

COMMENTARY

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Teaching children about immunization in a digital age

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ABSTRACT

We believe that public health efforts to address issues of vaccine hesitancy should increase their focus on childhood education. An opportunity exists to create positive, accurate vaccine attitudes through fun and interactive approaches early in life. Leveraging digital technologies may provide a way to deliver these messages to children in a way that complements immune system and immunization education in school curricula. We recommend that public health officials explore and identify the most effective ways to deliver positive digital messages to children in hopes of “inoculating” the next generation against vaccine hesitancy.

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A pediatrician is discussing the benefits of vaccination to a parent. The parent tells the physician that she has conducted her own research and found out that these vaccines are not safe and that all the research he is quoting is biased and funded by the pharmaceutical industry. All his efforts to reassure her fall on deaf ears.

This is a scenario many health care providers are all too familiar with.^{1,2} It can be time-consuming, frustrating, and potentially damaging to the relationship with the family.³ What it really speaks to is the futility in changing beliefs in adulthood. Studies have demonstrated that presenting pro-vaccination information to adults may actually encourage anti-vaccine sentiment, suggesting that, in some, these beliefs may be deeply held by adulthood.^{4,5} Is it possible to try to influence beliefs before they become firm and fixed? A key period when beliefs are formed is childhood. We believe that there is an opportunity for public health officials to focus educational efforts on vaccination in childhood. While this would begin with traditional means like including lessons in school curricula,⁶ there is a particular opportunity to leverage digital technologies to create and disseminate engaging and effective messaging to children. In doing so, we can create positive views on vaccination and simultaneously excite children about the science behind the immune system.

Digital opportunities

The anti-vaccine movement has been using the Internet and social media to communicate their message since the inception of these technologies.⁷ The virtually ubiquitous use of digital media and smartphones by children,⁸ however, also creates an ideal channel for public health officials to communicate their own positive messages about vaccination to this demographic.

Digital comic books can complement traditional books⁶ and are an excellent mechanism for children to read about the immune system. A comic called “viral attack” shows kids using immune system weapons like cytotoxic guns to fight viruses.⁹ Another comic, aimed at both children and parents, incisively debunks the myths about vaccines.¹⁰

Educational videos are a powerful way to communicate complex scientific concepts and have been shown to be effective in modifying health behaviors.¹¹ They can explain in detail how something works, summarizing large amounts of content in a way that is difficult through text or static photos.¹² Videos have also been shown to improve learning outcomes,¹³ and can be enhanced through the use of narratives.¹⁴ Research has shown that dramatized video increases viewer identification with characters, thus driving narrative engagement and the creation of episodic memories - which improves memory recall. A study evaluating video interventions in clinic waiting rooms supports this pathway, finding excellent recall and retention of the video's content at 3-month follow up.¹⁵ Further, narratives are intrinsically persuasive, potentially offering a medium to communicate scientific information to non-expert audiences, such as children¹⁶ Videos have been used to teach the fundamentals of the immune system through analogies such as a castle invasion theme.¹⁷ Many may remember the episode of *The Magic School Bus* on the immune system, where Ms. Frizzle and her class shrink and slip into Ralphie's veins to see what is making him sick.¹⁸ Videos can also provide public service messages from opinion leaders like the video of the Surgeon General with Elmo.¹⁹

As many parents unfortunately know, video games are an effective way to capture children's attention. Digital game-based learning (DGBL) has been shown to promote learning and motivation, although the area would benefit from further research.^{20,21}

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Table 1. A sample of digital resources for children's education on immunization.

Comic books	<ul style="list-style-type: none"> • Viral Attack: Askabiologist http://askabiologist.asu.edu/sites/default/files/resources/activities/body_depot/viral_attack/viral_attack.pdf • Vaccines work. Here are the facts. https://medium.com/the-nib/vaccines-work-here-are-the-facts-5de3d0f9ffd0#.mx9r6tz5r • Immunity Warriors: Invasion of the Alien Zombies! www.immunitywarriors.com
Videos	<ul style="list-style-type: none"> • Immunity and Vaccines Explained: Pbs.org http://www.pbs.org/video/2365317280/ • Immune System. Kidshealth.org http://kidshealth.org/en/kids/ismovie.html • Surgeon General and Elmo team up to talk vaccinations https://youtu.be/ZpOHlzkLP-g • Cybersleuth Kids. Immune System. http://cybersleuth-kids.com/videos/Immune-System_v2755 • Getvaxed.org – a resource for teens and young adults http://www.getvaxed.org/videos.htm
Games	<ul style="list-style-type: none"> • Vax Pack Hero: “Team up with vaccine heroes to beat germs and keep patients healthy” http://www.phillyvoice.com/chop-releases-vaccine-themed-video-game-kids/ • Flu Mania: https://itunes.apple.com/au/app/flumania/id970486995?mt=8 • Sid the Science Kid “Super Duper Antibodies” http://pbskids.org/sid/germs.html • Pox. Save the People https://itunes.apple.com/en/app/pox-save-the-people/id475604824?mt=8

Gamification and the creation of apps can use the criteria of story genre, immersion, fantasy, design, and gameplay to create positive concepts about vaccination. Examples of this already exist; the game *POX* helps teach the concept of herd immunity as the player tries to stop a spreading outbreak by vaccinating individuals.²² The game *Vax Pack Hero* from The Children's Hospital of Philadelphia teaches the history of vaccination while having the user fight up to 21 different vaccine-preventable diseases.²³

How should we do this?

The key to engaging children is, obviously, to make it fun and not seem like a school lesson. The immune system is fascinating and many analogies are effective – whether it be war and invasion or more positive imagery of teaching and training the immune system, perhaps like a sports team preparing for a game. Vaccine advocates could learn from the success climate change activists have had in communicating with children. The NASA “*Climate Kids*” website, for example, provides resources to help teach climate change to children.²⁴ Public health agencies should do so similarly for immunization. However, identifying the best modality to reach children will require more study.²⁵ All children learn differently and some may prefer more traditional methods of learning, and videos may only be particularly successful in students who are ‘visual learners’.

Research is needed to study the impact of different modalities, messaging and strategies on children's knowledge and perception of vaccines and the long-term impact of this messaging. There are strong disincentives in the cost of conducting this type of research, which may provide clues as to why there is so little available.¹⁴ A recent scoping review also found that there is a scarcity of evidence on the cost-effectiveness of media usage in public health messaging and relatively little on the use of visual methodologies, despite their potential to overcome literacy and language barriers.²⁶

Research should also seek to determine the best age range for childhood education to maximize appropriateness and effectiveness. There has been limited research examining how children of different ages understand and conceptualize health and illness.²⁷ Some suggest that the ability to link past events with current health behavior or problems emerges in middle childhood, which may provide guidance as to the best time to educate children about the delayed-benefits of vaccinations. To date, most efforts to educate children and youth about immunization has been focused on adolescents and the HPV vaccine.^{28,29}

Making immunization education fun

Albert Einstein is believed to have said “Common sense is the collection of prejudices acquired by age eighteen.”³⁰ In the case of immunization, most children's experience with vaccination is negative, a shot in the arm. However, the opportunity exists to create positive, accurate “prejudices” in a fun and interactive way and mobile devices provide a way to deliver these messages to children. Having these available on mobile health apps would enable parents to have their bored children learn about the immune system and vaccination while waiting to see their health care provider. These initiatives should complement efforts to introduce immunization education in school curricula. We strongly recommend that public health officials identify the most effective ways to deliver positive digital messages to children and protect the next generation of vaccinators from anti-vaccine ideas. And messaging that works on children just may also work on adults.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

References

- [1] Kempe A, Daley MF, McCauley MM, Crane LA, Suh CA, Kennedy AM, Basket MM, Stokley SK, Dong F, Babbal CI, et al. Prevalence of parental concerns about childhood vaccines: the experience of primary care physicians. *Am J Prev Med* 2011; 40(5):548-55; PMID:21496754; <http://dx.doi.org/10.1016/j.amepre.2010.12.025>
- [2] Siddiqui M, Salmon DA, Omer SB. Epidemiology of vaccine hesitancy in the United States. *Hum Vaccin Immunother* 2013; 9(12):2643-8; PMID:24247148; <http://dx.doi.org/10.4161/hv.27243>
- [3] Opel DJ, Mangione-Smith R, Robinson JD, Heritage J, DeVere V, Salas HS, Zhou C, Taylor JA. The influence of provider communication behaviors on parental vaccine acceptance and visit experience. *Am J Public Health* 2015; 105(10):1998-2004; PMID:25790386; <http://dx.doi.org/10.2105/AJPH.2014.302425>
- [4] Nyhan B, Reifler J, Richey S, Freed GL. Effective messages in vaccine promotion: a randomized trial. *Pediatrics* 2014; 133:e835-42; PMID:24590751
- [5] Wilson K, Mills EJ, Norman G, Tomlinson G. Changing attitudes towards polio vaccination: a randomized trial of an evidence-based presentation versus a presentation from a polio survivor. *Vaccine* 2005; 23(23):3010-5; PMID:15811647; <http://dx.doi.org/10.1016/j.vaccine.2004.12.002>
- [6] Why You'll Never Catch Small Pox. 2016. <http://www.schoolscience.co.uk/whyyoullnevercatchsmallpox/>.
- [7] Wilson K, Keelan J. Social media and the empowering of opponents of medical technologies: the case of anti-vaccinationism. *J Med*

- Internet Res 2013; 15(5):e103; PMID:23715762; <http://dx.doi.org/10.2196/jmir.2409>
- [8] Chaudron S. Young children (0-8) and digital technology. A qualitative exploratory study across seven countries Joint Research Centre European Commission 2015.
- [9] Roy J. Smallpox Zero: An Illustrated History of Smallpox and Its Eradication. 1 ed. Johannesburg, South Africa: African Comic Production House, Emory Global Health Institute; 2010.
- [10] Naro M. Vaccines Work: Here are the Facts. 15 December 2014 2014. [Available at: <https://medium.com/the-nib/vaccines-work-here-are-the-facts-5de3d0f9ffd0-a4gpn8in>].
- [11] Tuong W, Larsen ER, Armstrong AW. Videos to influence: a systematic review of effectiveness of video-based education in modifying health behaviors. *J Behav Med* 2014; 37(2):218-33; PMID:23188480; <http://dx.doi.org/10.1007/s10865-012-9480-7>
- [12] Merkt M, Weigand S, Heier A, Schwan S. Learning with videos vs. learning with print: The role of interactive features. *Learning and Instruction* 2011; 21(6):687-704.
- [13] Zhang D, Zhou L, Briggs RO, Nunamaker JF. Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information Management* 2006; 43(1):15-27; <http://dx.doi.org/10.1016/j.im.2005.01.004>
- [14] Downs JS. Prescriptive scientific narratives for communicating usable science. *PNAS* 2014; 111(Supplement 4):13627-33; PMID:25225369; <http://dx.doi.org/10.1073/pnas.1317502111>
- [15] Besera GT, Cox S, Malotte CK, Rietmeijer CA, Klausner JD, O'Donnell L, Margolis AD, Warner L. Assessing patient exposure to a video-based intervention in STD clinic waiting rooms: findings from the safe in the city trial. *Health Promot Pract* 2016; 17(5):731-8; PMID:27091608; <http://dx.doi.org/10.1177/1524839916631537>
- [16] Dahlstrom MF. Using narratives and storytelling to communicate science with nonexpert audiences. *PNAS* 2014; 111(Supplement 4):13614-20; PMID:25225368; <http://dx.doi.org/10.1073/pnas.1320645111>
- [17] Kids Health. Immune Cells; Nemours. 1999 [Available at: <http://kidshealth.org/en/kids/ismovie.html>].
- [18] May J, Stevenson J. Inside Ralphy; The Magic School Bus. 103: Scholastic Co; 1994 [Available at: <http://www.scholastic.com/magicschoolbus/tv/index.htm>].
- [19] Silverman M. Surgeon General and Elmo team up to talk vaccinations. *The Daily Dot*. 2015 [Available at: <https://www.youtube.com/watch?v=ZpOHlzkLP-g&feature=youtu.be>].
- [20] Erhel S, Jamet E. Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Comput Educ* 2013; 67:156-67; <http://dx.doi.org/10.1016/j.compedu.2013.02.019>
- [21] Girard C, Ecalle J, Magnan A. Serious games as new educational tools: how effective are they? A meta analysis of recent studies. *J Comput Assist Learn* 2013; 29(3):207-19; <http://dx.doi.org/10.1111/j.1365-2729.2012.00489.x>
- [22] Flanagan M. Tiltfactor, POX: Save the People; 2011 [Available at: <https://itunes.apple.com/en/app/pox-save-the-people/id475604824?mt=8>].
- [23] The Children's Hospital of Philadelphia. Vax Pack Hero: 2016 [Available from: <http://vaxpackhero.com/>].
- [24] Climate Kids: NASA's Eyes on the Earth. 20 July 2016 2016. <http://climatekids.nasa.gov/>.
- [25] Young MF, Slota S, Cutter AB, Jalette G, Mullin G, Lai B, Simeoni Z, Tran M, Yukhymenko M. Our princess is in another castle a review of trends in serious gaming for education. *Review of Educational Research* 2012; 82(1):61-89
- [26] Clar C, Dyakova M, Curtis K, Dawson C, Donnelly P, Knifton L, Clarke A. Just telling and selling: current limitations in the use of digital media in public health: a scoping review. *Public health* 2014; 128(12):1066-75; PMID:25443388; <http://dx.doi.org/10.1016/j.puhe.2014.09.009>
- [27] Erickson SJ, Gerstle M, Feldstein SW. Brief interventions and motivational interviewing with children, adolescents, and their parents in pediatric health care settings: a review. *Arch Pediatr Adolesc Med* 2005; 159(12):1173-80; PMID:16330743; <http://dx.doi.org/10.1001/archpedi.159.12.1173>
- [28] Miller MK, Wickliffe J, Jahnke S, Linebarger J, Humiston SG. Views on human papillomavirus vaccination: a mixed-methods study of urban youth. *J Commun Health* 2014; 39(5):835-41; PMID:24664875; <http://dx.doi.org/10.1007/s10900-014-9858-2>
- [29] Krawczyk A, Lau E, Perez S, Delisle V, Amsel R, Rosberger Z. How to inform: comparing written and video education interventions to increase human papillomavirus knowledge and vaccination intentions in young adults. *J Am Coll Health* 2012; 60(4):316-22; PMID:22559091; <http://dx.doi.org/10.1080/07448481.2011.615355>
- [30] Quote Investigator. Common Sense Is Nothing More Than a Deposit of Prejudices Laid Down in the Mind Before Age Eighteen: Albert Einstein? Lincoln Barnett? Apocryphal?; 2014 [Available from <http://quoteinvestigator.com/2014/04/29/common-sense/-note-8792-1>].