testing study examined the critical components of epinephrine administration for the treatment of anaphylaxis in untrained adolescents, comparing a recently approved Symjepi device with a standard EpiPen trainer. This simulated validation testing indicated a significantly higher failure rate in the EpiPen trainer group compared with the Symjepi group. This study demonstrates the ease of use of Symjepi for the acute treatment of anaphylaxis.

Ronald B. Moss, MD
 Karen Daniels, BS
 Thomas Moll, PhD
 Dennis J. Carlo, PhD
 Adamis Pharmaceuticals
 San Diego, California
rmoss@adamispharma.com

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