

Auvi-Q Versus EpiPen: Preferences of Adults, Caregivers, and Children

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What is already known about this topic? Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death. Current guidelines recommend the use of epinephrine autoinjectors for the management of anaphylaxis in the community.

What does this article add to our knowledge? In this large, multicenter, simulated-use study, experienced and inexperienced adults, caregivers, and children consistently preferred Auvi-Q over EpiPen for method of instruction, preference to carry, device size, and device shape.

How does this study impact current management guidelines? This large, multicenter, simulated-use study showed a preference for Auvi-Q over EpiPen. Whether the preference for Auvi-Q will result in patients carrying and correctly administering the device will need to be determined in future studies.

BACKGROUND: Auvi-Q is a novel epinephrine autoinjector (EAI) that provides audio and visual cues for patients at risk for life-threatening allergic reactions.

OBJECTIVE: We tested the preference for Auvi-Q or EpiPen with regard to method of instruction, preference to carry, device size, and device shape.

METHODS: This large, multicenter, simulated-use study evaluated whether adults (aged 18-65 years), caregivers (parents/guardians aged 18-65 years of children aged 5-17 years), and children (aged 11-17 years), with and without experience in using an EAI, had a preference for the current design of Auvi-Q or the current design of EpiPen. Participants were given a scenario that involved anaphylaxis and were instructed to

simulate use of an EAI. They received and tested each device individually according to the randomization assignment. After testing both devices, they completed a survey to indicate their preference for Auvi-Q versus EpiPen.

RESULTS: Among all 693 participants combined, Auvi-Q was preferred over EpiPen on all study end points ($P < .001$). For experienced and inexperienced participants in all 3 groups (adults, caregivers, and children), Auvi-Q was preferred over EpiPen for method of instruction, preference to carry, and device size (all $P < .001$). The preference for Auvi-Q device shape was not significant among experienced children ($P = .10$); however, it was significant for inexperienced children ($P = .04$) and highly significant for experienced and inexperienced adults and caregivers ($P < .001$).

CONCLUSION: In this large multicenter, simulated-use study, Auvi-Q was preferred over EpiPen by experienced and inexperienced adults, caregivers, and children. © 2013 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol: In Practice 2013;1:266-72)

Key words: Epinephrine autoinjector; Adrenaline autoinjector; Auvi-Q; EpiPen; User preference; Anaphylaxis; Caregivers; Children; Adults; Allergy

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Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death.¹ Epinephrine (adrenaline) autoinjectors (EAIs) can be lifesaving in the first-aid emergency treatment of anaphylaxis in the community,² as recommended in current guidelines for anaphylaxis management.^{3,4}

To facilitate the correct use of EAIs under stress, a unique epinephrine autoinjector (Auvi-Q), developed by Intelliject (Richmond, Va), was recently approved by the Food and Drug Administration and is marketed by Sanofi US (Bridgewater, NJ).⁵⁻⁷ Auvi-Q was designed to be portable (approximately the length and width of a credit card and the thickness of a small cell phone) and

Abbreviation used
EAI- Epinephrine autoinjector

was specifically developed for patients at risk for anaphylaxis in the community to help reduce barriers for timely self-administration of epinephrine in an allergic emergency. Auvi-Q has a retractable needle system to reduce potential unintentional injections before and after use and a safety tab mechanism located on the same end as the needle.⁸ In addition, it incorporates an electronic voice and visual prompt system that provides audible and visual instructions through a speaker and red/green blinking light-emitting diodes to guide patients in the correct administration of epinephrine.

A pilot study showed that the patient information leaflet and other labeling features (electronic voice and visual prompts) were effective in communicating the instructions for successful use of an Auvi-Q prototype by both adults and children.⁹ An earlier simulated-use study supported the benefit of the interactive voice-prompting system of an Auvi-Q prototype¹⁰ and showed that participants (adults and children) were significantly more likely to use the Auvi-Q prototype correctly than the EpiPen (Dey Pharma LP, Napa, Calif) and Twinject (Shionogi Pharma Inc, Atlanta, Ga), the EAI's marketed in the United States and Canada at that time.¹⁰ In this simulated-use study, malfunctions of the Auvi-Q prototype device were observed which involved the safety cap and the voice prompt. As a result, the safety cap and voice-prompting system were redesigned. Overall, the Auvi-Q prototype was preferred over EpiPen and Twinject for safety, clarity of instructions, ease of use, ease of carrying, size, and shape.¹⁰ In another small simulated-injection study, the Auvi-Q prototype was also shown to reduce the potential for sharps injury, improve the likelihood of correct usage, and was preferred by health care professionals.¹¹

Although these studies^{10,11} provided important information about the usability of and preferences for Auvi-Q, they compared preliminary designs of Auvi-Q with the EpiPen as designed and manufactured before April 2010. The aim of this large, multicenter, simulated-use study was to evaluate whether adults, caregivers, and children in the United States, with and without experience of using an EAI device, have a preference for the current design of Auvi-Q compared with the current design of EpiPen.

METHODS

Test centers

Participants were recruited from 12 office setting research facilities in the United States (Boston, Mass; Iselin, NJ; Baltimore, Md; Raleigh, NC; Orlando, Fla; Columbus, Ohio; Chicago, Ill; Dallas, Tex; Denver, Colo; Los Angeles, Calif; Seattle, Wash; and San Francisco, Calif). The locations of these facilities were selected to enroll a diverse group of participants from across the United States. Each office setting research facility recruited participants from their local databases.

Participants

Participants were recruited in several ways, including opt-in e-mail, co-registration, e-newsletter campaigns, traditional banner placements, call centers, in-person focus groups and other face-to-face encounters, and an internal and external affiliate network. Participants were contacted by telephone with the use of a screening

form. Recruitment to prespecified numbers by age, sex, experience level, and region were used to guarantee a representative sample of participants. Before the study was conducted, all monitors/proctors were trained simultaneously to ensure consistency and adherence to the study protocol.

Participants were screened according to age (beginning with interviews of those aged 18-65 years), and the number of people living in their household in the following age groups was recorded: 0 to 4, 5 to 10, and 11 to 17 years.

The adults (aged 18-65 years) interviewed qualified for the caregiver cohort if they were a parent/guardian of any children aged 5 to 17 years who were living in the household. Children with severe allergy who were aged 11 to 17 years qualified for the children cohort. Adults who had severe allergic reactions to food, medication, or insect venom qualified for the adult cohort if no children were living in the household or the caregiver group was full (adult participants in the caregiver cohort could have severe allergic reactions, but did not have to).

Adults, caregivers, and children were asked about their experience in using an EAI and were classified accordingly. Experienced participants were those who had received a prescription for an EAI and had either been trained to use or used an EAI. Inexperienced participants were those who had never received a prescription for an EAI, and those who had never been trained to use one, or actually used one.

Demographic information was obtained from adults and caregivers by multiple-choice questions about age, sex, race, Hispanic descent, primary language, highest level of education, employment situation, and income group. All participants were also asked if they had a prior prescription for an EAI, if they had been trained to use an EAI, and if they had ever used an EAI.

Participants were excluded if they or their child were in poor health (participants were asked to describe their or their child's overall health as excellent, very good, good, fair, or poor), they were unable to read at or above a sixth grade level, they were not native English speakers, they were not able to read and follow written instructions and to follow verbal instructions, or they had participated in any market research study on anaphylaxis/severe allergic reactions in the past month. Participants were also excluded if they or another member of the household were employed by, affiliated with, or engaged in any organization that might introduce potential bias into the study (eg, marketing or public relations, public media, pharmaceuticals, health care professionals, clinical investigators, Food and Drug Administration, health insurance, contract research organization, medical writer, etc).

Adults, caregivers, and children were remunerated for their participation. The protocol was reviewed and approved by Concordia Clinical Research Institutional Review Board (Cedar Knolls, NJ). Participants were recruited between October 25 and November 20, 2011. Preference testing was performed between November 4 and November 20, 2011.

Study design

Auvi-Q and EpiPen were evaluated by each participant in a randomly assigned order. For each of 6 groups (experienced and inexperienced adults, caregivers, and children), 2 randomization schedules were generated to ensure that Auvi-Q or EpiPen were presented in a balanced way to reduce potential analysis bias. Participants were stratified according to their experience with EAI's.

The current design of both devices was compared (Figure 1). At the time the study was conducted, Auvi-Q was not the brand name of the device. Auvi-Q is characterized by a retractable needle



FIGURE 1. Examples of both devices. The devices used were trainers that did not have a needle or contain epinephrine. Ruler is in inches (left) and centimeters (right).

system, a safety tab mechanism located on the same end as the needle, and an electronic voice and visual prompt system. Compared with the previous design (before April 2010), the current EpiPen has a one-step flip-top carry case, a bright orange tip to aid in needle-end identification, a blue safety release cap, automatic needle cover, and an oval shape. The devices used were trainers that did not have a needle or contain a drug.

Procedures

The first phase involved a simulated-use test, and the second phase involved a survey to evaluate preference. Participants were under the direct supervision of 2 trained monitors/proctors at all times to ensure compliance with the protocol. One staff member was responsible for providing instructions to the participants, and a second staff member served as an observer to confirm compliance with the randomization scheme and to assess the correct use of each device.

Potential participants were invited to participate in a study about severe allergic reactions. During the study, participants were given the following information. (1) You will be testing 2 different types of EAI devices. (2) The devices do not have a needle or drug and are for use in this study only. (3) You will be asked to imagine that you are having an allergic reaction that requires epinephrine. You will follow the instructions on the device to pretend that you are giving yourself an injection. You will hear some noise in the background to simulate an urgent simulation. (4) Please figure out how to use the device on your own. You may use any instructions that come with the device. We will not answer any questions about how to use the device. (5) We will stay in the room with you, but act as if we are not here.

To avoid potential bias, devices were presented to participants for use in a randomly assigned order. Participants tested each device individually according to the randomization schedule. Briefly, the steps followed in the simulated injection protocol were as follows. (1) Participants were given background information on anaphylaxis. (2) The 2 devices were presented to the participant in 2 brown paper bags (each being presented just before the test) according to the order of the randomization scheme, making sure the participant would test each device separately. (3) Participants were instructed to pretend that last year they found out they are severely allergic to peanuts and have

just accidentally eaten a peanut, their throat and lips are starting to swell, and they are beginning to have trouble breathing. They are having life-threatening anaphylaxis, and have to use an EAI. (4) Participants were instructed to begin, and the appropriate device was placed on the table. (5) Once the survey administrator cued the participant to start, the observer induced stress by sounding prerecorded beeping sounds. A clock was also visible to participants to add additional time stress. The participant informed the survey administrator when he/she was finished with an individual device test. (6) When the respondent indicated he/she was finished, the device was retrieved and placed out of the participants' view, and the simulated injection was repeated for the second device being tested.

During the study, no patient information leaflet, assistance, or training was provided to any participants. They were expected to perform the device test by relying on the labeling and/or voice instruction or intuition to perform the simulated injection correctly. They were not able to communicate with the monitors/proctors before or during testing. They had no contact with other participants before, during, or after testing. During the simulated injection, the observer recorded the correct completion of each step of the injection protocol.

On completion of testing both devices, participants were presented with both devices simultaneously and asked to complete a survey (see Appendix E1 in this article's Online Repository at www.jaci-inpractice.org). Each participant was asked to indicate their preference between the 2 devices (Auvi-Q and EpiPen) or to indicate no preference, in terms of the primary and secondary objectives that were set *a priori* before study initiation. The primary objectives were to test preferences about the 4 device attributes: method of instruction, preference to carry, device size, and device shape. The secondary objectives were to test preferences related to the use of the device: ease of use, ease of carrying, ease of following instructions, and device preferred to use overall.

Data quality was checked. Verification of 100% of the interviews took place to ensure the integrity of the data collected. After the survey, all participants were contacted by telephone to confirm that they had participated in the study.

Statistical analysis

The data were analyzed for each group and for all participants combined. Descriptive statistics were used to describe participant characteristics. According to the survey, a preference for Auvi-Q or EpiPen or "no preference" was determined for each comparison. The 2-sided sign test was used for each test (comparison) by excluding no preference data. To address multiplicity adjustment for multiple comparisons, the Hochberg (step-up) test procedure was used to control family-wise type 1 error rate up to 0.05 (2-sided). This was done for each group and for all participants for the 4 multiple comparisons about the primary end points, and the 4 multiple comparisons about the secondary end points. McNemar test was used to test the differences of the proportions of participants correctly completing all injection steps between Auvi-Q and EpiPen.

RESULTS

Characteristics of the 693 subjects who participated in this study are summarized in Table I. Among all participants combined, Auvi-Q was significantly ($P < .001$) preferred over EpiPen on all primary and secondary study end points measured (Figure 2).

For all 6 groups, Auvi-Q was significantly ($P < .001$) preferred over EpiPen for the method of instruction, which

TABLE I. Participant characteristics

	All participants* (n = 693)	Adults		Caregivers		Children	
		Experienced (n = 125)	Inexperienced (n = 116)	Experienced (n = 120)	Inexperienced (n = 108)	Experienced (n = 110)	Inexperienced (n = 114)
Age group, [†] %							
11-17 y	31	0	0	0	0	97	96
18-34 y	15	34	19	13	24	0	0
35-49 y	35	42	38	73	55	0	0
50-65 y	17	23	42	14	19	0	0
Data missing	2	0	<1	0	2	3	4
Female, %	71	70	70	77	81	61	69
Employment, %							
Employed	75	79	78	74	69		
Full time (>30 h/wk)	54	61	54	48	51		
Part time (<30 h/wk)	22	18	24	26	19		
Race, %							
White	63	71	66	65	57		
Black	23	20	22	23	31		
Asian	4	<1	3	7	2		
Other	6	6	6	3	11		
Data missing	4	2	3	2	0		
Education, %							
Did not complete high school	<1	<1	0	0	<1		
High school graduate	8	6	10	4	11		
Some college	36	28	47	25	45		
College graduate	38	41	33	48	30		
Some graduate school	4	5	4	3	5		
Completed graduate school	13	19	6	19	8		
Clinical factors							
Anaphylaxis trigger, [‡] %							
Food	46	61	22	77	33		
Medication	40	49	49	34	25		
Insect venom	35	50	22	33	32		
None of the above	14	2	27	2	30		

*Age and sex were recorded for all participants. All other demographic and clinical characteristics were recorded for 469 adults/caregivers only (the children cohort was excluded in the denominator for percentage calculations).

[†]Percentages do not always add up to 100 because of rounding.

[‡]The anaphylaxis trigger listed for caregivers relates to the anaphylaxis trigger observed in their children. Participants could be categorized to none of these 4 anaphylaxis triggers (none of the above) if anaphylaxis was triggered by other allergens not listed in the questionnaire or in case of idiopathic anaphylaxis.

included written (device labeling), visual, and auditory methods for Auvi-Q and written (device labeling) and visual methods for EpiPen (Table II; see also Figure E1 in this article's Online Repository at www.jaci-inpractice.org). Auvi-Q was also significantly ($P < .001$ for all groups) preferred over EpiPen for the device most prefer to carry and for device size (Table II; see also Figures E2 and E3 in this article's Online Repository at www.jaci-inpractice.org). Auvi-Q was also significantly ($P < .001$) preferred for device shape by experienced and inexperienced adults and by experienced and inexperienced caregivers ($P < .001$ for all these groups) and by inexperienced children ($P = .04$), but not for experienced children ($P = .10$) (Table II; see also Figure E4 in this article's Online Repository at www.jaci-inpractice.org).

For each of the secondary end points, Auvi-Q was significantly ($P < .001$) preferred over EpiPen in all groups (Table III; see also Figures E5–E8 in this article's Online Repository at www.jaci-inpractice.org).

Among all participants combined, a significantly ($P < .001$) higher percentage correctly completed all steps of the injection protocol with the use of Auvi-Q (75%) than with the use of EpiPen (35%) (Table IV). If the time step (ie, step 4 for EpiPen and step 5 for Auvi-Q) was excluded, the results remained higher for Auvi-Q (81% vs 61%; $P < .001$). Similar differences were observed in each of the 6 different groups (Table IV).

For both devices, experienced children were more likely to complete all of the steps correctly than inexperienced children (Table IV). This was also the case among experienced adults and experienced caregivers for EpiPen. For Auvi-Q, however, inexperienced adults and inexperienced caregivers were equally likely to complete all of the steps correctly as their experienced counterparts (Table IV).

DISCUSSION

This large, multicenter, simulated-use study in 693 diverse participants showed that Auvi-Q was preferred by most adults,

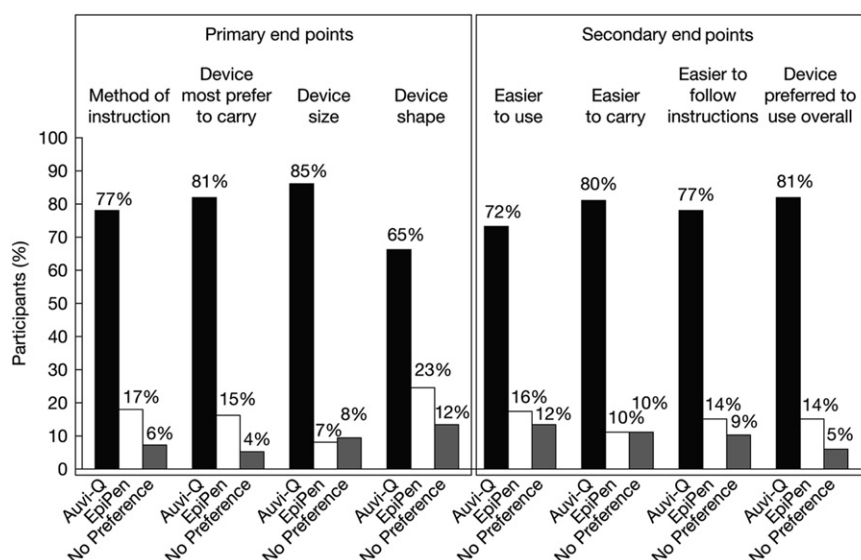


FIGURE 2. Preferences among all participants. All differences between Auvi-Q and EpiPen were significant ($P < .001$).

TABLE II. Preference between Auvi-Q and EpiPen for primary end points

		Adults		Caregivers		Children	
	All participants (n = 693)	Experienced (n = 125)	Inexperienced (n = 116)	Experienced (n = 120)	Inexperienced (n = 108)	Experienced (n = 110)	Inexperienced (n = 114)
Method of instruction, no. (%)							
Auvi-Q	533 (77)	99 (79)	95 (82)	97 (81)	90 (83)	69 (63)	83 (73)
EpiPen	117 (17)	16 (13)	17 (15)	17 (14)	15 (14)	30 (27)	22 (19)
No preference	43 (6)	10 (8)	4 (3)	6 (5)	3 (3)	11 (10)	9 (8)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Most prefer to carry with you, no. (%)							
Auvi-Q	561 (81)	104 (83)	105 (90)	98 (82)	89 (82)	77 (70)	88 (77)
EpiPen	101 (15)	16 (13)	9 (8)	13 (11)	18 (17)	25 (23)	20 (18)
No preference	31 (4)	5 (4)	2 (2)	9 (7)	1 (1)	8 (7)	6 (5)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Device size, no. (%)							
Auvi-Q	588 (85)	114 (91)	105 (91)	100 (83)	97 (90)	87 (79)	85 (75)
EpiPen	51 (7)	7 (6)	4 (3)	6 (5)	6 (6)	14 (13)	14 (12)
No preference	54 (8)	4 (3)	7 (6)	14 (12)	5 (4)	9 (8)	15 (13)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Device shape, no. (%)							
Auvi-Q	450 (65)	92 (74)	84 (72)	77 (64)	82 (76)	57 (52)	58 (51)
EpiPen	161 (23)	18 (14)	16 (14)	29 (24)	21 (19)	40 (36)	37 (32)
No preference	82 (12)	15 (12)	16 (14)	14 (12)	5 (5)	13 (12)	19 (17)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	.10	.04

caregivers, and children and by experienced and inexperienced users alike for all the primary end points, including method of instruction, preference to carry, device size, and device shape, as well as for all the secondary end points.

Anaphylaxis can occur without warning and is potentially fatal; therefore, it is crucial that all patients at risk for such a serious allergic reaction, or their caregivers, carry an EAI at all times, know how to use it, and recall how to perform a successful injection, even after a long period of not thinking about anaphylaxis. Unfortunately, patients and caregivers of patients at

risk for anaphylaxis do not always carry an EAI and do not always use it correctly.^{12,13} Current guidelines recommend training patients/caregivers in the correct administration of epinephrine^{3,4}; however, lack of time and resources may adversely affect the ability of health care professionals to provide this training.^{14,15} In addition, studies have shown that physicians do not consistently prescribe an EAI when it is indicated, and physicians, nurses, and pharmacists do not necessarily know how to use EAI correctly and do not always instruct their patients about proper use.^{12,14}

TABLE III. Preference between Auvi-Q and EpiPen for secondary end points

	All participants (n = 693)	Adults		Caregivers		Children	
		Experienced (n = 125)	Inexperienced (n = 116)	Experienced (n = 120)	Inexperienced (n = 108)	Experienced (n = 110)	Inexperienced (n = 114)
Easier to use, no. (%)							
Auvi-Q	499 (72)	88 (71)	92 (79)	92 (77)	82 (76)	66 (60)	79 (69)
EpiPen	114 (16)	18 (14)	12 (10)	10 (8)	16 (15)	32 (29)	26 (23)
No preference	80 (12)	19 (15)	12 (11)	18 (15)	10 (9)	12 (11)	9 (8)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Easier to carry, no. (%)							
Auvi-Q	552 (80)	108 (87)	102 (88)	98 (82)	87 (81)	76 (69)	81 (71)
EpiPen	70 (10)	9 (7)	7 (6)	6 (5)	11 (10)	24 (22)	13 (11)
No preference	71 (10)	8 (6)	7 (6)	16 (13)	10 (9)	10 (9)	20 (18)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Easier to follow instructions, no. (%)							
Auvi-Q	532 (77)	90 (72)	89 (77)	99 (82)	84 (78)	81 (74)	89 (78)
EpiPen	95 (14)	17 (14)	14 (12)	12 (10)	14 (13)	20 (18)	18 (16)
No preference	66 (9)	18 (14)	13 (11)	9 (8)	10 (9)	9 (8)	7 (6)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Prefer to use overall, no. (%)							
Auvi-Q	563 (81)	103 (83)	103 (89)	103 (86)	85 (79)	76 (69)	93 (82)
EpiPen	98 (14)	14 (11)	11 (9)	15 (12)	16 (15)	24 (22)	18 (16)
No preference	32 (5)	8 (6)	2 (2)	2 (2)	7 (6)	10 (9)	3 (2)
<i>P</i> value	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Auvi-Q was developed with human factors engineering principles to increase the ease of use and to reduce errors in the use of the device.^{11,16} In terms of method of instruction, this survey shows that not only inexperienced participants but also experienced participants preferred Auvi-Q over EpiPen, suggesting that the information provided by Auvi-Q might assist patients through the injection process during an anaphylactic reaction. The preference for shape of Auvi-Q was not significant among experienced children compared with all other groups of subjects studied, including inexperienced children. A possible explanation for this is that children experienced with EAI are more likely to carry the devices in a waist pouch or “fanny pack” rather than in a pocket.¹⁷

The design of this study has some potential limitations. First, participation was restricted to those willing and able to answer the survey; therefore, the respondents may not be representative of all patients who experience anaphylaxis. In addition, as poor health, inability to read at or above a sixth grade level, and not being a native English speaker were exclusion criteria, some patients who would be prescribed an EAI in actual clinical practice were excluded from this study. However, the participant demographics indicate that this study population was in fact representative of patients with anaphylaxis. Second, the fact that no instruction was given might have favored Auvi-Q, which has within-device voice prompts. However, even among experienced users many of whom were likely to have experience with EpiPen, correct usage and preference for easier to use and easier to follow instructions were significantly higher for Auvi-Q. Third, it is possible that the survey questions did not reflect real patient concerns. However, this is unlikely, because the questions were consistent with issues discussed in publications that describe limitations of EAI.^{5,14} Fourth, patients or caregivers can be under extreme stress when administering epinephrine in case of life-threatening anaphylaxis. Although this survey tried to simulate a stressful environment, participants were not under the

stress of a true medical emergency, and no medication was actually injected. Fifth, it could be argued that the difference in the percentage of participants who completed all injection steps correctly is caused by the difference in time to hold the device in place for Auvi-Q and EpiPen (5 vs 10 seconds, respectively). However, even when this time step is excluded from the analysis, this difference in correct administration was observed. Finally, the cost of the device was not evaluated in this study, but it should be weighed along with preference in prescribing decisions once pricing becomes available.

The strengths of the study include the size and diversity of the study population, and the fact that it compared the current design of Auvi-Q with the current design of EpiPen. The study population included a large cohort (n = 693) of potential EAI users over a wide geographic distribution. The preference was tested among adults, caregivers, and children, with and without experience in using an EAI device. This study also addressed some of the limitations of the previous studies^{10,11} by including patients/caregivers, randomizing according to prior experience with an EAI, providing no further training to any of the participants, and randomizing the order in which the devices were tested. For the disposal of the used device, which applies equally to Auvi-Q, EpiPen, and other epinephrine autoinjectors, it is recommended that the patient/caregiver takes the used device to the respective health care provider for disposal (not discard it in the regular trash).

In conclusion, this large, multicenter, simulated-use study showed a preference for Auvi-Q over EpiPen. Whether the observed preference for Auvi-Q will result in patients carrying and correctly administering the device will need to be determined in future studies.

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TABLE IV. Percentage of participants successfully completing each step of the injection protocol

	All participants (n = 693)	Adults		Caregivers		Children	
		Experienced (n = 125)	Inexperienced (n = 116)	Experienced (n = 120)	Inexperienced (n = 108)	Experienced (n = 110)	Inexperienced (n = 114)
Auvi-Q							
Step 1: Remove Auvi-Q from outer case, no. (%)	687 (99)	125 (100)	114 (98)	120 (100)	107 (99)	109 (99)	112 (98)
Step 2: Pull off red safety guard, no. (%)	680 (98)	125 (100)	114 (98)	118 (98)	105 (97)	108 (98)	110 (96)
Step 3: Place black end against outer thigh, no. (%)	611 (88)	116 (93)	103 (89)	109 (91)	94 (87)	102 (93)	87 (76)
Step 4: Press firmly, no. (%)	633 (91)	115 (92)	109 (94)	115 (96)	104 (96)	97 (88)	93 (82)
Step 5: Hold in place for 5 seconds, no. (%)	590 (85)	107 (86)	101 (87)	99 (83)	95 (88)	97 (88)	91 (80)
Step 6: Pull Auvi-Q away from outer thigh, no. (%)	641 (92)	122 (98)	109 (94)	111 (93)	99 (92)	105 (95)	95 (83)
Mean total time (seconds)	33	34	31	29	33	35	35
Completed all steps correctly, no. (%)	521 (75)	99 (79)	93 (80)	90 (75)	86 (80)	83 (75)	70 (61)
Completed all steps correctly (excluding time step), no. (%)	562 (81)	108 (86)	99 (85)	103 (86)	92 (85)	87 (79)	73 (64)
EpiPen							
Step 1: Remove EpiPen from outer case, no. (%)	683 (99)	124 (99)	114 (98)	119 (99)	106 (98)	108 (98)	112 (98)
Step 2: Pull off blue safety release, no. (%)	593 (86)	112 (90)	93 (80)	107 (89)	88 (81)	93 (85)	100 (88)
Step 3: Swing and firmly push orange tip against thigh, no. (%)	475 (69)	99 (79)	73 (63)	92 (77)	73 (68)	74 (67)	64 (56)
Step 4: Hold in place for 10 seconds, no. (%)	326 (47)	60 (48)	54 (47)	60 (50)	51 (47)	52 (47)	49 (43)
Step 5: Pull EpiPen away from outer thigh, no. (%)	600 (87)	117 (94)	96 (83)	109 (91)	90 (83)	102 (93)	86 (75)
Mean total time (seconds)	34	33	39	27	39	28	38
Completed all steps correctly, no. (%)	240 (35)	52 (42)	34 (29)	48 (40)	38 (35)	37 (34)	31 (27)
Completed all steps correctly (excluding time step), no. (%)	422 (61)	92 (74)	59 (51)	84 (70)	61 (56)	67 (61)	59 (52)
P value (Auvi-Q vs EpiPen, McNemar test)							
Completed all steps correctly	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Completed all steps correctly (excluding time step)	<.001	.004	<.001	<.001	<.001	.001	.01

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APPENDIX E1. Questionnaire included in the survey (the order of the 2 devices listed in the questionnaire was the same as the order in which the devices were presented to the participants). The questionnaire shown was for participants randomly assigned to test EpiPen first.

MAIN QUESTIONNAIRE – Version 1 (Blue)

NAME: _____ CITY: _____

For each item below, please indicate which device you prefer by checking the box next to that item as shown here ☒. If you have no preference, please check the box next to “No preference.” Please check one option only for each item.

1. Method of instruction:

- | | |
|---------------------------------------|--------------------------|
| EpiPen (Written and visual) | ☐ |
| AUVI-Q (Written, visual and auditory) | ☐ |
| No preference | ☐ |

2. Device you would most prefer to carry with you:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| AUVI-Q | ☐ |
| No preference | ☐ |

3. Size of the device:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

4. Shape of the device:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

5. Easier to use:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

6. Easier to carry:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

7. Easier to follow instructions:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

8. Device you would most prefer to use overall:

- | | |
|---------------|--------------------------|
| EpiPen | ☐ |
| Auvi-Q | ☐ |
| No preference | ☐ |

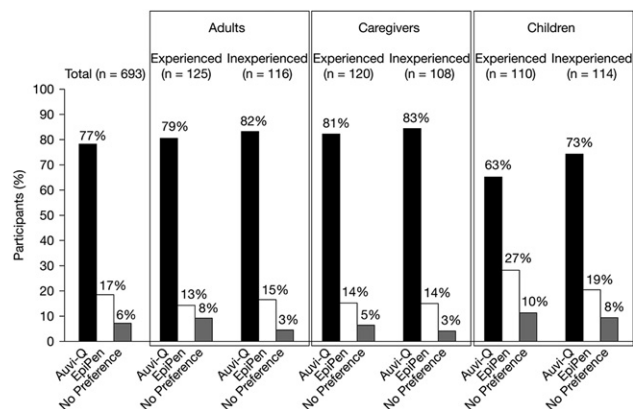


FIGURE E1. Preference for Auvi-Q over EpiPen among all participants for method of instruction. *P* values are listed in Table II.

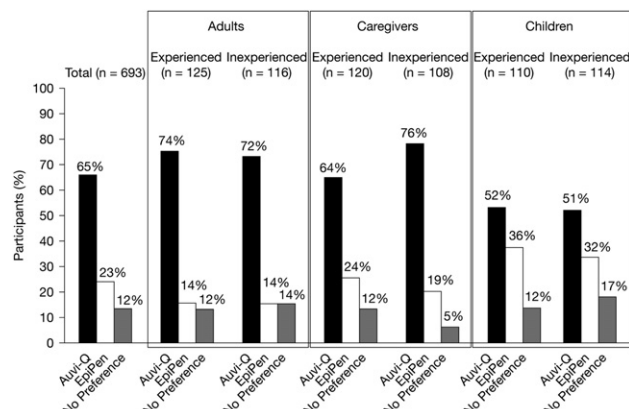


FIGURE E4. Preference for Auvi-Q over EpiPen among all participants for device shape. *P* values are listed in Table II.

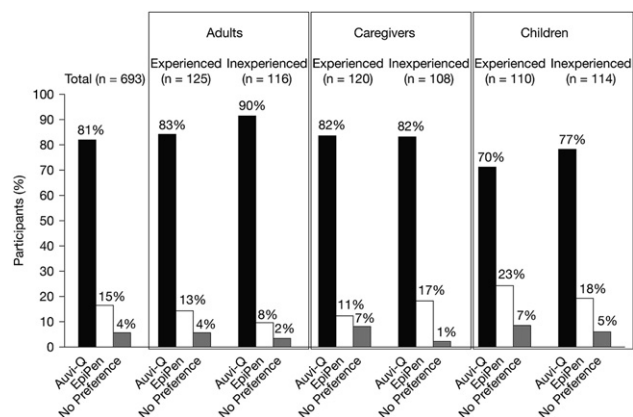


FIGURE E2. Preference for Auvi-Q over EpiPen among all participants for device most preferred to carry. *P* values are listed in Table II.

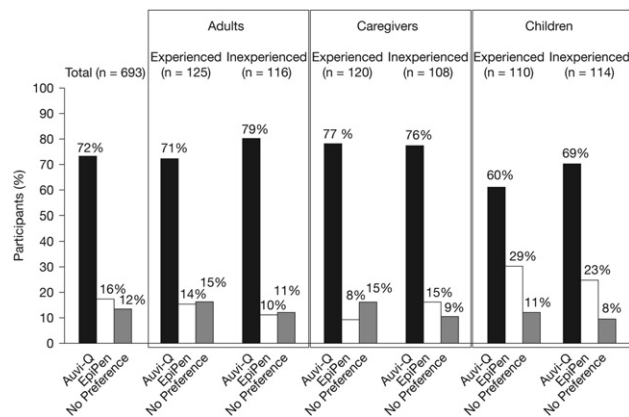


FIGURE E5. Preference for Auvi-Q over EpiPen among all participants for device easier to use. *P* values are listed in Table III.

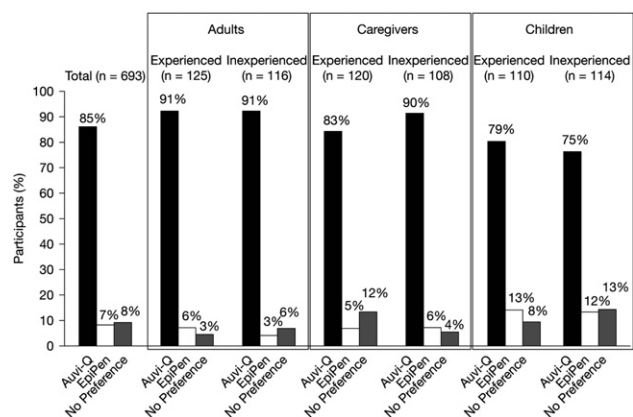


FIGURE E3. Preference for Auvi-Q over EpiPen among all participants for device size. *P* values are listed in Table II.

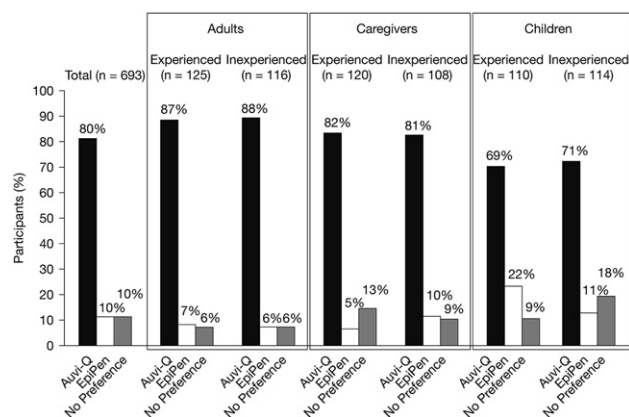


FIGURE E6. Preference for Auvi-Q over EpiPen among all participants for device easier to carry. *P* values are listed in Table III.

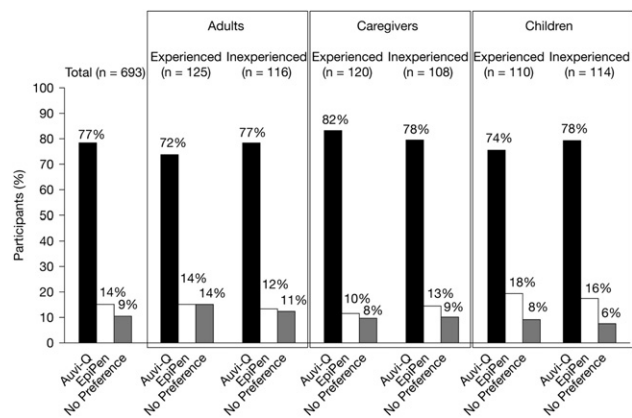


FIGURE E7. Preference for Auvi-Q over EpiPen among all participants for device easier to follow instructions. *P* values are listed in Table III.

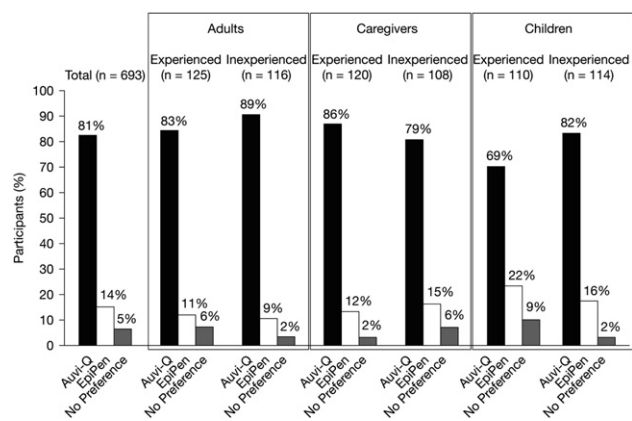


FIGURE E8. Preference for Auvi-Q over EpiPen among all participants for device preferred to use overall. *P* values are listed in Table III.