Meeting Report and Recommendations
Advisory Committee on Integration of Immunization Into Undergraduate Nursing Curriculum (ACIIUN)
Executive Summary
Advisory Committee on Integration of Immunization Into Undergraduate Nursing Curriculum (ACIIUN)

April 20, 2015 | Washington, DC

BACKGROUND:
The Association for Prevention Teaching and Research (APTR) has a long history of working with the Centers for Disease Control and Prevention (CDC), and the current National Center on Immunization and Respiratory Diseases (NCIRD), to develop and enhance educational and training programs around immunizations. Since 1990, APTR has partnered with CDC and other professional organizations to assess immunization training needs of health professionals and develop appropriate programs, publications workshops, presentations, articles, and websites based on those assessments.

PROCESS:
On April 20, 2015, APTR and the Centers for Disease Control and Prevention (CDC), National Center on Immunization and Respiratory Diseases (NCIRD), convened 21 academic nursing representatives for the first meeting of the Advisory Committee on Integration of Immunization into Undergraduate Nursing Curriculum meeting. The recent climate around immunizations, advancements in teaching methods for health professions education, and the practice of nursing have resulted in the need to enhance immunization resources for training and education of nurses. The advisory committee discussed current curriculum gaps, reviewed educational resources and training methods, and provided recommendations for improving the integration of immunization in undergraduate nursing education.

RECOMMENDATIONS
The Advisory Committee agreed that lacking is consistency and structure among nursing schools and programs on how and where to integrate immunization education into the nursing curriculum. The recommendation is that a framework and accompanying toolkit would provide guidance for faculty to integrate immunization content and a variety of learning resources into the curriculum and would provide the rationale and impetus for institutional support. The Advisory Committee agreed that the framework and toolkit/resource repository should focus on entry-level learning for the undergraduate nursing student and should include prioritization of content, resources, and curricular recommendations. The following are recommendations from the Advisory Committee in order of priority:

1. **Development of a Framework for Immunization Education in Undergraduate Nursing.**
   A framework is to increase immunization content in the undergraduate nursing curriculum, ensure consistency and the access to current information/recommendations for faculty and students, prioritize information and content to be included, and support the integration of this content into the curriculum.

2. **Development of a Resource Repository**
   This online or digital repository would provide current, vetted resources and teaching tools, as well as guidelines for faculty to support the integration of immunization into the curriculum. The repository would build on the framework described above.

3. **Development of Teaching Resources**
   Additional learning resources are necessary that use new teaching modalities. Several potential best-practice tools for learners identified were by the advisory group participants and detailed in the report.

FOR MORE INFORMATION:
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ADVISORY COMMITTEE MEMBERS
A full directory of the ACIIUN Committee Members is available in Appendix A

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<thead>
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<th>Participant Name</th>
<th>Representing Organization</th>
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<tbody>
<tr>
<td>Mary Paterson (Moderator)</td>
<td>American Association of Colleges of Nursing</td>
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<td>Beverly Bowers</td>
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The following CDC/NCIRD personnel joined part of the meeting by conference call: Raymond Strikas, Medical Officer and Susan Farrall, Health Communications Specialist.

GOALS & OBJECTIVES
An advisory panel comprised of experts representing diverse perspectives—including undergraduate nursing education, national nursing practice and education associations, and students—was tasked with creating a summary report for CDC detailing current educational resources used, content gaps in educational resources, current teaching around immunization and how instruction is delivered. The primary focus of the Committee is undergraduate nursing education, however, the Committee considered resources relevant to practicing nurses and the interprofessional audience.

CDC-NCIRD is seeking guidance to identify existing resources that are: currently used to teach nurses about immunization, resources used to teach others that may be adapted for use in undergraduate nursing education, or recommendations for new immunization resource(s) that could be developed. Due to the frequency of changes in immunization recommendations, evidence and schedules, the ability to update these resources in a timely and cost-effective way is a priority. The recommendations and information gathered from the advisory
committee meeting will inform the potential development of new resource(s) to enhance undergraduate nursing education.
The Committee was asked to:
- Provide recommendations on how to enhance immunization education for undergraduate nursing, including what should potentially be taught and resources that would facilitate the integration of this content into the undergraduate nursing curriculum.
- Consider changes in health care, technology and the environment in higher education with particular interest in best methods for teaching immunization content.

IMMUNIZATION IN SCHOOLS & PROGRAMS
Information on how and what is currently taught in undergraduate nursing curricula as well as current resources (See Appendix B) were shared with the Committee. This data was collected prior to the meeting from each participating organization and informed a discussion where committee members shared their experiences and insights.

When are content and/or skills related to immunization taught in your school or program? Select all that apply: (N=11)

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<th>Result</th>
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<td>Core courses</td>
<td>10</td>
<td>47.6%</td>
</tr>
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<td>Clinical rotations</td>
<td>9</td>
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<td>1</td>
<td>4.7%</td>
</tr>
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<td>1</td>
<td>4.7%</td>
</tr>
<tr>
<td>Elective courses</td>
<td>0</td>
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</tr>
<tr>
<td>Not taught at all</td>
<td>0</td>
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Where is immunization taught? Select all that apply: (N=11)

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<td>Didactic courses</td>
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<td>Clinical settings</td>
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<td>32.1%</td>
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<tr>
<td>Skill labs</td>
<td>8</td>
<td>28.5%</td>
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<tr>
<td>Other</td>
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<td>3.5%</td>
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<tr>
<td>Not taught at all</td>
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What technologies are used to deliver the content or instruction? Select all that apply: (N=11)

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<td>Simulations</td>
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<tr>
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</table>
Participants shared available immunization resources and teaching materials used in their respective programs. The list of recommended resources provided by participants in the survey and at the meeting is available in Appendix C.

The Advisory Committee discussed possible dissemination efforts for immunization resources. Participants provided the following recommendations:

**Content Areas of Focus**
- Information about barriers to vaccine access
- Models of vaccine success
- Recommended versus required immunizations
- The role of Advisory Committee on Immunization Practices (ACIP) & CDC
- Vaccine administration options
- Vaccine safety
- Details on members of the immunization neighborhood (i.e., schools, pharmacy, medical home)
- Immunization information systems
- Evidence-based strategies to support reaching national vaccine goals
- Professional views of those for and against vaccines and discussion guides
- Resources focused on the need for adult immunizations
- Interprofessional team case study/dialogue
- Motivational interviewing
- Evidence-based strategies to increase immunization rates, e.g. use of reminders, recalls, EHR.

**Suggested Formats**
- Toolkits (e.g., talking points for students, families, school personnel)
- Materials showing impact of diseases before vaccines were available
- A chart, graph or trend data showing herd immunity during and after vaccinations
- More emphasis on why immunization is important
- Update the cost of loss of time from work and school due to student sick days
- Case studies (on-line for use outside or inside the classroom/skills lab)

The Nursing Initiative Promoting Immunization Training (NIP-IT) authors, Beverly Bowers and Sheryl Buckner, presented their product and evaluation efforts to the group. CDC funded this product and the website (http://www.nip-it.org) hosts videos and exemplars of communication strategies and describes the role of nurses regarding immunizations. The authors described the initial assessment of nursing programs and survey results that indicated immunization is primarily taught in the pediatric nursing curriculum. NIP-IT is designed to improve the quality of immunization education for nurses and increase immunization rates. Prior to the launch of the resource, they convened five focus groups. The authors emphasized the time and effort required to develop and maintain the online resource and discussed the structure of their national advisory board that is responsible for content review. The presentation of NIP-IT and their evaluation method provided a foundation for discussion regarding priorities. The NIP-IT presentation slides are available in Appendix D.
GAPS IN IMMUNIZATION EDUCATION

The Immunization Skill and Knowledge Matrix (Appendix E) was distributed to the advisory committee. This matrix is based on the Public Health Agency of Canada Immunization Competencies for Health Professionals available at http://www.phac-aspc.gc.ca/im/pdf/ichp-cips-eng.pdf. It is intended to guide discussion on available training materials and the required skill level required of the baccalaureate nurse in each topic area.

As part of the discussion, the Advisory Committee identified the baccalaureate skill level thought to be required for each of the 14 topic areas. The Advisory Committee agreed that the framework is a useful tool for identifying gaps in available training materials and content that should be included in undergraduate nursing curricula, along with expected level of competence. The Advisory Committee recommended adding an introductory paragraph delineating the purpose and intended use of the framework, and that topic areas should be ranked by priority to improve organization and access challenges.

The advisory committee recommended important content gaps that should to be addressed. The areas recommended for development, but in no priority are:

- Socio-cultural aspects
- Communication technologies, i.e. how to improve patient access through telehealth or social media
- Rural health
- Herd immunity, ‘culture of health’
- Team-based practice, multi-sector / system involvement
- Documentation through the EHR for individuals, state records, evaluating quality outcomes
- Policies that affect immunization practices/programs, and special populations, e.g. National Vaccine Information Act
- Theories of Immunotherapy
- Storage and handling of vaccines
- Motivational interviewing/techniques, e.g. behavioral change techniques, “change talk”
- Outbreak Response/ mass-vaccination approaches, including implications, processes, policies, and workforce training
- Access to community and state resources, including relationship with state health department (navigating the system)
- Healthcare provider recommendations
- Historical background/overview, i.e. past outbreaks and consequences, rationale for immunizations
- Population health principles

The advisory committee discussed best methods for educators to reach and engage learners and identified the following techniques:

- Point of care learning applications (app) that are current and accessible
- Flipped classroom communications
- Scripts /scripted scenarios
- Videos less than 7 min. in length
- Webinars less than 30 min. in length
- Podcasts
- Simulations, including high-fidelity simulations, scripts, and interactive scenarios that are available and appropriate for a variety of settings
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- Unfolding case studies
- Online resource center or faculty toolkit for training materials
- Integration guide with curriculum suggestions, including available resources and suggestions for integration of content and leveling throughout curriculum, unfolding case studies, simulations, assessment items.

Handouts provided at the meeting as resource tools and exemplars are available in Appendix F.

EVALUATION: FORMATIVE, PROCESS, OUTCOME
The Advisory Committee discussed the role of evaluation in the development of a new resource for immunization education. Suggestions included pilot testing, user-satisfaction survey, 30/60-day follow-up or integration survey, self-assessment, community modifier and pre- and post-survey on knowledge, beliefs and attitudes. The Advisory Committee agreed that evaluating the outcome of the resource in regards to changes in nursing practice and outcomes of care was not feasible.

DISCUSSION SUMMARY & RECOMMENDATIONS
The Advisory Committee agreed that lacking is consistency and structure among nursing schools and programs on how and where to integrate immunization education into the nursing curriculum. The recommendation is that a framework and accompanying toolkit would provide guidance for faculty to integrate immunization content and a variety of learning resources into the curriculum and would provide the rationale and impetus for institutional support. The Advisory Committee agreed that the framework and toolkit/resource repository should focus on entry-level learning for the undergraduate nursing student and should include prioritization of content, resources, and curricular recommendations.

The following are recommendations from the Advisory Committee in order of priority.

   A framework similar to the Canadian Immunization Competencies/Matrix is needed that includes expected immunization competencies, level of competence, recommended content and available learning resources. The purpose of the framework would be to increase immunization content in the undergraduate nursing curriculum, ensure consistency and the access to current information/recommendations for faculty and students, prioritize information and content to be included, and support the integration of this content into the curriculum.

2. Development of a Resource Repository
   This online or digital repository would provide current, vetted resources and teaching tools, as well as guidelines for faculty to support the integration of immunization into the curriculum. The repository would build on the framework described above.

3. Development of Teaching Resources
   Additional learning resources are necessary that use new teaching modalities. Potential best-practice tools for learners identified by the advisory group include:
   - Point of care app providing up-to-date resources, information, schedules
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- Simulation\(^1\) script(s) for diverse care setting, interprofessional team care, adverse effects, and patient family
- Unfolding case studies, such as those found at: [http://www.nln.org/professional-development-programs/teaching-resources/aging/ace-s/unfolding-cases](http://www.nln.org/professional-development-programs/teaching-resources/aging/ace-s/unfolding-cases)
- Avatar simulation, similar to Shadow Health: [http://www.shadowhealth.com/](http://www.shadowhealth.com/)
  Note: Representatives from the National Association of Student Nurses stated that an avatar simulation program would not be in the students’ best interest. They said the programs are expensive to develop, time consuming and more bothersome to learn how to use than they are helpful to go through a virtual simulation of a hospital setting.
- Podcast with patient perspectives
- Website repository for existing, evidence-based online videos for use prior to and after a class or session, e.g. motivational interviewing, (Kognito has exemplars: [https://www.kognito.com/](https://www.kognito.com/)) negotiation techniques, guided questions, and debriefing strategies
- Exemplars of service-learning experiences

**NEXT STEPS**
The Advisory Committee expressed interest in continuing to engage with CDC on the nursing immunization resource project and the importance of keeping momentum. They addressed the importance of buy-in from faculty at nursing schools. They also agreed that a national needs assessment survey might not be valuable since the participants of this meeting represent nursing education and can make decisions and recommendations about best methods to reach nursing students.

\(^1\) An activity or event replicating clinical practice using scenarios, high-fidelity manikins, medium-fidelity manikins, standardized patients, role playing, skills stations, and computer based critical-thinking simulations. (Hayden, Jeffries, Kardong-Edgren, and Spector, 2009) Low fidelity to high fidelity represents a continuum; for example, low-fidelity simulation experiences utilize less similar supplies and equipment than those used in practice and include case studies or paper-and-pencil activities. High fidelity simulation includes the use of standardized patients and human patient simulators.
## Advisory Committee on Integration of Immunization into Undergraduate Nursing Curriculum (ACIIUN) Member Directory

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<td>Academic and Staff Developer, Assistant Professor</td>
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Participant Survey Responses

Participant Name
- Nichole Bobo
- Claire Smith
- Joshua Steward
- Ann
- Beverly Bowers
- Amy Spangler
- Susan K. Odom
- Janelle Macintosh
- Versie Johnson-Mallard
- Barbara Joyce
- Sheryl Buckner

11 responses in 11 results

Email
- nbobo@nasn.org
- claire.smith@gmail.com
- joshuasteward@gmail.com
- ahoffman@son.umaryland.edu
- Beverly-Bowers@ouhsc.edu
- aspangler@lourdes.edu
• sodom@lcsc.edu
• janelle-macintosh@byu.edu
• vjmallard@ufl.edu
• bjoyce@uccs.edu
• sheryl-buckner@ouhsc.edu

11 responses in 11 results

**Title**

• Director of Nursing Education
• Student
• Student Nurse
• MS, RN
• Associate professor
• Assistant Professor
• Professor of Nursing
• PhD
• Faculty
• Associate Professor
• Asst Professor

11 responses in 11 results

**Representing Organization or School**

• National Association of School Nurses
• University of Maryland, School of Nursing
• Community College of Baltimore County- Catonsville Campus
• University of Maryland School of Nursing at Shady Grove
• University of OK College of Nursing
• Loudes University
• National Council of State Boards of Nursing
• ANA
• NLN
• ACHNE
• University of Oklahoma College of Nursing
• 11 responses in 11 results

When are content and/or skills related to immunization taught in your school or program? Select all that apply:

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<tr>
<td>Not taught at all</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Didactic courses</td>
<td>10</td>
<td>35.7%</td>
</tr>
<tr>
<td>Skill labs</td>
<td>8</td>
<td>28.5%</td>
</tr>
<tr>
<td>Clinical settings</td>
<td>9</td>
<td>32.1%</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>3.5%</td>
</tr>
<tr>
<td></td>
<td>28 responses in 11 results</td>
<td></td>
</tr>
</tbody>
</table>

What teaching materials or resources are used at your school to teach about immunization?

• CDC publications, NASN literature, Community Guide, reputable websites
(e.g., CDC, Families Fighting Flu, National Foundation for Infectious Diseases), Healthy People 2020 objectives.

- Most recently we have addressed immunizations in our Pediatric course. The book used to learn about immunizations is Wong's Nursing Care of Infants and Children. Our professor also presented a lecture on immunizations.

- Our professors used slideshow presentations in combination with reading from our course books to teach immunization. We also heavily relied on the nip-it.org website, as recommended by our professors.

- CDC variety of immunization schedules Immunization Action Coalition (IAC) website, have a good screening tool Youtube for pro's and cons of immun. American Academy of Pediatrics is referenced Powerpoint slides: Active and Passive for lecture.

- (NIP-IT) nip-it.org - OK State Dept. of Health 'OK by One' website Lab-Practice injections Readings: Population-focused perspectives of vaccine preventable diseases and vaccines in Stanhope & Lancaster Communicable diseases in Hockenberry & Wilson.

- Administration techniques, primary prevention, disease information via textbooks. CDC information utilized in didactic, clinical settings and skills lab current articles on outbreaks Articles related to immunization hesitancy utilized.


- CDC guidelines and schedules.

- VCP Health departments School Health.

- Nip It Website.

- CDC Pink Book, NIP-IT.com.

11 responses in 11 results.
Describe materials or resources that you believe would be useful or are needed to teach about immunization at your school or program.

- Toolkits (e.g., talking points for students, families, school personnel); information about barriers to vaccine access; recommended versus required immunizations; vaccine options available; role of ACIP & CDC; vaccine safety; all members of the immunization neighborhood (i.e., schools, pharmacy, medical home); immunization information systems; evidence-based strategies to support reaching national vaccine goals.
- Nip-it.org is a wonderful website. It had all the information we needed on a convenient and free website.
- Professional views of the 'other side' or those against vaccines to be presented with the pro vaccine group. In educating about vaccines we have to respectfully discuss with the other side what they are afraid of, nurses need to know how to talk to patients and families and help them learn about the vaccines. We can't ignore them and just tell them they are wrong.
- more focus on need for adult immunizations
- CDC Pink Book, NIP-IT.com
- 5 responses in 11 results

What technologies are used to deliver the content or instruction? Select all that apply:

<table>
<thead>
<tr>
<th>Result</th>
<th>Responses</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>Simulations</td>
<td>3</td>
<td>21.4%</td>
</tr>
<tr>
<td>Podcasts</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Online learning modules</td>
<td>8</td>
<td>57.1%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>14.2%</td>
</tr>
</tbody>
</table>

14 responses in 11 results
Are there other resources that you use or would recommend?

- Immunization Action Coalition Children's Hospital of Philadelphia National Foundation for Infectious Diseases
- We were directed to Immunization Action Coalition as well as American Academy of Pediatric. I have also found American Academy of Family Physicians helpful and Khan academy in learning the pathophysiology of immunology.
- http://nip-it.org/
- The correct link to NIP-IT is http://nip-it.org Another resource is Teaching Immunization Delivery and Evaluation- http://tide.musc.edu/
- I like the article "Navigating Parental Vaccine Hesitancy" by Smith & Marshall PEDIATRIC ANNALS 39:8 | AUGUST 2010 p 476-482
- We teach immunization content in fundamental skills including patient teaching/communication content. Our Pediatric content is taught via mostly didactic and simulated clinical experiences. We also teach immunization content in our Community Health course. We also take advantage of community free clinics, Health Fairs, and venues where health care is not the primary focus (schools, Church, day-care) to teach about immunization, barriers to immunization, and Herd immunity.
- not at this time
- none at this time
- Faculty very complimentary about Nip It Web site "Could not teach it any better" . Use exam questions. Do not require the CE certificate for the $40 cost.
- ImmunizationEd used to have a nice app that kept up with the current
Other comments about how immunization content or instruction is delivered within your school or program.

- Note: I am representing a professional organization that delivers continuing education offerings. I am not currently a university faculty, but I do have 10 years experience teaching undergraduate (BSN) nursing, focused on community health - and was Chair of the Curriculum Committee at one point.

- We cover immunization primarily in the first, second and third semester. Two 1 hour lectures are done, one in 1st semester (immunization concepts) and then in 3rd semester for Pediatrics class. Immunization is referenced in the other semester but in the context of checking the status of patients immunization and patient history.

- Some student groups get the opportunity to participate in flu clinics or mass immunization events, but not consistently across programs.

- 5 semester of nursing content 1st semester: primary prevention focus 2nd semester: immunizations of vulnerable populations, learn admin techniques 3rd semester: acute care experiences, pediatrics with focus on nursing responsibilities related to immunizations, infectious disease and knowledge of what immunizations are due in pediatric population at what well visits. 4th semester: acute care inpatient experiences 5th semester: disaster/epidemic control.

- We are including more information on global immunization, Herd immunity, ethical components of parent education, and overcoming barriers to immunization.

- Most information is included with systems... i.e flu and pneumonia are included with respiratory instruction.

- Clinical experiences provide application of content in clinical settings.

- Students work with healthcare agencies in providing immunizations of
employees.
8 responses in 11 results
Advisory Committee on Integration of Immunization into Undergraduate Nursing Curriculum (ACIIUN)

Participant Recommended Resources

Survey Responses

- Immunization Action Coalition: http://www.immunize.org/
- Children's Hospital of Philadelphia
- National Foundation for Infectious Diseases
- American Academy of Pediatric
- American Academy of Family Physicians
- Khan academy for pathophysiology of immunology
- The Nursing Initiative Promoting Immunization Training (NIP-IT) http://nip-it.org/
- http://www2.aap.org/immunization/
- http://www.healthychildren.org/English/safety-prevention/immunizations/Pages/default.aspx
- Vaccine trivia game: http://vec.chop.edu/service/parents-possessing-accessing-communicating-knowledge-about-vaccines/trivia-corner/
- Teaching Immunization Delivery and Evaluation: http://tide.musc.edu/
- "Navigating Parental Vaccine Hesitancy" by Smith & Marshall PEDIATRIC ANNALS 39:8 | AUGUST 2010 p 476-482
- ImmunizationEd mobile app: http://www.immunizationed.org/

Meeting Suggestions

- ATI online modules/textbook: https://www.atitesting.com/Solutions/DuringNursingSchool/SkillsModulesSeries.aspx
- Evolve website textbook, https://evolve.elsevier.com
- Immunization - You Call the Shots: http://www.cdc.gov/vaccines/ed/youcalltheshots.htm
- Kahn Academy: https://www.khanacademy.org/
- Omnio, https://market.omnio.com
- Perdue Owl Online Writing Lab (for usability): https://owlenglish.purdue.edu
- Spillover: Animal infections and the Next Human by David Quammen: www.davidquammen.com
- YouTube: baby with pertussis cough
- Motivational Interviewing: Change Talk: https://www.kognito.com/changetalk/web/
- University of Washington, Persuade Vaccine Resistant Parents With Straight Talk: www.medicaldaily.com
Improving Quality and Safety of Immunization Practices through EBP

Beverly Bowers, PhD, APRN-CNS, ANEF
Sheryl Buckner, PhD(c), RN

The UNIVERSITY of OKLAHOMA
College of Nursing
Background

- Teaching immunizations a low priority for many nursing programs
- Taught as part of pediatrics curriculum
- Immunizations required throughout the lifespan
- Review of nursing textbooks demonstrated very little content about immunizations except in Pediatric texts
• Nurses have key roles in vaccines
• Communicate with patients/families
• Vaccine administration
• Vaccine safe handling and storage
• Nursing Initiative Promoting Immunization Training (NIP-IT), based on the Theory of Planned Behavior
• Online evidence-based educational program developed through a cooperative agreement with the Centers for Disease Control (CDC)
• Designed to improve quality and safety of immunizations
• Designed for pre-licensure nurses, but is appropriate for licensed nurses
Theory of Planned Behavior
(Azjen & Fishbein, 1980)

• Human behavior based on 3 types of beliefs
  – Behavioral beliefs
  – Normative beliefs
  – Control beliefs
• More positive beliefs - intent to perform behavior
• Negative beliefs - intent to perform
NIP-IT Influences Behavioral Beliefs

• Presents evidence based content to counteract false beliefs
NIP-IT Influences
Normative Beliefs

• Teaches the nurse’s role
• Creates a nursing norm that immunizations are a professional responsibility
• Engages learners emotionally - target affective domain of learning
NIP-IT Influences Control Beliefs

- Influences Control Beliefs
  - Provides information
  - Provides role models and nurse-patient communication exemplars
  - Focuses on nurse’s professional roles related to immunization
Needs Assessment

● Purpose: validate need for immunization curriculum & guide course development

● 5 focus groups conducted at Sigma Theta Tau Biennial in Indianapolis in fall 2009

● 32 nurses participated (25 nurse educators, 7 clinicians)

● States represented: California, Connecticut, Delaware, Indiana, Massachusetts, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Texas, Washington, Wisconsin, and Ontario, Canada
Themes

- Content Delivery
- Content
- Teaching Barriers
- Teaching Facilitators
- Openness to Web-Based Immunization Curriculum
What 32 Nurse Educators Told Us

Content Delivery

Q: Where in nursing program is immunization taught & how much time is allotted for it?
A: Fragmented across the curriculum & difficult to know time since content delivery was fragmented.

- “teach in several areas of curriculum such as flu injection clinics”
- “immunizations taught across many courses—good that it is separate; connect the dots to previous learning”
- “eventually get all the curriculum”
- “Cognitive learning, lab learning, but disconnect at clinical sites”
- “Often teach skill then content”
What 32 Nurse Educators Told Us

**Content**

**Q:** What immunization content & skills are you currently teaching?

**A:** Teaching how to give injections, immunization schedules, how to talk to patients, and participating in flu clinics.

- “In clinical area, focus on what should they have, what do they have”
- “I did not know one needed a curriculum for immunization. I am sure any nurse can give immunization shots.”
- “What is taught or what is it they remember?”
What 32 Nurse Educators Told Us

**Teaching Barriers**

**Q:** What are barriers to teaching immunization?

**A:** Time, not on the NCLEX so not a focus of curriculum, frequently changing recommendations, and student attitudes to learning content.

- “Students have a fear of autism”
- “Why nurses don’t get vaccinated? H1N1 not tested enough”
What 32 Nurse Educators Told Us

Teaching Facilitators

Q: What are facilitators to teaching immunization?
A: Participating in an immunization initiative, online resources, using movies to touch affective behavior, and simulations.

- "Adequate faculty resources"
- "Mixed method teaching strategies"
- "Get to competency level. Keep it basic. Give talking points."
- "Students will plan clinic"
What 32 Nurse Educators Told Us

Openness to Web-Based Immunization Curriculum

Q: Would you be willing to pilot test an online curriculum?

A: Overwhelmingly, the response to participate was positive.

- “Would use it if they had a good one and quiz.”
- “Online learning—it’s there but people not using it. Time for it.”
- “Online has to happen.”
• Online survey of 1647 U.S. nursing programs with 506 responses described how immunizations are taught and resources used in nursing education
What Nurse Educators Told Us

Content Delivery

Q: Where in nursing program is immunization taught & how much time is allotted for it?

A:
78.8% taught content in more than one course
81.4% taught content mainly in Pediatric Theory
37.4% taught didactic content in 1-2 hours
37.8% taught injection skills for more than 4 hours
n=495

Takeaway message: Fragmented across the curriculum, more time spent in teaching skill than didactic, and a focus on pediatric population.
What Nurse Educators Told Us

**Content**

**Q:** What immunization content (and how well is it covered) & skills are you currently teaching?

**A:**

- **Highs**
  - 63.2% taught current immunization schedule
  - 60.5% emergency response in event of reaction
  - 60.3% role of the nurse as an educator

- **Lows**
  - 34.1% safe storage of vaccines
  - 30% herd immunity
  - n=467

**Takeaway message:** Focused on injections and schedule, less emphasis on principles of immun
What Nurse Educators Told Us

**Teaching Barriers**

**Q:** What are barriers to teaching immunization?

**A:**

**Highs**
- 44.7% content fragmentation
- 33.6% inadequate resources
- 32.5% confusing content

**Lows**
- 24.8% barriers not a problem for my program

n=452

**Takeaway message:** Fragmentation exists, resources to teach are lacking. ¼ do not view barriers as a problem.
What Nurse Educators Told Us

**Teaching Facilitators**

Q: What are facilitators to teaching immunization?

A:

**Highs**
- 42% partnerships with public health
- 41.6% assimilating new information easily
- 34.5% content introduced in curriculum logically

**Lows**
- 16.6% more barriers than facilitators exist

n=452

**Takeaway message:** Participation with public health system and sequencing curriculum logically are important.
What Nurse Educators Told Us

Openness to Web-Based Immunization Curriculum

Q: Would you be willing to pilot test an online curriculum?

A: 
62.8% Yes
24.1% Maybe
13.1% No

n=452

Takeaway message: Nurse educators willing to review online modules. Many nursing programs open to using web-based curriculum.
Please rate your personal comfort level teaching the following content.

- Symptoms and sequelae of vaccine preventable diseases
- Historical significance of infectious diseases
- Principles of developing antigen immunity
- Herd Immunity
- Current immunization schedule recommendations
- Emergency response in event of an outbreak
- Safe storage of vaccines
- Vaccine precautions and true contraindications
- Role of the Nurse as an Educator communicating
- Role of the Nurse as an Advocate - Advocating
- Other

Historical Significance
Principles of Antigen Immunity
Herd Immunity
Emergency Response
Role of the Nurse as Educator
Role of the Nurse as Advocate

n=438
Which of the following social media are your students using? Check all that apply.

- Facebook
- MySpace
- Twitter
- YouTube
- Linkedin
- Second Life

n=413
How do you keep current with changes in immunization practices?

- CDC Website
- Other immunization websites
- Other teaching colleagues
- Physicians
- Public Health Nurse Clinicians

n=440
• Six online modules (nip-it.org)
• Available free to nursing schools and students
• Each module includes updated evidence-based information that has been coordinated with the CDC
• Information presented in a variety of interactive methods to appeal to various learning styles
  – videos of nurses interacting with patients and families
  – interactive learning objects
  – polls
  – quizzes
• Faculty may assign from one to six modules based upon their curriculum needs
• Students receive a certificate after satisfactory completion of each module
• Continuing Education credit is available to nurses who request it for a small fee
Targeted Learning Outcomes

After completion of the NIP-IT program students will be able to:

• Discuss vaccine preventable diseases
• Identify current vaccine recommendations across the lifespan
• Discuss vaccines concerns of the public and barriers to immunization
• Discuss nursing roles related to immunization
• Discuss effective communication strategies
• Identify elements of safe vaccine storage
• Safely administer vaccines by various routes
• Explain nursing roles and responsibilities in a mass immunization event
## Demographics

<table>
<thead>
<tr>
<th>Who They Are</th>
<th>How Many of Them</th>
</tr>
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<tbody>
<tr>
<td>Total Registered</td>
<td>21214</td>
</tr>
<tr>
<td>Health Care Student</td>
<td>19603</td>
</tr>
<tr>
<td>RN Students</td>
<td>15973</td>
</tr>
<tr>
<td>LPN/LVN Students</td>
<td>2450</td>
</tr>
<tr>
<td>Nursing Assistant/Med Tech Students</td>
<td>408</td>
</tr>
<tr>
<td>Health Care Provider</td>
<td>8879</td>
</tr>
<tr>
<td>RN/APRN</td>
<td>5096</td>
</tr>
<tr>
<td>LPN/LVN</td>
<td>1422</td>
</tr>
<tr>
<td>CNA/CMA</td>
<td>1129</td>
</tr>
<tr>
<td>Health Care Faculty</td>
<td>6174</td>
</tr>
<tr>
<td>Nursing Programs Represented</td>
<td>&gt;400</td>
</tr>
</tbody>
</table>
NIP-IT Module Completions
Jan. 2011-March 2013

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Number Who Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1- Vaccine Preventable Diseases</td>
<td>15530</td>
</tr>
<tr>
<td>Module 2- Vaccine Recommendations</td>
<td>14821</td>
</tr>
<tr>
<td>Module 3- Vaccine Concerns</td>
<td>12571</td>
</tr>
<tr>
<td>Module 4- Nursing Roles</td>
<td>13346</td>
</tr>
<tr>
<td>Module 5- Vaccine Administration</td>
<td>12570</td>
</tr>
<tr>
<td>Module 6- Mass Immunization</td>
<td>10116</td>
</tr>
<tr>
<td>Modules 1-6</td>
<td>9221</td>
</tr>
</tbody>
</table>
Evaluation

• Nursing faculty and students supportive of program
• Faculty report curriculum is sound and evidence-based
• During pilot testing students completed online evaluations after completion of each module
Student Evaluation Results

Student Survey Monkey ® evaluation comments about NIP-IT (n=1411)

Awesome  Clear  Concise  Easy to Follow
Enjoyable  Easy to Understand  Educational
Engaging  Entertaining  Excellent  Fantastic  Fun
Informative and Easy  Interactive  Interesting
Learning Organized  Provoking  Simple  Thorough
User Friendly  Wonderful
<table>
<thead>
<tr>
<th></th>
<th>Please share with us any questions, comments or concerns that you have about the NIP-IT modules.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>interesting program</td>
</tr>
<tr>
<td>2</td>
<td>Very informative.  been a nurse 33 years and learned a lot of new things about immunizations.</td>
</tr>
<tr>
<td>3</td>
<td>I've been working Immunizations for some time, this was a good review.</td>
</tr>
<tr>
<td>4</td>
<td>I thought it was so well put together. It was very interesting and interacting and watching videos helped me remember information.</td>
</tr>
<tr>
<td>5</td>
<td>Excellent CEU education. Very interesting.</td>
</tr>
<tr>
<td>6</td>
<td>Module 4 was the best one</td>
</tr>
<tr>
<td>7</td>
<td>an excellent program, use of multiple strategies, and well documented resources</td>
</tr>
<tr>
<td>8</td>
<td>I thought the modules were very good, the activities required a lot of time but were also good</td>
</tr>
<tr>
<td>9</td>
<td>Took a long time to complete for the amount of credit but were very good</td>
</tr>
<tr>
<td>10</td>
<td>Kudos to you all for developing such an excellent training resource!  I'm very sorry to hear that CE's will not continue to be available after sept 2011.</td>
</tr>
<tr>
<td>11</td>
<td>I really liked the modules and shared them with others at the Florida Department of Health</td>
</tr>
<tr>
<td>12</td>
<td>Administration of vaccines-in the videos, the persons administering the vaccines had many rings on fingers. This shows poor technique.</td>
</tr>
<tr>
<td>13</td>
<td>Very good for us licensed persons in education and ceus</td>
</tr>
<tr>
<td>14</td>
<td>This was a wonderful learning experience. Personally, if I had to read pages of information it gets a little difficult. So breaking it up with activities made it</td>
</tr>
<tr>
<td>Comment</td>
<td>Date</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>enjoyable as well as educational. Thank you.</td>
<td></td>
</tr>
<tr>
<td>i thoroughly enjoyed these units - very instructional and kept my attention</td>
<td>Apr 19, 2011 8:30 AM</td>
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<tr>
<td>NA</td>
<td>Apr 15, 2011 9:01 AM</td>
</tr>
<tr>
<td>this was an excellent program</td>
<td>Apr 14, 2011 7:07 AM</td>
</tr>
<tr>
<td>This was an excellent overview.</td>
<td>Apr 12, 2011 11:50 AM</td>
</tr>
<tr>
<td>I learned so much and thought this was a very well done program. Thank you!</td>
<td>Apr 10, 2011 11:45 AM</td>
</tr>
<tr>
<td>great program</td>
<td>Mar 29, 2011 1:32 PM</td>
</tr>
<tr>
<td>none</td>
<td>Mar 21, 2011 11:03 AM</td>
</tr>
<tr>
<td>Very informative, good training.</td>
<td>Mar 17, 2011 2:10 PM</td>
</tr>
<tr>
<td>Very thorough, thank you for this opportunity</td>
<td>Mar 6, 2011 5:43 PM</td>
</tr>
<tr>
<td>This is an excellent learning module.</td>
<td>Feb 22, 2011 9:11 AM</td>
</tr>
<tr>
<td>I had difficulty at times with viewing my learning assessment responses and scores for 3 of the modules, requiring me to go back and repeat the material several times. I have had nursing students review the modules as a required learning activity in my course. The format for learning is excellent.</td>
<td>Feb 3, 2011 12:04 PM</td>
</tr>
<tr>
<td>This was great learning information.</td>
<td>Jan 31, 2011 9:18 PM</td>
</tr>
</tbody>
</table>
Excellent! I was the immunization coordinator for Mayo Clinic prior to my current position in addition to being the immunization program coordinator for the State of North Dakota and this truly is the best online curriculum out there. Trust me.......I have viewed them all. You should be very proud of it :) 

Kari Mongeon Wahlen, RN, MSN
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Contact

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Sheryl Buckner PhD(c), RN: sheryl-buckner@ouhsc.edu
Beverly Bowers PhD, RN: beverly-bowers@ouhsc.edu

Website: http://www.nip-it.org/
## Immunization Skill and Knowledge Matrix

This matrix is based on the Public Health Agency of Canada Immunization Competencies for Health Professionals available at [http://www.phac-aspc.gc.ca/im/pdf/ichp-cips-eng.pdf](http://www.phac-aspc.gc.ca/im/pdf/ichp-cips-eng.pdf). It is intended to guide discussion on available training materials and the required skill level required of the baccalaureate nurse in each topic area. Training material examples mentioned by survey respondents are listed where appropriate.

<table>
<thead>
<tr>
<th>Topic/General Competency</th>
<th>Training Materials Available/Used</th>
<th>Baccalaureate Skill Level Required (Aware, Knowledgeable, Proficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. The Immunization System and Vaccines</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Explains how vaccines work using basic knowledge of immune system | ✓ CDC – How do vaccines work publication on CDC vaccine website ([http://www.cdc.gov/vaccines/](http://www.cdc.gov/vaccines/))  
| **2. Vaccine-Preventable Diseases** | | |
| Demonstrates an understanding of the rationale and benefit of immunization as relevant to the practice setting | ✓ Nip-it Module 1 and 2 ([http://nip-it.org/](http://nip-it.org/))  
✓ CDC vaccine website  
✓ Healthy Children website  
| **3. Vaccine Development and Evaluation** | | |
| Integrates into practice knowledge about the main steps in vaccine development and evaluation | ✓ Nip-it Module 2  
✓ CDC Vaccine website ([http://www.cdc.gov/vaccines/resdev/test-approve.htm](http://www.cdc.gov/vaccines/resdev/test-approve.htm))  
✓ ACOG website ([http://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Integrating-Immunizations-Into-Practice](http://www.acog.org/Resources-And-Publications/Committee-Opinions/Committee-on-Obstetric-Practice/Integrating-Immunizations-Into-Practice)) | |
<p>| <strong>4. Types of Immunizing Agents and Their Composition</strong> | | |
| Applies the knowledge of | ✓ Nip-It Module 5 | |</p>
<table>
<thead>
<tr>
<th>Topic/General Competency</th>
<th>Training Materials Available/Used</th>
<th>Baccalaureate Skill Level Required (Aware, Knowledgeable, Proficient)</th>
</tr>
</thead>
</table>
| the components and properties of immunizing agents as needed for safe and effective practice | ✓ CDC Vaccine website “pinkbook” [www.cdc.gov/vaccines/pubs/pinkbook/](http://www.cdc.gov/vaccines/pubs/pinkbook/)  
✓ Healthy Children website                                                 |                                                                 |
| 5. Population Health                                                                    | ✓ CDC Vaccine website – improving vaccine coverage fact sheet  
✓ Immunization Action Coalition  
(http://www.immunize.org/journalarticles/serv_ass.asp)                        |                                                                 |
| 6. Communication                                                                      | ✓ Nip-It Module 4  
✓ Healthy Children website  
✓ CDC Vaccine website  
✓ Immunization Action Coalition                                                  |                                                                 |
| 7. Storage and Handling of Immunization Agents                                        | ✓ Nip-It Module 5  
✓ CDC Vaccine website  
✓ Immunization Action Coalition  
✓ American Academy of Pediatrics                                                   |                                                                 |
| 8. Administration of Immunizing Agents                                                 | ✓ Nip-It Module 5  
✓ CDC Vaccine website  
✓ Immunization Action Coalition  
✓ American Academy of Pediatrics                                                   |                                                                 |
| 9. Adverse Events Following Immunization                                              | ✓ Nip-It Module 5  
✓ CDC Vaccine website  
✓ Immunization Action Coalition                                                    |                                                                 |
<table>
<thead>
<tr>
<th>Topic/General Competency</th>
<th>Training Materials Available/Used</th>
<th>Baccalaureate Skill Level Required (Aware, Knowledgeable, Proficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✅ American Academy of Pediatrics</td>
<td></td>
</tr>
</tbody>
</table>
| **10. Documentation**    | ✅ Nip-it Module 5  
|                          | ✅ CDC Vaccine website  
|                          | ✅ Immunization Action Coalition  
|                          | ✅ American Academy of Pediatrics  
|                          | ✅ Kahn Academy  
|                          | ✅ Children's Hospital of Philadelphia, Vaccine education center  
|                          | http://vec.chop.edu/service/vaccine-education-center/home.html |                                  |
| **11. Populations Requiring Special Consideration** | ✅ National Foundation for Infectious Diseases (http://www.nfid.org/)  
|                          | ✅ Immunization Action Coalition  
|                          | ✅ CDC  
|                          | ✅ Massachusetts Department of Public Health Guide to reaching diverse populations for immunization  
| **12. Immunization Policy** | ✅ Nip-it Module 3  
|                          | ✅ Immunization Action Coalition (http://www.imunize.org/vacpolicy/)  
|                          | ✅ American Nurses’ Association  
|                          | (http://www.nursingworld.org/MenuCategories/ThePracticeofProfessionalNursing/Improving-Your-Practice/Immunizations) |                                  |
| **13. Legal and Ethical Aspects of Immunization** | ✅ Nip-it Module 3  
<p>|                          | ✅ CDC Vaccine requirements and laws (<a href="http://www.cdc.gov/vaccines/imz-managers/laws/index.html">http://www.cdc.gov/vaccines/imz-managers/laws/index.html</a>) |                                  |</p>
<table>
<thead>
<tr>
<th>Topic/General Competency</th>
<th>Training Materials Available/Used</th>
<th>Baccalaureate Skill Level Required (Aware, Knowledgeable, Proficient)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>14. Immunization Issue Management</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Addresses current immunization issues using an evidence-based approach | ✓ Nip-it Module 3  
✓ CDC Immunization website  
✓ Immunization Action Coalition | |
IMPLEMENTING A COMMUNITY-SUPPORTED SCHOOL-BASED INFLUENZA IMMUNIZATION PROGRAM

Cuc H. Tran, Josephine McErlath, Patricia Hughes, Kathleen Ryan, Jean Munden, Joan B. Castleman, Jackie Johnson, Randell Dory, Dallas R. McKay, Jim Stringfellow, Rosalee A. Holmes, Paul D. Myers, Parker A. Small, Jr., and J. Glenn Morris, Jr.

School-based influenza immunization programs are increasingly recognized as a key component of community-based efforts to control annual influenza epidemics. Computer modeling suggests that immunizing 70% of schoolchildren could protect an entire community from the flu. Most of the school-based influenza immunization programs described in the literature have had support from industry or federal grants. This article describes a program that used only community resources to administer live, attenuated influenza vaccine supplied by the state health department. Beginning in 2006, the Alachua County Health Department and school system, working in collaboration with the University of Florida, began exploration of a nonmandatory community-wide school-based influenza immunization program, with the goal of achieving high levels of immunization of the ~22,000 public and private pre-K through grade 8 students in the county. In 2009-10 the program was repeated. This report describes the procedures developed to achieve the goal, the barriers that were encountered, and solutions to problems that occurred during the implementation of the program. Preliminary data suggest that the crude immunization rate in the schools was approximately 55% and that at least 10% more students were immunized by their health providers. At an operational level, it is possible to achieve high immunization rates if the stakeholders share a common vision and there is extensive community involvement.

School-based influenza immunization programs are increasingly being recognized as a key component of community-based efforts to control annual influenza epidemics. Schools facilitate virus transmission because they are effective virus exchange systems and children are "super spreaders," shedding more virus for longer periods of time than adults. Since 2008, the Advisory Committee on Immunization Practices (ACIP) has recommended that all children ages 6 months to 18 years receive yearly seasonal flu vaccine. During the 2008-09 flu season, the overall immunization rate for the seasonal vaccine ranged from 9.1% to 47.8% in children ages 6 months to 18 years old.
with immunization rates decreasing dramatically with increasing age.9

Achieving the ACIP recommendation for universal immunization will be extremely difficult if implementation is left to pediatric office practices and clinics. Logistically, such an approach would mean a substantial increase in workload for already overburdened pediatric practices. Pediatricians' enthusiasm for office-based immunization is further dampened by the fact that available compensation from third-party payers frequently does not adequately cover the associated costs.10 Even so, a recent survey indicated that 86% of pediatricians would support a school-based vaccine program, and 61% would be willing to participate in one.10 Furthermore, given the time and personal cost involved, it is unclear how frequently parents can or will take children to pediatricians' offices for immunization.

Computer modeling studies suggest that immunizing 20% of children in a community is more effective at protecting those over 65 than immunizing 90% of the elderly.11 Another study suggests that immunizing 70% of schoolchildren could protect an entire community from the flu.12

An example of the effectiveness of school-based influenza immunization programs comes from Japan. In 1957, during the 1957 pandemic, Japan experienced the largest flu death toll in its history, thus prompting the start of their school-based flu vaccination campaign. During the 10 years that it was mandatory, excess deaths attributed to influenza and pneumonia, and even those from all causes of death, dropped to half of the pre-program levels. However, once the program was no longer mandatory, immunization rates fell, the program was subsequently abandoned, and death rates rose dramatically. The study showed that for every 40 schoolchildren immunized, 1 life was saved, predominantly among the elderly.2

The Japanese program used the inactivated flu vaccine, which was the only flu vaccine available at the time. Inactivated vaccine decreases clinical illness by inducing IgG antibody, but IgG antibody does not prevent nasal flu infection.13-15 Vaccinating children using inactivated flu vaccine has been shown to protect adults from illness but not from infection.16 The live, attenuated influenza vaccine (LAIV, FluMist®) induces mucosal IgA antibody, which does prevent nasal infection17,18 and has been shown to be more protective than inactivated vaccine for children.19 Thus, it can be hypothesized that using live, attenuated influenza vaccine in a school-based influenza immunization program would provide even greater protection than that shown in the Japanese study.

Most school-based immunization programs reported in the literature have received funding from industry and/or grants (Table 1). This article describes what is possible with state-supplied vaccine and community support but without industry or federal support. We provide a description of the procedures developed to achieve high levels of immunization through a voluntary school-based seasonal influenza immunization program.

Table 1. Descriptive Characteristics of Published School-Based Influenza Immunization Programs

<table>
<thead>
<tr>
<th>County</th>
<th>State</th>
<th>Immunization Rate</th>
<th>Funding Type</th>
<th>Administrative Cost per Dose</th>
<th>Year</th>
<th>Vaccine Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleutia</td>
<td>Florida</td>
<td>65%</td>
<td>VFC/state/federal govt funded the vaccine; community grants funded the administrative cost.</td>
<td>~$6</td>
<td>2009</td>
<td>mist</td>
</tr>
<tr>
<td>Aleutia</td>
<td>Florida</td>
<td>25%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2006</td>
<td>mist</td>
</tr>
<tr>
<td>Lyon</td>
<td>Minnesota</td>
<td>58%</td>
<td>VFC/MedImmune funded</td>
<td>~$10</td>
<td>2006</td>
<td>mist</td>
</tr>
<tr>
<td>Mower</td>
<td>Minnesota</td>
<td>54%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2006</td>
<td>mist</td>
</tr>
<tr>
<td>Stearns</td>
<td>Minnesota</td>
<td>33%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2006</td>
<td>mist</td>
</tr>
<tr>
<td>Carroll</td>
<td>Maryland</td>
<td>44%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2005</td>
<td>mist</td>
</tr>
<tr>
<td>Knox</td>
<td>Tennessee</td>
<td>44%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2006</td>
<td>mist</td>
</tr>
<tr>
<td>Knox</td>
<td>Tennessee</td>
<td>45%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>2005</td>
<td>mist</td>
</tr>
<tr>
<td>Kaua</td>
<td>Hawaii</td>
<td>42%</td>
<td>State/federal govt funded the vaccine; MedImmune funded the administrative cost.</td>
<td>~$14</td>
<td>2007</td>
<td>mist</td>
</tr>
<tr>
<td>Honolulu</td>
<td>Hawaii</td>
<td>48%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>1968</td>
<td>shot</td>
</tr>
<tr>
<td>Maui</td>
<td>Hawaii</td>
<td>39%</td>
<td>MedImmune funded</td>
<td>not available</td>
<td>1968</td>
<td>shot</td>
</tr>
<tr>
<td>Honolulu</td>
<td>Hawaii</td>
<td>48%</td>
<td>NIH</td>
<td>not available</td>
<td>1968</td>
<td>shot</td>
</tr>
</tbody>
</table>
BACKGROUND

Alachua County is located in north central Florida and is home to the University of Florida. Demographically, county residents are younger, better educated, and less affluent than the Florida and U.S. population in general (Table 2). There are proportionally more non-Hispanic white people and non-Hispanic black people, but fewer Hispanic people, than in Florida or the U.S. overall. Alachua County residents may be more receptive to public health initiatives because of the influence of the university. In addition, the community and the university pediatric physicians are a cohesive group that helped promote the program.

Table 2. Descriptive Characteristics of the Community

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Alachua County</th>
<th>Florida</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>239,046</td>
<td>18,182,321</td>
<td>301,237,703</td>
</tr>
<tr>
<td>Median age</td>
<td>30.2</td>
<td>40.1</td>
<td>36.7</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>160,334</td>
<td>11,033,832</td>
<td>198,420,355</td>
</tr>
<tr>
<td>67.1%</td>
<td>60.7%</td>
<td>66.0%</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>45,341</td>
<td>2,689,657</td>
<td>36,397,922</td>
</tr>
<tr>
<td>19.0%</td>
<td>14.8%</td>
<td>12.0%</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>17,150</td>
<td>3,725,173</td>
<td>45,432,158</td>
</tr>
<tr>
<td>7.2%</td>
<td>20.5%</td>
<td>15.0%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>16,221</td>
<td>4,458,831</td>
<td>66,419,425</td>
</tr>
<tr>
<td>6.8%</td>
<td>8.8%</td>
<td>7.0%</td>
<td></td>
</tr>
<tr>
<td>Education, population ≥25 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>43,815</td>
<td>5,765,607</td>
<td>89,092,609</td>
</tr>
<tr>
<td>31.4%</td>
<td>45.9%</td>
<td>45.0%</td>
<td></td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>22,555</td>
<td>2,512,750</td>
<td>39,756,516</td>
</tr>
<tr>
<td>16.1%</td>
<td>20.0%</td>
<td>20.1%</td>
<td></td>
</tr>
<tr>
<td>Associate’s degree</td>
<td>14,759</td>
<td>1,060,503</td>
<td>14,723,709</td>
</tr>
<tr>
<td>10.6%</td>
<td>8.4%</td>
<td>7.4%</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree or higher</td>
<td>58,626</td>
<td>3,227,990</td>
<td>54,221,942</td>
</tr>
<tr>
<td>41.9%</td>
<td>25.7%</td>
<td>27.4%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>139,753</td>
<td>12,566,850</td>
<td>197,794,576</td>
</tr>
<tr>
<td>Median household income (in 2008 inflation-adjusted dollars)</td>
<td>$40,987</td>
<td>$48,637</td>
<td>$852,175</td>
</tr>
</tbody>
</table>

Source: census.gov.
and given the uncertainties at the time about the risk of seasonal versus H1N1 strains, the program was undertaken with seasonal vaccine.

**PILOT PROGRAM: 2006-07**

Planning was initiated in March 2006 for the 2006-07 pilot program. MedImmune generously agreed to provide live, attenuated influenza vaccine without charge. Because of the time frame of negotiations with MedImmune, the program did not start until November. This interfered with appropriate community involvement and compromised relationships with local physicians who had already purchased vaccine for their patients. Overall, the 2006-07 program obtained a 25% immunization rate among schoolchildren.

**2009-10 IMMUNIZATION PROGRAM**

**Program Objectives and Strategy**

The goals of the program are described below.

1. Immunize at least 70% of all children in pre-K through grade 8, in both public and private school. High school students were excluded for the following reasons: (1) pregnancy is a contraindication for LAIV administration, and community and health department personnel had concerns about approaches to identifying high school girls who might be pregnant; (2) the program wanted to use only LAIV in all age groups; and (3) the additional students might overburden the staff and resources of a newly developing program.

Plans are to include high school students in the influenza immunization program currently planned for 2010-11. Focus groups of high school students are being used to help develop appropriate outreach programs for this age group to try to increase participation rates. For the coming year, there has been agreement (in keeping with standard practice in private practice settings) that adolescent girls will be asked about pregnancy before receiving the vaccine but will not be required to have a pregnancy test.

2. Provide vaccine (LAIV) free of charge to all children. Vaccine is provided free of charge by the state of Florida under the Vaccines for Children (VFC) program to children in lower income groups (including children in the free or reduced-cost lunch program). However, it was felt that restricting the program to these groups would be highly counterproductive from a public health standpoint, as it would reduce overall immunization rates and highlight possible socioeconomic disparities among the children.

Similarly, the decision was made not to attempt to bill insurance companies for children who had private insurance; the process of trying to collect billing information would require additional personnel resources that were simply not available, would reduce parent enthusiasm for school-based immunization because of reluctance to provide insurance information to the schools, and would result in substantial delays during the actual immunization process as insurance status was verified. According to telephone surveys in 2008 and 2010, free vaccine was the second most appreciated aspect of the program, after convenience.
3. Actively involve the community. The program was guided by a steering committee that consisted of essential coalition members who had a vested interest in program goals and who had critical expertise (Figure 1). A program coordinator was chosen—in this case, an MPH student. In addition, the committee was composed of the administrator of the county health department and the superintendent of the county school system; key university personnel, including representatives from the Department of Pediatrics in the College of Medicine and the College of Nursing; a well-respected community child advocate; the nursing supervisors of the county school system and county health department; and the public information officer for the school system. During the program-planning phase, members of the steering committee recruited and/or met with local community organizations and community leaders to garner support for the program.

In March 2009, once availability of the vaccine was confirmed, the pediatric medical community was notified so they could reduce their vaccine orders accordingly. Partnering with the local medical community was critical to increasing program support (many parents ask their pediatricians if they should participate in the program) and to reducing wasted flu vaccines, a lesson learned from the pilot program. Frequent communication with the community pediatric liaison, a steering committee member and faculty member in the Department of Pediatrics (Figure 1), kept the community pediatricians informed about all aspects of the program. Community partners included the county African American Accountability Alliance ("4A's"), the Black Nurses' Association, the Junior League, other local service organizations, and members of the university community (including Delta Zeta, a University of Florida sorority). Local businesses also assisted by disseminating information to encourage their partners, members, and employees to participate in the program.

4. Increase participation of schools with higher percentages of students eligible for free and reduced-cost lunch. In the 2006-07 pilot program, immunization rates were low at schools in African American communities. Therefore, the team placed particular emphasis on collaboration with community leaders associated with the 4A's and the Black Nurses' Association. With their help and the support of the health department, information on the program was provided to approximately 400 churches in the community. Additional promotional materials purchased with donated funds were placed at sites throughout the county, including laundromats, summer school programs, and local grocery stores.

5. Rate program awareness through a comprehensive public health campaign. In the spring, a public relations team was formed with the Alachua County Public Schools public information officer, Alachua County Health Department and public school nursing supervisor, and the program coordinator (all members of the steering committee) (Figure 1). This team provided leadership to coalition members involved in the public relations aspect of the program.

Parents were notified about the program before the end of the school year. A letter was sent home with each child describing the program. The letter was signed by the director of the health department, the superintendent of the public school system, and the director of the Emerging Pathogens Institute (EPI) at the university. Printing of this letter was donated by a local printing business. Parents with children entering kindergarten that upcoming fall were reached at school-related events geared toward them (eg, "Kindergarten Round-up").

At the beginning of the school year, a media blitz was led by the Alachua County Public Schools public information officer. Local media coverage of the school-based influenza immunization program was overwhelmingly positive. The director of the health department, university faculty, the community pediatric liaison, and the school public information officer were available to answer media questions about the program. The PR campaign consisted of press releases, TV and radio interviews, and letters to the editor in the local newspaper.

In addition to free media coverage, the coalition used donated funds to pay for 3 billboards that were strategically placed around the community and targeted the harder-to-reach lower socioeconomic groups. A public service announcement featuring a well-known and admired former football player from the University of Florida, with his school-aged children, promoting the program aired on local TV and radio stations. Air time was purchased with donated funds. A photo of the mayor's children being immunized also appeared in local newspapers.

During the first week of school, the consent packet (a letter explaining the program, the vaccine information sheet, and the consent form) was sent home with each child's back-to-school folder. Parents were given a month to return the forms to the school nurse. The consent packet was printed by the health department using donated funds and was delivered to the school system for distribution. In addition, electronic copies of the consent packet were made available on both the school system and health department websites.

Volunteers, predominately from the University of Florida's Colleges of Nursing, Pharmacy, and Public Health, helped in promoting the program and collecting consent forms at various back-to-school events such as Meet the Teacher Night and community gatherings such as the UF Sports Medicine Jambooree. Volunteers were also involved in distributing information at a number of public locations, including supermarkets and discount stores; locations were targeted to optimize access to lower income groups.
6. Have an adequately trained task force of program volunteers. In order to be effective, the volunteers had to be knowledgeable, so the university team members created a 50-minute online video (available online at www.lieberonline.com/bsp) to teach about the program, the seriousness of flu as an illness, the importance of flu vaccines, and LAIV side effects. Viewing this video was mandatory for all student volunteers involved in promoting the program. In addition, the volunteers were given talking points and the health department’s phone number to give to parents if they were unable to answer a question. From an educational point of view, this was positive for the volunteers because they gained “real world” experience and they needed to be able to explain concepts fundamental to their professions. From a promotional standpoint, it is very important to note that promoting the program at school-related events resulted in the greatest success in collecting consent forms.

Use of Seasonal LAIV in the Schools

The use of live, attenuated influenza vaccine, as compared with the injectable vaccine, significantly simplified the administration process, eliminating the need for needles and associated procedures for handling sharps. As mentioned earlier, LAIV is a superior vaccine for children, and its spray form is far more acceptable to children than shots. As previously noted, plans were complicated by the H1N1 pandemic, which began after the initial planning phases of the program. The steering committee decided to proceed with seasonal vaccine administration in October and to not wait for the availability of the H1N1 vaccine. Based on consultation with influenza investigators at the University of Florida, it was felt that seasonal vaccine would offer protection against a possible subsequent “seasonal” epidemic and, in the absence of such an epidemic, might provide some protection against a drifted virus and perhaps shifted viruses. Once enough H1N1 LAIV was available, the health department was able to use the program foundation for the school-based influenza immunization program to return to schools and immunize for H1N1. Having the program infrastructure already in place greatly facilitated the H1N1 vaccine campaign.

Program Implementation

Program Organization

The steering committee established a time line (Figure 2) and met regularly to discuss the program’s direction. Key
issues included building the program’s infrastructure, identifying funding sources, and increasing community involvement.

There were a number of financial issues, including the cost of the vaccine and funding for both the infrastructure and the public relations aspects of the program. For the fall 2009 immunization campaign, only 10,000 LAIV doses were initially promised through the state Vaccines for Children program out of the 17,500 doses that were needed for the target group; the cost of the additional vaccine was estimated to be approximately $150,000. Fortunately, because of the subsequent availability of federal stimulus funding, the Florida Department of Health was able to provide the additional doses needed for the campaign. Furthermore, the coalition secured approximately $35,000 in private grants to cover the cost of a program coordinator and the public relations outreach program.

Vaccine Logistics

Determining medical eligibility for LAIV: Alachua County is fortunate to have at least 1 school nurse stationed at each school. The nurses played an important role in supporting the school-based influenza immunization program at each school. Their tasks were to: (1) disseminate program materials (consent forms, promotional flyers) to parents, teachers, and school administrators; (2) review each child’s medical record to make sure he or she was medically eligible to receive the LAIV; (3) collect and organize the consent forms; and (4) establish the logistics of the school’s immunization clinics. The consent form can be viewed online at http://uflopl.coursework24-7.com/p110395/player.HTM.

The most labor-intensive task was to organize the consent forms and to determine each child’s eligibility for the program. Volunteers from the PTA and the Colleges of Public Health, Nursing, and Pharmacy and program staff assisted the school nurse by organizing the consent forms. A system was developed to organize and expedite the process. The forms were divided into 4 categories:

- Parent/guardian does not want the child immunized against flu
- Yes (medically eligible with no contraindications)
- No (medically ineligible due to a confirmed contraindication)
- Maybe (has an unconfirmed contraindication)

An attempt was made to contact each child’s guardian and/or pediatrician for clarification if a contraindication was noted on the consent form. A list of contraindications created by the health department was given to the school nurses to use for screening the consent forms and medical records. If the nurses were unsure of a particular illness, the community pediatric liaison was contacted for more information. Ineligible children were given a letter informing their parents of their contraindication and were encouraged to visit their pediatricians to receive a flu shot. Asthma was by far the most common contraindication, accounting for about 20% of students, but according to a follow-up telephone survey, more than half were immunized by their health providers.

Increasing consent form return rate: Schools with low rates of consent form returns alerted the program coordinator, who then dispatched volunteers to aid the school. The volunteers had a significant impact on the program’s success by reaching out to the parents and collecting the consent forms. University nursing students were able to help 2 schools raise their initial 25% consent form return rate to 80% by talking to parents during morning carpool drop-offs and visiting classrooms to educate students about the flu program.

Vaccine preparation, storage, and distribution: The county health department pharmacy was in charge of vaccine arrival, preparation, storage, delivery, and pick up. Once the vaccine shipment arrived at the health department, its pharmacy was in charge of storing the vaccine. A few days before each school’s clinic, the pharmacy was given the number of doses required, and it prepared the vaccines for transportation. The delivery method used all available sectors of the health department to drop off and pick up leftover vaccine, while maintaining the cold chain.

Vaccine clinic preparation: The school nurses reviewed the consent forms up to the morning of the vaccine clinic. In addition, clinic dates were planned according to the people power available to help administer the vaccines and to minimize school disruption. The smaller charter and private schools’ children were immunized in late September when the health department staff was able to run these clinics with little help from volunteers. The students in larger public schools were immunized in October, when the volunteers were available to help administer the vaccine.

Vaccine clinic flow: A day prior to each school’s clinic date, an automated phone message was sent to remind parents of their child’s clinic date. The health department immunization teams prepared and brought emergency medical supplies in case of an adverse event. At these clinics, the school health and county health department representatives supervised the immunization team. Nursing students and volunteers from the Medical Reserve Corps were in charge of checking temperatures and administering the vaccines while non-medically trained volunteers assisted with paperwork and directed student traffic (Figure 3). A team was able to immunize about 2 children per minute.

Children who require a second dose or who missed their first dose: It is recommended that children 8 and under who have not received prior flu immunizations receive an additional dose 1 month after their first dose.7,8 After administration of the first dose, an additional consent form and a letter was sent home explaining why an additional dose was necessary. The second clinic date was scheduled a month after the first clinic date. A smaller immunization team repeated the immunization protocol, immunizing children who required a second dose or who had missed the
Figure 3. Flow Diagram of School Immunization Clinics. Some of the volunteers should be people with whom the children are familiar, to decrease apprehension. The volunteers guide the children to the correct locations. Color images available online at www.liebertonline.com/lsp.

Station 1: Medically eligible children were taken to the immunization clinic location, by classroom, at their assigned time. The children were lined up in alphabetical order outside the clinic. The teacher placed a name tag on each child before the child left the classroom, and the volunteer at Station 1 handed each child his or her completed parental consent form.

Station 2: Once the clinic was ready to receive the children, the volunteer at Station 2 directed each child to an open intake station.

Station 3: At the intake station, a medical volunteer double-checked the child's parental consent form to ensure that he or she was eligible. Next, the child's temperature was taken to evaluate his or her current health status. If a child was febrile (defined as $>100°F$), he or she was not given the vaccine and the parents were notified. These children will receive the vaccine at a make-up clinic. The county health department felt it was necessary to take a temperature to ensure the child was not ill with H1N1.

Station 4: Children who passed their health check were sent to a volunteer at Station 4. This volunteer directed the child to an open vaccination station.

Station 5: Children at the vaccination station were greeted by the medical volunteer and seated face to face with the volunteer. The child was given time to ask questions about the vaccine and to get comfortable. Once the child was ready, a tissue was given for him or her to hold onto in case the vaccine dropped from his or her mouth. After the children received the vaccine, they were directed to head to Station 6.

Station 6: At this station, the children were asked to discard their tissues and were given hand sanitizer to clean their hands. They were given a certificate of completion to give to their parents to confirm that they had received the vaccine. The children lined up and waited for the rest of their classmates. The volunteers and teachers were instructed to contact the school immunization team leaders if they noticed any adverse reactions.

First immunization clinic. For any child who required an additional visit after the second visit, additional vaccines were delivered to the school nurse to administer individually at a later date. Additional support was provided by nursing staff from the health department.

Homeschooled children and private schools without school nurses: Homeschooled children were directed to the local health department to receive their vaccine. The local health department helped private and charter schools without school nurses review their consent forms and plan and conduct the immunization clinics.

*Adverse events:* To the best of our knowledge, there were no major adverse events.

Program costs: The major expense in this type of immunization program is the cost of vaccine. We were fortunate that vaccine was provided by the Florida Department of Health. Had that not happened, it is unlikely the community could have raised the necessary funds. Vaccine admin-
Table 3. Cost for Alachua County’s School-Based Influenza Immunization Program

<table>
<thead>
<tr>
<th>Program promotion</th>
<th>Description</th>
<th>Actual Cost</th>
<th>Potential Cost</th>
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<tbody>
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<td>$10,000</td>
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<td>Printing cost</td>
<td>Consent forms, flyers, posters</td>
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<td>OPD nurses, data entry clerks, transportation, medical supply kits</td>
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<tr>
<td>Total</td>
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<td>$92,500</td>
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</table>

Administration was done by school and public health nurses plus volunteers. Table 3 summarizes program expenditures. The $35,000 raised in the community was used to support the program coordinator, the PR campaign, and printing costs. Additional funds and staff were provided by the health department. With the vaccine supplied by the state and the extensive use of unpaid volunteers, the total cost to immunize a child was about $6. Without the support that we had in this program, the cost would have been $12 per student for administration, in addition to the cost of the vaccine.

Program Evaluation

Early in the planning process, we decided to collect the following data: (1) percentage of returned parental consent forms from medically eligible students; (2) percentage of returned consents from medically ineligible children; (3) percentage of returned forms from parents indicating they did not want to participate; and (4) number of students enrolled. Other data, such as demographic information, percentage of students receiving free and reduced-price lunch from school, and contraindications, gave a snapshot of the community. Analysis of preliminary data suggests that the crude immunization rate (10,671 of the 19,402 of students enrolled in public schools were vaccinated) was approximately 55%. The overall immunization rate for schools with 80% or more of students receiving free or reduced-cost lunch went from 12% in 2006-07 to 47% in 2009-10. In schools with less than 40% of such students, the rates went from 34% to 52%. The rates at all schools, but especially the latter, would probably have been higher except for some parents taking their children to their private doctors to get the seasonal vaccine in September rather than waiting for the program.

Analysis of these data is continuing, including collection of data on immunizations (both LAIV and injectable vaccine) received in physicians’ offices and at the county health department; with the addition of these latter data, we anticipate that overall community immunization rates for children will be well above 65%.

A follow-up telephone survey showed that more than half of the approximately 20% of the children excluded for medical reasons received flu shots from their providers. It also showed parents were very grateful for the convenience of not having to take their children to the doctor and for the free immunization. Children preferred the spray to shots.

Lessons Learned

The Alachua County Program

Although statewide vaccine databases are of great value, it is difficult to obtain real-time data from the FloridaSHOTS vaccine registry. This is primarily a function of delays in data entry related to the availability of data entry time at the level of the health department and in private practice offices.

Parental consent forms are complex and require careful thought. The Alachua County consent forms had some inadequacies. First, receiving another live, attenuated vaccine within the previous month is a contraindication for the LAIV; therefore, the consent forms should ask whether the child has received or plans to receive a measles/mumps/rubella (MMR) vaccine, measles/mumps/rubella/varicella (MMRV), or any other vaccine in the month preceding (or following) the school-based campaign. This question would have saved our nurses and volunteers time spent contacting parents. Communicating expected flu immunization dates to community pediatricians and asking them to try to avoid live virus immunization a month prior might be of some help.

Second, many children did not qualify for the program because their consent form indicated they had “asthma and/or a reactive airway disease.” Approximately 20% of the
students were reported to have asthma, accounting for >90% of medically ineligible children. A better question might be, “Does your child have active asthma (taking asthma medication)?”

Third, for children younger than 9 years old, who require 2 doses of vaccine, it would be better not to require 2 separate consent forms but rather to have 1 form that gave permission for both. If 1 consent form is not possible, print the separate consent forms on different color paper to reduce confusion.

School-Based Influenza Immunization Programs

The CDC plays a critical role in determining when a school-based influenza immunization program can begin. The Alachua County program was ready to enroll children during the summer; however, the 2009-10 Vaccine Information Sheet (VIS) was not made available until mid-August. In Florida, health departments are required to provide parents with the updated VIS in order to obtain parental consent; therefore, our program lost weeks of recruitment time. This year’s 2010-11 VIS was not available until August 10, 2010—8 days before the first day of school.

Achieving high rates of school-based influenza immunization requires a concerted community effort, with substantial volunteer assistance. It is important to have the volunteer task force adequately trained so they can provide correct information to the community.

Use of live, attenuated influenza vaccine (with no needles) substantially reduces the complexity of vaccine administration and is readily accepted by schoolchildren of all ages.

Finally, a program of this magnitude requires a program coordinator to organize and streamline communication within the coalition. It is essential to have 1 person involved in all aspects of the program to filter, disseminate, and direct the information to the right people. Additionally, a coordinator keeps the coalition organized, focused, and on track. This person can also provide an overall perspective of the program to community organizations.

CONCLUSION

This project demonstrates that, at an operational level, it is possible to achieve high immunization rates through a nonmandatory community-wide school-based influenza immunization program if the school system, the health department, and the community share a common vision. While the program was targeted toward influenza, the basic concepts would apply to any voluntary, school-based immunization program. The decision to provide school-based LAIV immunization free of charge to all students (public and private), regardless of insurance status, was critical to achieving the levels of immunization that were obtained. At the same time, this decision raises significant public policy issues related to sustainability—that is, how can costs associated with vaccine purchase and administration be covered, particularly in a setting of decreasing state support for public health activities occurring as a result of state budget deficits? At a national policy level, the decision has been made to recommend universal vaccination of children for influenza. School-based influenza immunization programs are critical to achieving this goal, but, if they are to be implemented at a national level, there is an urgent need to come to grips with how they can be financed.

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School-Located Influenza Vaccination Reduces Community Risk for Influenza and Influenza-Like Illness Emergency Care Visits


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Abstract

Background
School-located influenza vaccination (SLIV) programs can substantially enhance the sub-optimal coverage achieved under existing delivery strategies. Randomized SLIV trials have shown these programs reduce laboratory-confirmed influenza among both vaccinated and unvaccinated children. This work explores the effectiveness of a SLIV program in reducing the community risk of influenza and influenza-like illness (ILI) associated emergency care visits.

Methods
For the 2011/12 and 2012/13 influenza seasons, we estimated age-group-specific attack rates (AR) for ILI from routine surveillance and census data. Age-group specific SLIV program effectiveness was estimated as one minus the AR ratio for Alachua County versus two comparison regions: the 12 county region surrounding Alachua County, and all non-Alachua counties in Florida.

Results
Vaccination of ~50% of 5–17 year-olds in Alachua reduced their risk of ILI-associated visits, compared to the rest of Florida, by 79% (95% confidence interval: 70, 85) in 2011/12 and 71% (63, 77) in 2012/13. The greatest indirect effectiveness was observed among 0–4 year-olds, reducing AR by 89% (84, 93) in 2011/12 and 84% (79, 88) in 2012/13. Among all non-school age residents, the estimated indirect effectiveness was 80% (54, 65) and 38% (31, 41) for 2011/12 and 2012/13. The overall effectiveness among all age-groups was 85% (61, 70) and 48% (42, 50) for 2011/12 and 2012/13.

Conclusion
Wider implementation of SLIV programs can significantly reduce the influenza-associated public health burden in communities.

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Data Availability: The authors confirm that, for approved reasons, some access restrictions apply to the data underlying the findings. Data utilized for this particular analysis were obtained from the Florida Department of Health (third party). Per Florida Department of Health (FLDOH) policy, the authors do not own the data and are restricted from redistributing the data. Those interested in obtaining the data can send a formal data request to the FLDOH for approval through http://irb.researchexcellence.net/. Once permission has been granted by FLDOH, please contact Paul Myers at Paul.Myers@flhealth.gov to access the data.

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Competing interests: The authors of this manuscript have read the journal's policy and have the following competing interests: CHT, MEH, & JGM have received unrelated grant funding in the past from MedImmune in the previous 3 years. This does not alter the authors' adherence to PLOS ONE policies on sharing data and materials.
Influenza is an important vaccine-preventable disease. Children demonstrate the highest levels of influenza transmission, [1]–[3] suggesting that reducing the rate of infection in this population could indirectly lead to substantial risk reduction among other community members. [4] Vaccination of schoolchildren, through school-located influenza vaccination (SLIV) programs promises to be an efficient complementary strategy for increasing the sub-optimal influenza immunization rates achieved through existing immunization delivery programs. [5] Recently, the United Kingdom announced a £100 million expansion of their influenza vaccination program to include healthy schoolchildren [6] and began to pilot these SLIV programs this past season [7].

Three decades of computer modeling [8], [9] and epidemiologic studies [10] support the concept that immunizing children can indirectly protect unimmunized adults in the same community. Mathematical modeling suggests that vaccination of 20% of children 5–18 years could be more effective at reducing influenza-associated mortality among adults older than 64 years than immunizing 90% of the latter age group. [11] Furthermore, immunizing 70% of schoolchildren could prevent outbreaks from occurring in a community. [11] Field studies show that schools are virus exchange systems, [12] and children shed greater quantities of virus and for longer periods of time than adults. A retrospective study of the first nationwide influenza vaccination program suggested that one life was saved for every 420 Japanese schoolchildren immunized. [10] More recently, a study in California reported a 30% reduction in laboratory-confirmed infection among the students enrolled in schools with an SLIV program, relative to schools lacking such a program [13].

The level of indirect effectiveness predicted by mathematical modeling investigations [9], [11], [14] and intervention trials [15]–[17] has yet to be corroborated through empirical assessment of routine SLIV programs delivering live attenuated influenza vaccine (LAIV) to schoolchildren of all ages. This report estimates the effectiveness of an ongoing "opt in" SLIV program implemented in all preK-12 schools (public and private) of Alachua County, Florida, USA for the prevention of influenza-like illness (ILI) outpatient visits at emergency departments and urgent care centers.

Methods

Influenza Immunization in the United States

Non-Alachua Counties

In Florida (and elsewhere in the USA), the majority of routinely-administered vaccinations are funded through private health insurance. Children on Medicaid (a government-sponsored health care program for low income families) or who have no insurance are eligible to receive free vaccine through the Vaccines for Children Program (VFC) paid for by the US federal government. VFC recipients are required to obtain their vaccine at a local health department or specific VFC providers. Regardless of insurance status, most children who receive influenza vaccination do so at a health care facility [18]. Based on a recent analysis of confirmed seasonal influenza vaccinations, we expect the vaccination coverage among privately insured children 5–8 years and 9–17 years to be between 20%–31% and 9%–18% respectively [19].

Alachua County

Implementation of the Alachua County SLIV program is described in detail elsewhere. [5] In brief, the county health department, the public school system, the local pediatricians, the University of Florida, and the county government support this major community initiative to control influenza. The program's goal is to protect the community from influenza by eliminating the financial impediments and access-to-care barriers that tend to prevent schoolchildren from receiving influenza vaccine. The pilot phase of the "opt in" SLIV program began with MedImmune providing free LAIV to kindergarten through 8th grade students in November 2006. The comprehensive program was launched at the start of the 2009/10 school year with the support of local pediatricians and 29 other community partners. Vaccine was made available through the Florida Department of Health and programmatic support was funded through a county health sales surtax, the Children's Miracle Network, and the AvMed Health Plans. In 2010/11, the program was expanded to include high school students. Children ineligible to be vaccinated with LAIV (mostly children with asthma) at school are referred to local pediatricians or other healthcare providers for vaccination with inactivated influenza vaccine.

Data Sources and Analysis

Data sources

Influenza vaccination rates for Alachua County were obtained from the Florida Department of Health’s Florida SHOTS Vaccine Registry. Through collaboration between the Health Department and community pediatricians, all influenza vaccinations of Alachua County residents were entered into the Florida SHOTS Vaccine Registry. Because the state registry does not require all medical providers to report influenza vaccination, comparable vaccination coverage data were not available for other counties. However, we expect the vaccination coverage to be between 18%–31% among privately insured schoolchildren between 5–17 years old [19].

Weekly influenza and influenza-like illness (ILI) associated outpatient visits to emergency departments and urgent care centers were obtained from Florida's Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE). Emergency department and urgent care centers will be referred to as emergency care (EC). This system systematically downloads chief complaint data on a daily basis for all participating EC facilities within Florida. For the 2011/12 and 2012/13 school years, ESSENCE reporting covered approximately 79% of eligible facilities statewide, 65% in Region 3 (12 northeastern counties of the state, excluding Alachua County), and 100% in Alachua County (intervention); levels of participation by EC facilities before 2011 were not felt to be adequate to permit inclusion of ESSENCE data prior to 2011 in this study. The ESSENCE case definition for influenza and influenza-like illness (ILI) is an outpatient visit to a reporting facility with a chief complaint of "influenza," "flu," or "fever" plus "cough" and/or "sore throat." Investigators received the number of ILI-associated weekly visits aggregated by the patient's permanent county of residence and age-group (0–4, 5–17, 18–44, 45–64, and 65 years and older). County and age-group specific resident counts were obtained from the 2010 US Census, [20] and school enrollment data was obtained from the Florida Department of Education [21]. All residents of a county were considered to be at-risk for ILI-associated EC visits.

To reduce the potential that ILI will be misclassified as being caused by influenza infection (i.e., false positive), only ESSENCE surveillance data collected during influenza epidemic periods were analyzed. Influenza epidemic periods were defined for the 2011/12 and 2012/13 school years using the Centers for Disease Control and Prevention (CDC) guidelines [22], [23] and laboratory-based surveillance data for the Southeastern Health and Human Services Region 4 of the United States (Fig. 1). [24] Specifically, an influenza epidemic period begins with the first set of two or more consecutive weeks during which the proportion of
respiratory isolates testing positive for influenza A or B exceeds 10% and remains elevated during the subsequent weeks. The end of the influenza season is defined as the first of a period of two or more consecutive weeks during which each week accounts for <2% of the total number of specimens that tested positive for influenza during the entire season. Data from sentinel providers and viral surveillance were not utilized because this information is not systematically collected across Florida.

Figure 1. Establishing Influenza Epidemic Periods.
The proportion of the laboratory specimens positive for influenza A (light bar) and B (dark bar) viruses among isolates submitted by the states of the Health and Human Services Southeastern Health Region 4 to the National Respiratory and Enteric Virus Surveillance System maintained by the United States Centers for Disease Control and Prevention (CDC). Data are shown for 2011/12 and 2012/13. [24] Influenza epidemic periods (horizontal bars) for each year are defined using CDC criteria [22], [23].

doi:10.1371/journal.pone.0114479.g001

Statistical methods.
The attack rates (AR) were estimated as the number of cases of ILI-associated emergency care visits per 100,000 resident population. ARs were estimated by epidemic period and age-group, for each of the following geographic regions: Alachua County; the 12 surrounding counties (Region 3); and all non-Alachua counties in Florida. The SLIV program effectiveness at reducing the risk of ILI-associated EC outpatient visits was estimated for each combination of epidemic period and age-group as one minus the ratio of the corresponding ARs for Alachua County and a comparison region (either Region 3 or Florida). The effectiveness among 5–17–year-olds is considered to estimate the overall protection, both direct and indirect, associated with the Alachua County SLIV program. [25] Effectiveness for all other age-groups is considered to estimate the age-specific level of indirect protection associated with the Alachua County SLIV program. [25] Data analysis was conducted using the epitR package in R v3.0.3. [26], [27] Ninety-five percent confidence intervals (CI) for the AR and SLIV program effectiveness estimates are respectively based upon exact and asymptotic methods for estimating the standard error.

Sensitivity analysis for possible observation bias in SLIV effectiveness estimates.

A sensitivity analysis was conducted to investigate potential bias due to differential levels of ascertainment of ILI-associated outpatient emergency care visits between Alachua County and the comparison areas. Since the number of ILI outpatient EC cases reported by ESSENCE facilities may be a function of the overall EC visit volume, the ARs for ILI-associated outpatient EC visits were standardized to the overall visit volume seen in Alachua County ESSENCE facilities. The existence of the SLIV program in Alachua County could plausibly exert influences on the sensitivity and/or the specificity of the county’s ESSENCE system for ILI–associated outpatient EC visits, potentially through elevated vigilance by those responsible for reporting to ESSENCE. Any added vigilance among the surveillance staff at Alachua County ESSENCE facilities (relative to reporting ECs in the comparison areas) should be at least partially apparent in the rates of other chief complaints recorded by ESSENCE, even for chief complaints that are reasonably expected to be weakly associated or unassociated with the direct and/or indirect effects of the LAIV delivered by the SLIV program. The impact of this potential source of differential ascertainment was investigated by adjusting the point estimate for the SLIV program’s effectiveness against ILI-associated outpatient EC visits using the estimate of the program’s effect on each of three negative control outcomes (outpatient EC visits for gastrointestinal illness, respiratory illness other than ILI, or physical injury), as well as the combined effect on all three. A detailed description of the analytic approach for the sensitivity analysis is provided in S1 Text.

Ethics Statement.

This research was reviewed and approved by the University of Florida Institutional Review Board. The aggregated data was anonymized and de-identified prior to analysis; therefore, informed consent was not required.

Results

Influenza vaccination in Alachua County

During the 2011/12 influenza season, approximately 47% of school-age (5–17 years) residents of Alachua County received influenza vaccination, with 10,480 students vaccinated with LAIV through the SLIV program and an additional 1,936 students receiving any type of vaccine from a non-SLIV source (Table 1). The overall influenza vaccination coverage rate among school-age children for the 2012/13 season was approximately 50%, with 11,188 students vaccinated through the SLIV program and an additional 2,391 students receiving any type of influenza vaccine from other sources. In both years, a small subset of schoolchildren received their LAIV at their medical provider instead of through the SLIV program.
Table 1. Influenza vaccination coverage (%) among children under 18 years of age for Alachua County.
doi:10.1371/journal.pone.0114479.t001

Influenza Epidemic Period

The mild 2011/12 epidemic period [22] was defined as being 20-weeks long, extending from CDC week 7 through week 26 of 2012. The moderately-severe 2012/2013 epidemic period [23] was defined as being 21-weeks long, extending from CDC week 44 of 2012 to week 13 of 2013. The CDC Region 4 definition for the 2011/12 epidemic period was consistent with laboratory-based surveillance data collected by the Florida Department of Health, but the 2012/13 epidemic period saw transmission of influenza beginning earlier in Florida than the regional data. [28] Formulations of both LAIV and the inactivated influenza vaccine delivered in the US during the 2011/12 and 2012/13 school years were considered to be homologous to the strains circulating during the subsequent epidemic periods [22], [23], [29].

Cases of emergency department and urgent care ILI visits

The weekly rate of ILI-associated outpatient EC visits per 100,000 population were consistently higher in the comparison regions (Region 3 and Florida) than in Alachua County (Fig. 2). The same trend was observed for age-group specific ARs (Table 2), though the relative magnitude of the difference between Alachua County and the comparison regions dropped with increasing age.

Figure 2. Number of cases (per 100,000 residents) of influenza-like illness (ILI) associated outpatient visits by geographic region and calendar week.

Chief complaint information is reported for outpatient visits to 183 emergency departments and urgent care facilities located throughout the state of Florida. Rates are presented for Alachua County (bars), the location of a novel school-located influenza vaccination program, and two comparison regions: the nearby 12 counties (Region 3, dashed line) and all non-Alachua counties (Florida, solid line). The map inset depicts the locations of Alachua and Region 3 within the state of Florida.
doi:10.1371/journal.pone.0114479.g002

Table 2. The attack rates (95% confidence limits) per 100,000 residents for cases of influenza-like illness associated outpatient visits to sentinel emergency departments and urgent care facilities, influenza epidemic season, geographic region, and age-group.
doi:10.1371/journal.pone.0114479.t002

Effectiveness

Due to the relative similarity between the age-group specific ARs for the Region 3 and Florida comparison regions (Table 2), only effectiveness estimates comparing Alachua County and Florida are presented in the main text, but estimates involving Region 3 were similar in value (Fig. 3, Table 3, and Table 4). The estimated overall effectiveness of the Alachua SLIV program among 5–17 year-olds was 79% (95% CI: 70%, 85%) for the milder 2011/12 epidemic period and 71% (95% CI: 63%, 77%) for the moderately-severe 2012/13 period (Fig. 3, Table 3, and Table 4). Among all non-school age residents, i.e., excluding 5–17 year-olds, the estimated indirect effectiveness was 60% (95% CI: 54%, 65%) for 2011/12 and 36% (95% CI: 31%, 41%) for 2012/13. The overall effectiveness among all age-groups was 65% (95% CI: 61%, 70%) for 2011/12 and 46% (95% CI: 42%, 50%) for 2012/13.
Figure 3. Estimated effectiveness of the Alachua County school-located influenza vaccination (SLIV) program (upper panel) and attack rates for influenza-like illness (ILI) associated outpatient visit to sentinel emergency care facilities (lower panel) by age-group and epidemic periods. School-age children (5–17 years) are the target age-group for the SLIV; thus, the SLIV effect in this age-group is considered a measure of the program’s overall effectiveness. SLIV effects in all other age-groups are considered measures of indirect effectiveness. SLIV effectiveness is defined as 1 minus the ratio of the age-group specific seasonal attack rates for ILI-associated outpatient visits in Alachua County versus the rates for one of two comparison regions: the surrounding 12 counties (Region 3, open circles) and all non-Alachua counties of Florida (squares). Vertical error bars represent 95% confidence intervals.
doi:10.1371/journal.pone.0114479.g003

Table 3. Unadjusted and bias-corrected effectiveness estimates of the Alachua County school-located influenza vaccination program for 2011/12 epidemic period.
doi:10.1371/journal.pone.0114479.t003

Table 4. Unadjusted and bias-corrected effectiveness estimates of the Alachua County school-located influenza vaccination program for 2012/13 epidemic period.
doi:10.1371/journal.pone.0114479.t004

For both epidemic periods, indirect protection associated with the Alachua SLIV program decreased with increasing age (Fig. 3, Table 3, and Table 4), excluding 5–17 year-olds. During the mid 2011/12 period, the SLIV program was associated with an indirect protection of 69% (95% CI: 84%, 93%) among 0–4 year-olds, 52% (95% CI: 42%, 59%) among 18–44 year-olds, 30% (95% CI: 3%, 50%) among 45–64 year-olds, and 22% (95% CI: −50%, 42%) among those 65 years and older (Fig. 3, Table 3, and Table 4). For the moderately-severe 2012/13 epidemic period, the estimated indirect protection was 84% (95% CI: 79%, 88%) among 0–4 year-olds, 30% (95% CI: 22%, 37%) among 18–44 year-olds, 10% (95% CI: −8%, 25%) among 45–64 year-olds, and 12% (95% CI: −15%, 33%) among those 65 and older. The CIs for the indirect effectiveness estimates among those 65 years and older included the null effect of 0%.

As reflected in Fig. 2, and S1 and S2 Figures, decreases in the rate of ILI-associated outpatient EC visits in Alachua County were noted during both epidemic and non-epidemic periods, particularly among children. Because of concerns that this might be associated with an underlying ascertainment bias, we used data on total visits and visits for other clinical syndromes to correct our estimates of vaccine effectiveness. We did find variability in overall rates of EC utilization among counties, with Alachua County residents in the 18–44 year old age-group being less likely to go to the EC, and those over 44 being slightly more likely to visit the EC than persons in the comparison counties. However, as shown in Table 3 and Table 4, when we corrected the estimates of
vaccine effectiveness for rates of EC visits and for differences in rates of presentation with other diagnostic categories (gastrointestinal illness, respiratory illness other than ILI, and physical injury), the reductions in the observed effectiveness for the 0–4 and 5–17 year old age-groups were relatively minor; we did see a fairly substantial drop in effectiveness in the 18–44 year age-group, but then increases in vaccine effectiveness estimates in older age-groups.

Discussion

During the 2011/12 and 2012/13 influenza epidemic period, a substantial reduction in the risk of ILI-associated outpatient EC visits among under 65 year-old residents of Alachua County was associated with vaccination of approximately 50% of all school-age children residing within the county through a routine school-located influenza vaccination program. The SLIV program is associated with a 70–79% reduction in the risk of medically-attended ILI among the 5–17 year-olds, a group with an overall vaccination coverage of 47–51%. The risk of ILI-associated outpatient EC visits among 0–4 year-old Alachua County residents was 84–89% lower than the rest of Florida, providing strong evidence that vaccination of school-aged children contributes indirect protection to younger members of the community.

We found some evidence of an indirect effect of the SLIV program among working-age adults (18–44 years), although the effect was relatively small after correction for overall EC visits volume and/or the rates of presentation to reporting ECs for other negative cold control cases; however, the magnitude of the population in this age-group in Alachua County is highly atypical for Florida counties, including, as it does, approximately 50,000 students attending the University of Florida. These students constitute some 28% of the total population of the County, and have an immunization rate of <10%. Without this admixture of University students, who do not fit into the typical model of adults living at home with children, we wonder if the indirect vaccine effectiveness for the 18–44 year age-group may have been higher. The level of indirect effectiveness did continue to drop as we moved into older age-groups. This trend of decreased levels of indirect protection with increased age is consistent with higher vaccination coverage rates among older adults, [30], [31] as well as with higher levels of full or partial acquired immunity associated with a longer history of exposure to vaccination and/or natural infection. Across all age-groups, the effectiveness of the SLIV program was found to be greater in the mild season (2011/2012), which is consistent with the theoretical prediction that indirect vaccine effects are greater in low transmission intensity settings [9].

Similar to other studies, [32] we did not observe the same level of indirect effectiveness among the elderly as was reported for the previously noted 1977–87 study of mandatory influenza immunization in Japan [10] and suggested by mathematical modeling studies. [8], [9] One possible explanation is the consistently high influenza vaccination coverage rates among the elderly in the US [30], [31] that may leave little room for an indirect effect of the SLIV program. Furthermore, evidence suggests that the contact rate between schoolchildren and the elderly is substantially lower in the US relative to Japan, reducing the risk of exposure and the potential for indirect protection. A US Census report estimated that ~5% of families live in multigenerational households, [33] much lower than in Japan [10].

Despite the ecologic nature of this study and its reliance on data collected by a surveillance system for clinical disease, the results of this study are consistent with smaller scale randomized trials and community-based studies. Our results among the 5–17 age-group are consistent with a study using PCR-confirmed influenza as the outcome, which saw a 60% reduction in risk of influenza in an elementary school with 50% of its students vaccinated with LAIV. [13] A county-wide program with a 41–48% LAIV vaccination rate reported a 50% reduction in ED department visits based on ICD-9 ILI among the target age-group. [34] A similar study in Maryland observed fewer cases among the 5–11 and 19–64 year-old residents of communities with SLIV programs, relative to those lacking this type of public health intervention strategy. [32] Our analytic approach has the advantage of harnessing existing surveillance systems that systematically collect clinical data throughout the State, overcoming the difficulty of obtaining parental consent to collect clinical specimens from children for laboratory confirmation [35].

It is of interest that reductions in ILI rates in Alachua County were seen during both "epidemic" and "non-epidemic" time periods. Our initial concern was that this observation could be reflective of ascertainment or other bias in reporting of Alachua County cases through the ESSENCE system. However, despite an extensive sensitivity analysis we could not demonstrate the presence of any significant biases in relative levels of the ascertainment of ILI-associated outpatient EC visits for Alachua County versus the comparison regions, nor did we see any major biases in vaccine effectiveness rates for the 5–17 and 0–4 year age-groups. Because of concerns that these corrections might, in and of themselves, inadvertently introduce additional biases, we elected to present the uncorrected values in the main body of the manuscript. Further discussion of the potential implications of the bias studies is provided in the S1 Text material accompanying the manuscript.

In considering possible reasons for the non-negligible summer ILI rates: Alachua County has had an aggressive SLIV program since the fall of 2009, with overall vaccination rates among schoolchildren consistently above 40%. It may be that maintenance of consistently high levels of immunity in a community among the age-group associated with elevated influenza transmission, i.e., school-age children and young adults, over a period of several years resulted in longer periods of transmission, but at lower rates. Further studies are warranted of the physiologic, virologic, sociologic, and/or epidemiologic mechanisms underlying this reduction, given that circulation of influenza is thought to be negligible during such non-epidemic periods.

Conclusions

Our results show that immunization of school-age children with influenza vaccination protects them from ILI-associated outpatient EC visits, and also protects the very young, one of the most vulnerable age-groups for adverse morbidity and mortality outcomes. [3] Our study highlights the value of SLIV programs for increasing influenza immunization coverage rates by complementing the traditional delivery strategy that depends upon medical offices and pharmacies. Through the SLIV program, we have observed increase vaccination uptake among minorities and lower socioeconomic groups that may not normally get vaccinated. [5] We hope this study will promote dialogue among the members of the research community and the general public regarding the effectiveness of the SLIV approach for reducing the public health burden attributable to influenza, particularly as wider implementation of routine SLIV programs is being considered in the USA and abroad (for example, the United Kingdom [7]). Our work provides a compelling argument for further community-based research into the nature and extent of the impact of SLIV programs.

Supporting Information

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http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0114479

4/15/2015
S1 Figure.
Among the 0 to 4 year-old residents of Alachua County (gray bars), the rest of Region 3 (dashed line), and Florida (excluding Alachua County, solid line), the weekly rates of outpatient visits (per 100,000 residents) to sentinel emergency room and urgent care departments for chief complaints associated with influenza-like illness. The epidemic periods are denoted by thick horizontal lines located at the base of the plot. doi:10.1371/journal.pone.0114479.s001 (TIF)

S2 Figure.
Among the 5 to 17 year-old residents of Alachua County (gray bars), the rest of Region 3 (dashed line), and Florida (excluding Alachua County, solid line), the weekly rates of outpatient visits (per 100,000 residents) to sentinel emergency room and urgent care departments for chief complaints associated with influenza-like illness. The epidemic periods are denoted by thick horizontal lines located at the base of the plot. doi:10.1371/journal.pone.0114479.s002 (TIF)

S1 Text.
Sensitivity analysis for ascertainment bias in the estimation of the effectiveness of the school-located influenza vaccination program in Alachua County, Florida, from 2011–2013. doi:10.1371/journal.pone.0114479.s003 (DOCX)

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Author Contributions

Conceived and designed the experiments: CHT JDS JRCP KAR IML MEH JGM PAS. Performed the experiments: CHT JDS JRCP KAR YY PDM NK JB GL CAH CA IML MEH JGM PAS. Analyzed the data: CHT JDS JRCP PAS JGM MEH IML YY. Contributed reagents/materials/analysis tools: CHT JDS JRCP KAR PDM JBC RD JJ JS NK JB LLC BC GL CAH CA YY IML MEH JGM PAS. Wrote the paper: CHT JDS JRCP KAR PDM JBC RD JJ JS NK JB LLC BC GL CAH CA YY IML MEH JGM PAS.

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