

Developing a Virtual Teach-To-Goal™ Inhaler Technique Learning Module: A Mixed Methods Approach



Meng Wu, BA^a, Nicole M. Woodrick, MA^b, Vineet M. Arora, MD, MAPP^b, Jeanne M. Farnan, MD, MHPE^b, and Valerie G. Press, MD, MPH^b Chicago, Ill

What is already known about this topic? Self-management education has been shown to improve patient care and health outcomes; however, patients often need repeated educational sessions for long-term retention of learned skills. In addition, clinicians often lack the resources to provide training.

What does this article add to our knowledge? We describe the development of an interactive, adaptive learning module that can be used for repeated educational sessions in multiple settings, allowing for a tailored training session to learn effective inhaler technique skills.

How does this study impact current management guidelines? This study provides important insights into using patient feedback to improve a novel technology-based intervention and obtaining pragmatic information on access and willingness to use the module.

BACKGROUND: Most hospitalized patients with asthma or chronic obstructive pulmonary disease misuse respiratory inhalers. An in-person educational strategy, teach-to-goal (TTG), improves inpatients' inhaler technique.

OBJECTIVE: To develop an effective, portable education intervention that remains accessible to hospitalized patients postdischarge for reinforcement of proper inhaler technique.

^aPritzker School of Medicine, University of Chicago, Chicago, Ill

^bDepartment of Medicine, University of Chicago, Chicago, Ill

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Corresponding author: Valerie G. Press, MD, MPH, University of Chicago Medicine, 5841 S Maryland Ave, MC 2007, Chicago, IL 60637. E-mail: vpress@medicine.bsd.uchicago.edu.

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METHODS: A mixed methods approach at an urban academic hospital was used to iteratively develop, modify, and test a virtual teach-to-goal™ (V-TTG™) educational intervention using patient end-user feedback. A survey examined access and willingness to use technology for self-management education. Focus groups evaluated patients' feedback on access, functionality, and quality of V-TTG™.

RESULTS: Forty-eight participants completed the survey, with most reporting having Internet access; 77% used the Internet at home and 82% used the Internet at least once every few weeks. More than 80% reported that they were somewhat or very likely to use V-TTG™ to gain skills to improve their health. Most participants reported smartphone access (73%); half owned laptop computers (52%). Participants with asthma versus chronic obstructive pulmonary disease were more likely to own a smartphone, have a data plan, and have daily Internet use ($P < .05$). Nine focus groups ($n = 25$) identified themes for each domain: access—platform and delivery, Internet access, and technological literacy; functionality—usefulness, content, and teaching strategy; and quality—clarity, ease of use, length, and likability.

CONCLUSIONS: V-TTG™ is a promising educational tool for improving patients' inhaler technique, iteratively developed and refined with patient input. Patients in our urban, academic hospital overwhelmingly reported access to platforms and willingness to use V-TTG™ for health education. © 2017 American Academy of Allergy, Asthma & Immunology (*J Allergy Clin Immunol Pract* 2017;5:1728-36)

Key words: Self-care; Patient education; Asthma; Pulmonary disease; chronic obstructive

In the United States, asthma and chronic obstructive pulmonary disease (COPD) affect almost 30 million adults.^{1,2} Medications delivered by inhalers provide the mainstay of

Abbreviations used

COPD- Chronic obstructive pulmonary disease
REDCap- Research Electronic Data Capture
TTG- Teach-to-goal
UCM- University of Chicago Medicine
V-TTG™ - Virtual teach-to-goal™

treatment in controlling and preventing symptoms for both diseases.³⁻⁸ However, respiratory inhaler misuse is exceedingly common,^{9,10} with 86% of observed inpatients with asthma or COPD displaying incorrect technique.^{3,11} Improper inhaler use, especially certain critical errors such as inspiratory effort, leads to ineffective medication delivery and correlates closely with sub-optimal symptom control, lower quality of life, and increased emergency room visits and hospitalizations.^{12,13} This ineffective inhaler technique is often not considered before escalating treatment; therefore, doses of medications or even additional medications may be unnecessarily added to patients' regimens.¹⁰ The economic cost of wasted medications alone is estimated to be \$5 billion to \$7 billion annually, and the burden on the health care system due to uncontrolled chronic symptoms is tremendous.^{12,14-18} Proper inhaler technique education is therefore crucial for effective self-management of asthma and COPD.^{13,19}

Our previous work has shown that teach-to-goal (TTG), an in-person educational method of cycles of demonstration and assessment,^{11,20} is effective for teaching inhaler technique to hospitalized patients with asthma or COPD.^{11,21,22} However, we have also shown that the improved inhaler technique initially obtained through TTG wanes within 30 days postdischarge.²¹ Because providing in-person inhaler teaching postdischarge is often impractical, but reinforced teaching is necessary, a need exists for an effective, portable education strategy that remains accessible to patients both in-hospital and postdischarge.

With increasing Internet access among the American public,²³ using a virtual teach-to-goal™ (V-TTG™) education module for inhaler training may be a viable and efficient alternative.²⁴ Previous studies have shown technology-based interventions to be effective at improving self-management for other chronic conditions.²⁵⁻³¹ However, access and willingness to use technology for home-based self-management education among inpatients with asthma or COPD is unknown, particularly among an underserved patient population. Furthermore, the use of adaptive learning technology for self-management education for this topic and population has not been widely studied. Therefore, when developing the V-TTG™ learning module it was necessary to iteratively modify and test each module component, which included demonstration and narration videos, predemonstration and postdemonstration self-assessment questions, and overall video module design and delivery, to ensure that we optimized V-TTG™ for patient use.

The overall goal was to develop V-TTG™ into an effective and acceptable interactive learning module that would be easily accessed postdischarge on patients' home devices. After developing the inhaler technique demonstration videos produced by Click To Play Media (Berkeley, Calif), we partnered with Smart Sparrow (Sydney, NSW, Australia) for its adaptive learning technology platform. Our aim was to optimize the V-TTG™ through mixed methods, including surveys and focus groups, to offer 2 different perspectives across 3 key domains of the module

design and delivery: access, functionality, and quality. Using mixed methods, we aimed to (1) understand patient access to technology, including which platforms would be both favorable and available to our patient population using quantitative survey data, and (2) obtain in-depth feedback on the usability and quality of the module assessment questions and the overall learning module itself using qualitative patient focus group data.

METHODS

Design and setting

We conducted a prospective mixed methods study³² at the University of Chicago Medicine (UCM), an urban, predominantly underserved adult patient population. Iterative testing of V-TTG™ and its components was completed with surveys on patients' use and ownership of technology and with patient focus groups, collecting quantitative and qualitative data, respectively. This use of mixed methods was selected for the insight it could offer into 2 different aspects of V-TTG™: (1) the proportion of inpatients who have used specific devices or have accessed the Internet and (2) the subjective experience of interacting with and learning from the module.³² The former could be best examined using quantitative methods, whereas the latter by qualitative.

Participants

Technology survey. Survey participants were recruited from the general medicine service from January to September 2014. Patients who provided written informed consent to take part in the Hospitalist Project, an ongoing study on cost and quality of care,³³ and who met inclusion criteria for the technology survey study were approached during the same hospitalization by trained research assistants. For this report, we only used survey data from inpatients with a diagnosis of asthma and/or COPD. Patients with asthma only were included in the asthma cohort, whereas patients with COPD or COPD and asthma were included in the COPD cohort. Additional inclusion criteria included being older than 18 years and English-speaking. Exclusion criteria included inability to provide consent. All participation was voluntary. The study was approved by the UCM Institutional Review Board (IRB16-0763).

Focus groups. Participants were recruited from the UCM Department of Internal Medicine and Asthma and COPD Center between December 2013 and April 2014. Inclusion criteria included being older than 18 years and English-speaking, physician diagnosis of asthma or COPD, and prescribed use of a metered dose inhaler. Exclusion criteria included current hospitalization and inability to provide consent. Potential participants were contacted using a phone script and, if interested, were mailed or emailed a letter regarding their participation. All participation was voluntary and written informed consent was obtained. This study was approved by the University of Chicago Institutional Review Board (IRB13-1139).

Data collection

Technology survey. The survey was developed to obtain a comprehensive understanding of our patient population's use, ownership, and access to technology, and their willingness to use technology for health-related information. Survey items were benchmarked against similar items from the existing literature including the national Pew survey³⁴ and questions from a local research study,³⁵ in addition to V-TTG™—specific questions for more detailed information on patients' willingness and ability to use V-TTG™.

For this study, we focused our analysis on a subset of survey items that pertained to Internet access, device ownership and preference, and willingness to use V-TTG™. Surveys were completed on paper-based forms and managed using Research Electronic Data Capture (REDCap³⁶) tools hosted at the University of Chicago.

Focus group interviews. The qualitative approach taken in this study was that of phenomenology, which examines a particular phenomenon, in this case V-TTG™, through the perceptions of users interacting with the module.³² This approach allows for the collection of detailed data regarding how participants personally relate to and interpret V-TTG™ as a tool for self-management education.

Focus groups were selected as the specific means of data collection for their ability to capture participant reactions to the perspectives shared by others, allowing the collective conversation to clarify or build upon the breadth of participant insight. Therefore, focus group data not only capture similar and conflicting viewpoints but also provide a deeper understanding of why and how these viewpoints may inform the development of V-TTG™.

All focus groups were conducted using a semi-structured interview format in which moderators asked open-ended questions to elicit participant feedback on the 3 predetermined themes of interest: access (eg, "What device would you prefer to use to watch this module?"), functionality (eg, "How useful is this module?"), and quality (eg, "How interesting did you find the module?") based on prepared scripts. Further probing questions were improvised by the moderators during the focus group sessions to draw out additional participant comments. All focus group activity was video-recorded and transcribed to ensure accuracy of qualitative data, with identifying markers removed.

Three rounds of focus groups were held, with each round building upon the findings of the previous, in a snowball fashion. Focus group scripts were prepared for each round on the basis of results from the previous round and introducing the next phase of the focus group testing, as appropriate. The first round of focus groups discussed the videos and a list of assessment questions provided on paper. The second round focused on the videos and electronic assessment questions. The third round viewed and discussed the entirety of V-TTG™, with full adaptive learning functionality enabled. After the focus groups had been completed and V-TTG™ finalized, a member check meeting was held, in which all participants of previous focus groups were invited back to view and comment on the final V-TTG™. Participants rated their satisfaction with the incorporation of their feedback on a Likert scale from 1 to 10.

Data analysis

Technology survey. Descriptive statistics (means, medians, and proportions) were computed using Stata 14 software (College Station, Texas) and used to summarize respondents' demographic and technology characteristics. Chi-square and Fisher exact tests were used for categorical differences; *t* tests were used for continuous variables. Survey data regarding technology ownership and use were considered in determining the optimal platform for V-TTG™ (ie, Web-based vs application-based). Statistical significance was defined as $P < .05$.

Focus groups. Qualitative content analysis was completed from professionally transcribed recordings using a deductive approach with subsequent subthemes developed. Participants' comments were grouped under 3 predetermined domains of interest: access,

functionality, and quality. Access referred to participants' ability to use the V-TTG™ in terms of possessing and knowing how to use necessary Internet devices. Functionality was judged according to how effective participants perceived the V-TTG™ to be in teaching patients about inhaler technique. Quality was defined as the degree to which participants had a positive experience while using the V-TTG™. Transcript sections were then inductively coded using the constant comparative method to generate new themes within each domain. Three members of the research team coded the interview transcripts. One principal investigator (V.G.P.) and 1 research assistant (N.M.W.) independently coded 10% of the same interview transcripts to establish a coding scheme.^{37,38} Two research assistants (N.M.W. and M.W.) then independently coded all the transcripts using that coding scheme, with V.G.P. coding a further 20%.³⁹⁻⁴¹ Discrepancies between investigators were resolved via consensus. Coding continued until theme saturation was reached. Transcripts and codes were not returned to focus group participants. However, the general results were reported to the member check focus group participants.

All qualitative analysis of the data, including retrieving, coding, and sorting the data, was completed using Atlas.ti 7.5 (Berlin, Germany).

RESULTS

Technology survey

A total of 48 participants with asthma (67%, 32 of 48) or COPD (33%, 16 of 48) completed the technology survey. Most were black (77%) and female (60%), with a mean age of 48 years (Table 1). No demographic differences were found by diagnosis except that patients with asthma (vs COPD) had a median younger age (38 years vs 56 years; $P < .001$).

Survey findings regarding technology ownership and use (Table 1) indicated that Internet access and use frequency were generally high, with 77% (37 of 48) of respondents reporting Internet use at home, 62% (30 of 48) reporting phone data plans, and 82% (40 of 48) reporting frequent Internet use. Survey respondents showed high willingness to use V-TTG™ postdischarge, with more than 80% (39 of 48) stating that they would be "somewhat" or "very" likely to use it to learn more about skills to improve their health problems. Most survey participants (73%, 35 of 48) possessed a smartphone, followed by laptop computers (52%, 25 of 48), desktop computers (42%, 20 of 48), tablets (23%, 11 of 48), and other devices (19%, 9 of 48). Similarly, participants who reported that they would be willing to use V-TTG™ most preferred using smartphones (44%, 21 of 48), followed by laptop computers (35%, 17 of 48), desktop computers (25%, 12 of 48), tablets (21%, 10 of 48), other devices (17%, 8 of 48), and finally public computers (8%, 4 of 48). (Figure 1).

Participants with asthma compared with participants with COPD were more likely to own a smartphone (88% vs 44%; $P = .004$), have a data plan (77% vs 38%; $P = .007$), and use the Internet at least daily (81% vs 53%; $P = .046$). However, there were no significant differences among participants with asthma or COPD with respect to owning laptop, desktop, or tablet computers, use of the Internet at their home or their families', or use of WiFi in public ($P > .05$). There were also no differences between the groups with respect to willingness to use V-TTG™ at home ($P = .5$). (Table 1).

TABLE I. Demographic, technology ownership, and technology use characteristics of technology survey respondents with asthma and/or COPD (n = 48)

Variables	Asthma or COPD (n = 48)	Asthma (n = 32)*	COPD (n = 16)†	P
Sex: female, n (%)	29 (60)	22 (69)	7 (44)	.07
Age (y), median (IQR)	48 (34-55)	38 (31-51)	56 (52-61)	<.001
Race, n (%)				.7
Black	37 (77)	24 (80)	13 (81)	
White	8 (17)	5 (17)	3 (19)	
Other	1 (2)	1 (3)	0 (0)	
Device ownership, n (%)				
Smartphone	35 (73)	28 (88)	7 (44)	.004
Laptop	25 (52)	19 (59)	6 (38)	.2
Desktop	20 (42)	13 (41)	7 (44)	.8
Tablet	11 (23)	9 (28)	2 (13)	.3
Internet access, n (%)				
Uses the Internet at home	37 (77)	28 (88)	12 (69)	.1
Uses the Internet at family's home	21 (44)	17 (53)*	4 (25)†	.1
Uses WiFi in public spaces	27 (56)	20 (63)	7 (44)	.2
Has phone data plan	30 (63)	24 (7)*	6 (38)	.007
Internet use frequency, n (%)‡				.046
Several times per day	29 (60)	22 (69)	7 (44)	
About once a day	5 (10)	0 (0)	1 (6)	
3-5 d per week	1 (2)	0 (0)	1 (6)	
1-2 d per week	3 (6)	0 (0)	3 (19)	
Every few weeks	2 (4)	2 (6)		
Less often than every few weeks	4 (8)	3 (9)	1 (6)	
Never	3 (6)	1 (3)	2 (13)	
NA	1 (2)	0 (0)	1 (6)	
Willing to use V-TTG™ postdischarge, n (%)	39 (81)	27 (84)	12 (75)	.5

IQR, Interquartile range; NA, not applicable/available.

*Data missing for n = 2 sex, race; n = 9 for Internet use at family's home for asthma; n = 1 for data plan.

†Data missing for n = 9 for Internet use at family's home.

‡Internet use frequency dichotomized into "less than" or "at least" daily use for statistical analysis.

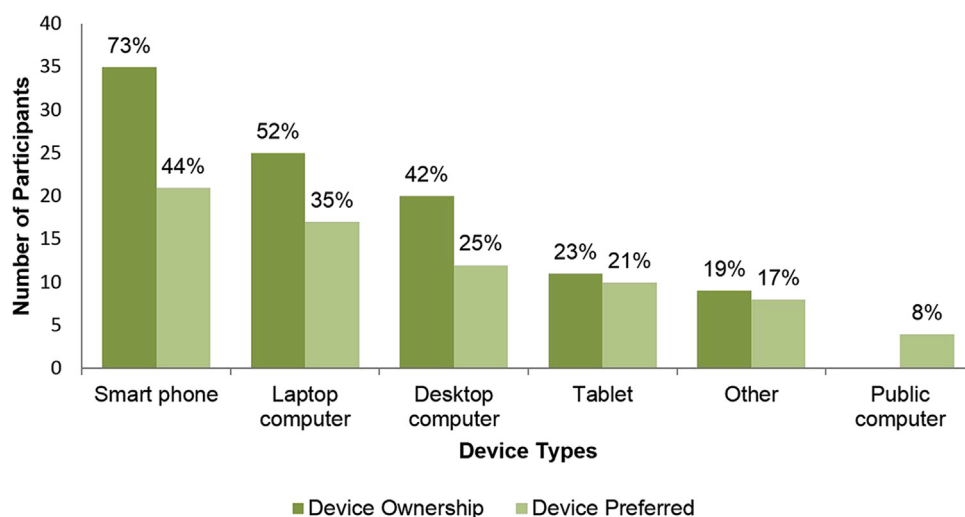


FIGURE 1. Patients' device ownership rates and preferred devices for accessing V-TTG™. Percent totals exceed 100% because respondents were instructed to select all devices they own or would use.

Focus groups

A total of 9 focus groups with 25 participants took place over the 5-month period between December 2013 and April

2014. All participants had diagnoses of asthma and/or COPD. Nine participants returned for the member check meeting.

TABLE II. Domains, themes, and representative positive and constructive quotes

Domain	Theme	Positive quote	Constructive quote/suggestion
Access	Platform & delivery	[MODERATOR: <i>What do you think the best way to deliver this video would be?</i>] I think probably email.	[T]here's a distinction there about how people want to get the information... you can give people the option of how they're going to get it.
	Internet access	[E]verywhere I go... there's WiFi... I have five sisters and they have WiFi. I have three daughters and they have WiFi so, the majority of the time everywhere I go I'm using WiFi...	[P]robably more people now have DVD players at home than they have Smartphones for example. Or, maybe even Internet access so... then you can use a DVD or CD.
	Technological literacy	I think most people in 2014 are just so literate when it comes to these things and like almost everything is password and using it [for] paying bills, looking at a movie...	I don't think that serves [this] general population. I think you're going to have... less tech-savvy people.
Functionality	Usefulness	Anyone that has any asthma and COPD or anything like that, I think they would really benefit from watching the movie...	[T]hey're basically fairly simple steps to take. And, you know, why do I need to watch a video to learn how to do this?
	Content	[A] lot of people think they know how to use their inhaler but they don't or... there are little things that they're not doing correctly... [T]his makes sure that you know exactly what you're doing...	Does your video go further into detail without... using the spacer? ... I mean spacer is a very, very good instrument, but the bottom line most people just don't use it.
	Teaching strategy	One positive thing I would say is that the demonstration was repeated, and so whatever was there, was reinforced... so I thought that was helpful.	I didn't like the way they kept you asking you the steps... but then... I guess I need to be aggravated because I got it wrong.
Quality	Clarity	I think it is informative and clear.	But why do they mention step 7 and then they don't say here's step 1, here's step 2, here's step 3?
	Ease of use	[T]he drop-down with the options in it makes it a lot easier.	[I]f I was looking at it a really long time I would probably want a bigger font.
	Length	It was short and to the point.	I thought it was a little bit too long.
	Likeability	[I]t was just really good... easy to follow, self-explanatory.	I don't know if I would watch it again. It was a little tiring.

Themes. Participants' comments, grouped under 3 pre-determined domains of interest (access, functionality, and quality), were then evaluated using inductive analysis to reveal themes within each domain. Themes identified for access were platform and delivery, Internet access, and technological literacy. A representative quote under the access Internet theme was "I do have a friend that she does not have WiFi or — as a matter of fact she don't have a computer. But, she will go to the library to watch anything and look up anything..." For functionality, themes identified were usefulness, content, and teaching strategy. A representative quote for the functionality content theme was "[The module] pertains to my health and it's helpful because some things I didn't know and I learned that from that video..." Themes identified for quality were clarity, ease of use, length, and likeability. A representative quote for the quality likeability theme was "[T]hat video was fantastic because I could comprehend and I understood everything that she said."

When applicable, participants' comments were also thematically coded as positive or constructive regarding V-TTGTM; examples of positive versus constructive quotes can be found in Table II.

Iterative development of V-TTGTM. Further analysis of the themed feedback was completed to identify concrete changes that could be made to the V-TTGTM. Positive comments led to retention of that aspect of the V-TTGTM with no changes made. Constructive comments were sorted into "able to change" or "unable to change." Changes made affected 3 components: videos, questions, or the module as a whole (Table II). For

instance, it was found that the first round of focus group participants (#1-4), who watched the individual videos and reviewed the prevideo and postvideo questions on paper, had positive comments regarding the conciseness and content of the videos, but questioned the inclusion of the spacer, found certain aspects of the video narrator and demonstrator distracting, and pointed out segments that needed additional clarification. Constructive comments that were deemed changeable informed the revision of the V-TTGTM before the second round of focus groups (Table III).

The second round of focus group participants (#5-6), who watched the videos and separately answered prevideo and post-video questions online, gave feedback regarding question wording and areas in which ease of use of the online interface could be improved. Again, constructive comments that were deemed changeable informed the revised V-TTGTM before the final round of focus groups (Table III). Participants in round 3 focus groups (#7-9), who completed the full V-TTGTM learning platform, found it highly useful in teaching inhaler technique and noted that the pretest and posttest questions were particularly effective at elucidating aspects of inhaler technique of which they were previously unaware. Any final constructive comments that could be addressed informed the development of the final version of the V-TTGTM (Figure 2).

When changes could not be made, it was due to 1 of 4 reasons: (1) suggestions went against clinical guidelines, for example, some participants asked if the demonstration video could show inhaler technique without inclusion of the spacer; (2) participants had differing opinions regarding that aspect of V-TTGTM and did not reach a consensus, in which case the final

TABLE III. Changes made after focus group feedback and survey data with corresponding domains and themes

Component	Feedback	Change made	Domain	Theme
Video	Narrator comment regarding “step 7” confusing; video had made no reference to other steps	Removed comment	Quality	Clarity
	Preferred explicit demonstration of “whistle” sound created when breathing from spacer too quickly	Added “whistle” sound effect	Functionality	Content
	Youtube video ads popped up after instructional videos finished	Extended instructional video length to prevent pop-up ads	Quality	Likeability
	Did not like video showing incorrect inhaler technique	No change made— differing opinions	Quality	Likeability
	Suggested multiple videos for different inhalers	No change made— videos could not be reshot	Functionality	Content
	Issues with appearances of video narrator/ demonstrator	No change made— videos could not be reshot	Quality	Likeability
Questions	Wording	Simplified wording	Quality	Clarity
	Tested redundant and/or nonessential concepts	Removed question	Functionality	Teaching strategy
	Preference for drop-down menu vs manual input or list format	Changed to drop-down format	Quality	Ease of use
	Pretest questions did not match posttest questions	Changed from 4 pretest and 6 posttest questions to 6 matched pretest and posttest questions	Functionality	Teaching strategy
Module	Include statistics on rates of inhaler misuse	No change made	Quality	Likeability
	Brought up unfamiliarity with spacer use in target population	Added introduction to spacers and explanation of their importance	Functionality	Content
	Requested inclusion of cleaning instructions for spacer	Added instructions	Functionality	Content
	Suggested offering multiple options for accessing V-TTG™	Made V-TTG™ Web-based and delivered via email to optimize multimodal access	Access	Platform & delivery
	Need for clarification on which type of inhaler V-TTG™ is targeted toward	Clarified V-TTG™ instruction targeted toward MDI devices	Quality	Clarity
	Disliked having to redo all questions if answered any incorrectly	Changed lesson setup so that patients redo only incorrect questions in subsequent rounds	Functionality	Teaching strategy
	Wanted feedback for incorrect answers	Feedback given if answer still incorrect after round 3	Functionality	Teaching strategy
	Font size small	Increased module font size	Quality	Ease of use
	Include instructions to rinse mouth with water after use of controller medication	Added instructions	Functionality	Content
	Include instructions to call 911 in emergency situation if patient experiences no symptom relief after use of rescue medication	Added instructions	Functionality	Content

MDI, Metered dose inhaler.

decision was made according to the research team’s discretion; (3) videos could not be reshot; for example, some participants commented on aspects of the video narrator and demonstrator that they found distracting, but the videos had been created before the focus groups and could not be redone; and (4) some suggestions fell out of the scope of the project, for example, playing the instruction videos in pulmonary clinic waiting rooms.

To incorporate all necessary changes, the V-TTG™ went through a total of 7 versions. Member check participants reported a median satisfaction score of 9 (out of 10) with the changes made. The median satisfaction score with the degree to which participants felt their comments had been considered was 10.

DISCUSSION

The findings of the technology survey demonstrated that patients with asthma and/or COPD from our hospital population largely have home access to the Internet and frequently use it,

making baseline access to V-TTG™ a feasible option. However, there were some important differences found between the asthma and COPD cohorts that need to be taken into consideration when implementing V-TTG™ for home use for patients with these different diseases. Feedback from focus group participants praised the ease of use and conciseness of the module, while pinpointing areas of improvement within the user interface. A finalized V-TTG™ module generated high rates of satisfaction among participants in the final member check meeting.

By using a mixed methods strategy that investigated patient technology usage and incorporated end-user feedback early in the intervention design process, we were able to refine V-TTG™ for optimal accessibility, acceptability, and effectiveness for patients’ use. The quantitative data from surveys allowed us to broadly determine the appropriateness of V-TTG™ for our population of interest, whereas qualitative findings from focus groups allowed us to fine-tune V-TTG™ for optimal patient use. Both components of the intervention design process led to the incorporation of end-user needs and preferences into the module and better

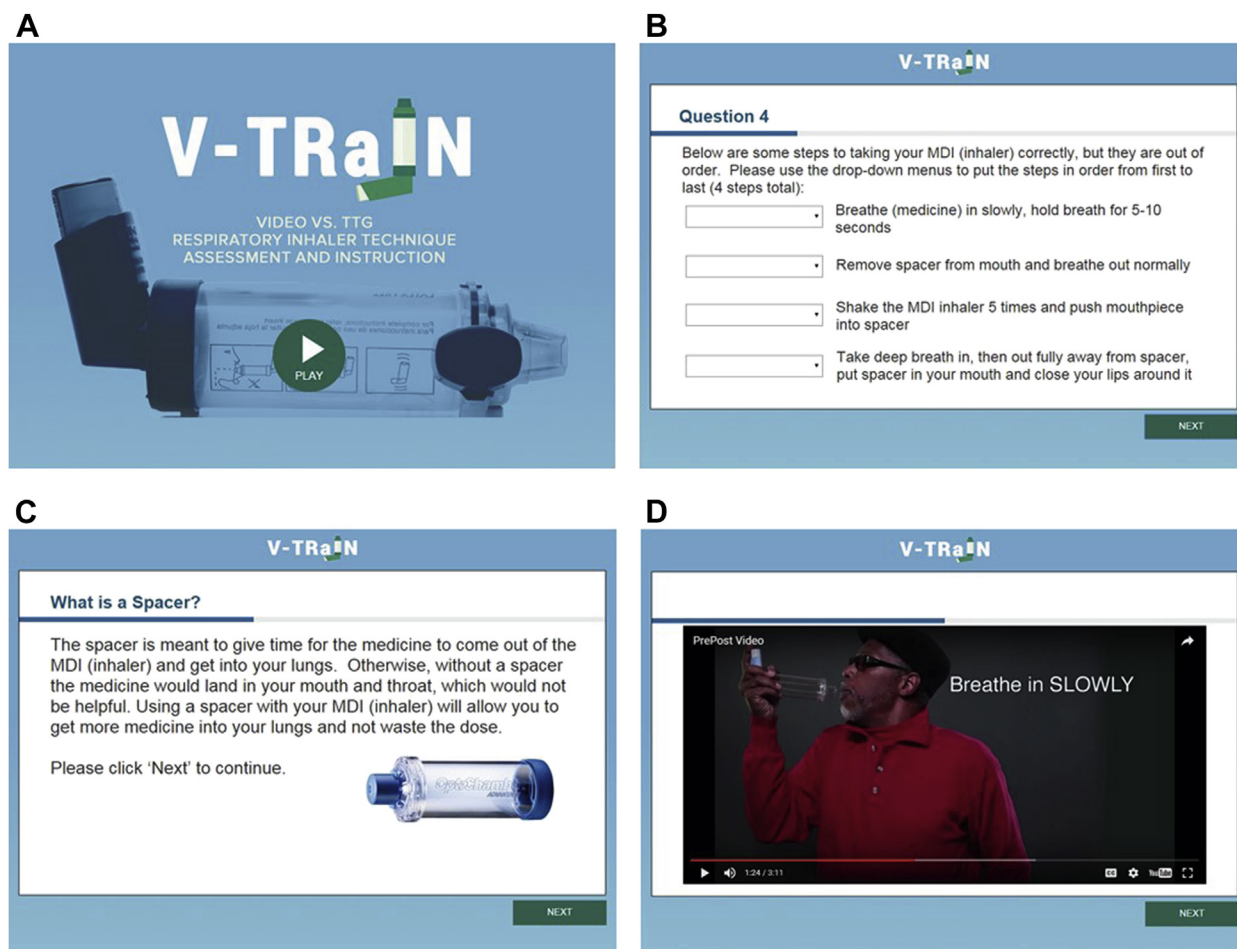


FIGURE 2. The finalized V-TTG™ educational module. **A**, Title screen. **B**, Example question. If answer is incorrect in posttest rounds 1 and 2, prompts to retake the question after reviewing the demonstration. **C**, Additional information on spacer function. **D**, Demonstrator during the video of the correct inhaler technique.

tailored it to our patient population, demonstrating that a V-TTG™ interactive module holds promise as a way to educate hospitalized patients with asthma or COPD about proper inhaler technique.

Focus group feedback was particularly important in improving the functionality and quality of V-TTG™. Constructive comments and suggestions from focus group participants led to several changes that streamlined the user interface experience and increased the clarity of both video demonstrations and wording of assessment questions. In addition, suggestions that were grounded in participants' personal experiences with managing asthma or COPD led to the inclusion of content that increased the relevancy of V-TTG™ to our patient population by better addressing their needs and concerns.

Focus group feedback was mixed on the subject of access. Therefore, we supplemented our understanding of any potential access barriers to the Internet or to technological devices with data from the technology survey. Preliminary findings from the survey were consistent with previous work done within our local population, showing that 65% of the general community uses the Internet daily.³⁵ Basic access to V-TTG™ is therefore available to most of our patients. From the survey data, it is clear that

most patients were open to using technology for health-related information; however, various access types and devices are needed. Although the most commonly owned and preferred device was smartphones, no single device was overwhelmingly selected over others. Feedback from our focus group participants that pertained to the theme of access also revealed a similar pattern of heterogeneity in device preference. The final version of our module, therefore, can be used on any device with Internet connectivity, maximizing flexibility of access for our patients.

Importantly, implementation of V-TTG™ into home-based interventions will need to consider unique aspects of the target populations. For instance, patients with COPD, who tend to be older than patients with asthma, are less likely to own a smartphone or have a data plan. Therefore, the accessibility of V-TTG™ on any device makes this a feasible intervention for this population. Furthermore, patients with COPD were found to use the Internet less often than patients with asthma, so the schedule of use of V-TTG™ needs to take these data into consideration.

An additional learning point from the study was the strength of applying a mixed methods approach to intervention design. Although a mixed methods strategy has been increasingly used

within the realm of medical education research,⁴² it has been less frequently applied to the design of interventions for patient care. Combining the advantages of qualitative methods that elicit end-user perspectives with quantitative approaches may result in improved usability and likeability of clinical interventions.

This study has limitations that should be noted. Both survey participants and focus group members were recruited from a single academic center with a majority black patient population. Levels of interest in V-TTG™ and overall relevance to patients may not be generalizable to patients at other clinical sites. In addition, participants in both the technology study and focus groups were limited to those who spoke English. It is possible that speakers of other languages may have differential technology access and perceptions of the usefulness and relevance of V-TTG™. The technology survey was also a preliminary study with a small sample size that will require further testing when broader samples are collected.

In summary, V-TTG™ shows promise as a Web-based educational tool for improving hospitalized asthma or COPD patients' inhaler technique. It combines the advantages of in-person TTG training with the portability, flexibility, and decreased resources of an online module that patients can access using their own devices postdischarge for increased learning reinforcement. Although some technology use and ownership rates differ among patients with asthma compared with COPD, this V-TTG™ intervention was designed for flexible use among technology device types. The completed development and validation of V-TTG™²⁴ positions us well to move forward with further efficacy and effectiveness studies to determine the full impact and range of use for V-TTG™ to enhance patient self-management skills for asthma or COPD.

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