RESEARCH

Immunization Education in US Pharmacy Colleges and Schools

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Submitted August 30, 2017; accepted October 8, 2017; published June 2019.

Objective. To determine the extent to which immunization is covered at US colleges and schools of pharmacy and to characterize what immunization- and vaccine-related content is taught.

Methods. An invitation to complete a 23-question online survey instrument was sent to 128 accredited US pharmacy colleges and schools. Frequency and descriptive statistics were used to characterize the data, and the Fisher exact test was used to compare opportunities for students to engage in introductory and advanced pharmacy practice experiences (IPPEs and APPEs) at schools located in states that did or did not allow pharmacy students and interns to vaccinate.

Results. Eighty accredited US pharmacy schools responded to the survey (62.5% response rate). The APhA Pharmacy-Based Immunization Delivery Program was offered by 73 (91.3%) schools, while a different immunization certificate program was offered by 5 (6.3%) schools. Sixty-nine (86.3%) and 36 (45%) of the schools had integrated immunization topics into their required core curriculum (mean 8.4 contact hours) and elective curriculum, respectively. Of the 27 immunization-related topics identified, 23 (85.2%) were covered by at least 80% of schools. More than 80% of schools offered IPPEs and more than 90% offered APPEs that provided opportunities for students to engage in immunization-related activities. Schools located in states that permitted pharmacy students and interns to vaccinate more commonly offered immunization-related opportunities through IPPEs (86.5% vs. 0%) and APPEs (97.3% vs. 20%) than those schools in states that did not.

Conclusion. Immunization curricula at US colleges and schools of pharmacy appear to align with ACPE standards, as well as the recommendations of the American Association of Colleges of Pharmacy and the American College of Clinical Pharmacy. Furthermore, nearly all of the schools are using the APhA Program to do so.

Keywords: pharmacy education, immunization, vaccine, curriculum

INTRODUCTION

Maintaining high immunization rates across the US population is important to preventing widespread transmission of communicable diseases. Although childhood vaccination rates vary from state to state and are often contingent on a state's vaccine exemption legislation, they generally meet or exceed acceptable thresholds set by the Office of Disease Prevention and Health Promotion.^{1,2} In contrast, adolescent vaccination rates are acceptable for some but not all vaccine-preventable diseases, and adult vaccination rates for most vaccine-preventable diseases, although improving, fail to meet public health goals.^{2,3} A multidisciplinary approach to immunizing the population is one way

to address the issue of suboptimal vaccination rates in certain populations, and the pharmacy profession is well positioned to help the medical community accomplish this.⁴

As of July 2016, pharmacists are authorized to administer vaccinations in all 50 US states, the District of Columbia, and Puerto Rico. Although pharmacy students and interns were allowed to vaccinate in only 47 states as of July 2016, they can now do so in all 50 US states. Completion of a certificate training program and pharmacist oversight are the common requirements for students and interns to vaccinate.⁵ The vaccines that can be administered and the specific populations that can be vaccinated by a pharmacist vary from state to state: 48 states and territories authorize pharmacists to administer any vaccine, and 45 states and territories permit pharmacists to vaccinate both pediatric and adult patients.⁵ Through provision of vaccination services, the pharmacy profession has helped improve vaccination rates across the country.⁴

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However, the quality of vaccination services provided by new pharmacy practitioners and students may be contingent on the quality of education they receive on the topic.

To equip pharmacy students to serve effectively in this role, colleges and schools of pharmacy need to have immunization training integrated into their required core curricula.⁶ The Accreditation Council for Pharmacy Education (ACPE), the American College of Clinical Pharmacy (ACCP), and the American Association of Colleges of Pharmacy (AACP) all support educating students on the topic of immunization.⁷⁻⁹ The manner in which and the extent to which this topic is taught at US schools of pharmacy is unknown, but based on a variety of published reports, it varies across the country.¹⁰⁻¹⁶ The primary objective of this study was to determine the extent to which immunization is taught at US schools of pharmacy and the secondary objective was to assess what immunization/vaccine-related content is being taught.

METHODS

A 23-question survey instrument was developed, pretested, and approved by the University at Buffalo Social and Behavioral Sciences Institutional Review Board in 2017. The survey was pretested by a faculty member intricately familiar with his school's immunization curriculum. The faculty member was asked to take the survey and provide written feedback for each question as indicated to assess the survey's question clarity, overall flow, and length (the individual was specifically asked if he was able to focus for the duration of the survey in order to assess the presence or absence of survey fatigue), and, to provide feedback regarding whether the survey adequately addressed the study's primary and secondary objectives. The survey instrument was then revised based on this feedback.

The survey instrument included questions regarding demographics of the respondent's school of pharmacy, if the school offered an immunization certificate program, if the school included immunization content within required (core) and/or elective curricula, how many hours were dedicated to immunization content, when immunization content was covered in the curriculum, and what immunization content was taught. Immunization content was classified into one of four categories: foundational immunization-related topics, foundational vaccine topics, pharmacy management-based topics, and practice-based skill topics.

Data on each pharmacy school's location, accreditation status, and the number of years the school had been in existence were collected from data available on the ACPE website. Private and public institution data were retrieved from the Pharmacy College Application System website

and individual school websites. As determined by its location, each school was assigned to one of the four regions described by the US census bureau (ie, Northeast, South, Midwest, and West). Skip logic, which directs the respondent through different paths in the survey based on their responses, was integrated to minimize survey fatigue.

An electronic hyperlink to the survey instrument was distributed to all 128 accredited US colleges and schools of pharmacy by e-mail using the curriculum special-interest group e-mail list (purchased from AACP) on June 1, 2017. A reminder email was sent to all schools two weeks later. To optimize the survey response rate, the websites of pharmacy schools that did not initially respond to the survey were reviewed to identify faculty members specializing in three key areas: infectious diseases, pediatrics, and immunizations. An email was sent to this targeted list on June 29, 2017, and a reminder email was sent two weeks later. The survey instrument was available online for two months.

The survey response rate and distribution of responses were determined to generalize the study findings. If multiple responses were received from a single school, the following order of preference was assigned based on which faculty member we believed would have the best understanding of their school's immunization curriculum: pharmacy practice faculty members designated to teach immunizations, curriculum committee chair, department chair/vice-chair, pharmacy practice faculty member (other), assistant/associate dean of academics, and dean. When multiple responses were received from a single school and the responding faculty members' positions were the same, their responses were combined. If there were conflicting responses that could not be combined, preference was given to the faculty member who completed the survey in its entirety. If that was the same, then preference was given to the faculty member who responded first.

Data were analyzed using Excel and MYSTAT 12, Version 12.02.00 (SYSTAT Software, Inc, San Jose, CA). Frequency and descriptive statistics were used to characterize the data. The Fisher exact test was used to compare demographic data and opportunities for students to engage in introductory pharmacy practice experiences (IPPEs) and advanced pharmacy practice experiences (APPEs) at schools located in states and territories that did and did not allow pharmacy students and interns to vaccinate at the time of this survey. The a priori level of significance was set at $<.05$.

RESULTS

Eighty accredited US pharmacy colleges and schools responded to the survey (62.5% response rate).

The demographics of respondent schools were similar to the pertinent demographics of all US pharmacy colleges and schools. Specifically, there were no differences found based on state legislation permitting pharmacists to vaccinate, regional location, or public or private school status ($p>.05$) (Table 1). The mean class size among responding schools was 121.4 (SD=57.9) students.

The American Pharmacists Association (APhA) Pharmacy-Based Immunization Delivery Program was offered by 73 (91.3%) schools. Among schools that indicated offering this program, the majority (63%) provided the training in either the first or second year of the Doctor of Pharmacy (PharmD) program. Reasons cited for not offering the APhA program included: cost

(\$99.00 registration fee per student at the time of manuscript submission), structure of the program, preference for their state's immunization training program, and a perceived lack of need for the program. Of the seven schools that indicated not offering the APhA program, five (71.4%) indicated offering an immunization certificate-type program other than that offered through APhA (eg, Collaborative Education Institute Immunization Training, Minnesota College of Pharmacy Immunization Delivery Program). A total of 78 (97.5%) schools offered either the APhA program or another, non-APhA immunization certificate-type program.

The topic of immunization was integrated into the required curricula (in addition to or in lieu of the APhA program) at 69 (86.3%) schools. All responding schools

Table 1. Demographics of US Doctor of Pharmacy Programs Participating in a Survey About Immunization Education in Pharmacy (n=80)

Demographic	No. (%)	National Data, No. (%) ^c
College/School in a state that permits pharmacy interns to immunize ^a		
Yes	75 (93.8)	119 (93.0)
No	5 (6.3)	9 (7.0)
Regional distribution ^a		
South	32 (40.0)	48 (37.5)
Midwest	22 (27.5)	32 (25.0)
Northeast	14 (17.5)	25 (19.5)
West	12 (15.0)	23 (18.0)
Public/Private ^a		
Public	45 (56.3)	64 (50.0)
Private	35 (43.8)	64 (50.0)
No. students per graduating class		
< 50	2 (2.5)	
50-100	38 (47.5)	
101-150	21 (26.3)	
151-200	11 (13.8)	
>200	8 (10.0)	
No. years of college/school's existence		
≤ 5 years	0 (0.0)	
6-10 years	14 (17.5)	
11-20 years	13 (16.3)	
> 20 years	53 (66.3)	
Position of Responder		
Pharmacy practice faculty (designated to teach immunization)	46 (57.5)	
Department chair / Vice-chair	10 (12.5)	
Dean (Assistant/Associate) of Academics (or the equivalent)	9 (11.3)	
Pharmacy practice faculty (other)	7 (8.8)	
Curriculum Committee Chair	4 (5.0)	
Dean	1 (1.3)	
Other ^b	3 (3.8)	

^a $p>.05$

^b Professor, Department of Pharmaceutical Systems and Policy and Director of CE (n=1), Experience programs faculty (n=1), Pharmaceutical Science faculty (n=1)

^c Data from the American Pharmacists Association, the Accreditation Council for Pharmacy Education, the Pharmacy Online Residency Centralized Application Service, and individual school of pharmacy websites

indicated that immunization knowledge and skills are taught either through a certificate program or via the required curricula. The mean “contact hours” dedicated to this topic (outside of the certificate programs) was 8.4 (SD=8.3) hours. Based on this and considering that over 90% of schools indicated that they offered the APhA program, which contains 8 hours of live programming, colleges and schools provide, on average, 16 “contact hours” of didactic and case-based instruction relating to immunization. The topic of immunization was most frequently introduced during the first year (47.6%). However, when asked when the majority of immunization-related topics are taught, respondent’s most common answer was the second year (41.3%). Immunization-related content was taught most commonly as a subsection of a pharmacotherapy topic (70.5%) rather than as a stand-alone topic. Immunization-related content was offered within elective curricula at 36 (45.0%) schools, with four (11.1%) offering a stand-alone immunization elective. The mean number of “contact hours” dedicated to immunization in the elective curricula was 8.2 (SD=12.1) hours. Eleven (13.8%) schools indicated not offering immunization-related content in either their elective or required curricula; however, these schools all offered the APhA program.

Of the 27 immunization-related topics included in the survey instrument, 23 (85.2%) were covered through either the required curricula or via the APhA program by at least 80% of the schools (Table 2). The following immunization-related topics were covered by all schools: immunology, the role of the pharmacist as immunizer, vaccine and immunization resources, vaccine storage, vaccine indications, vaccine precautions and contraindications, vaccine adverse reactions and safety, vaccine doses, vaccine routes of administration, documentation and record keeping of immunizations, utilizing immunization charts and schedules, screening patients for vaccination, administration technique, aseptic technique, response to anaphylactic reactions, disposal procedures, and patient education (Table 2).

Among responding schools, 64 (81%) indicated offering IPPEs that provide students with opportunities to engage in immunization-related activities. Schools that were located in states that permitted pharmacy students and interns to vaccinate were more likely to offer immunization-related opportunities through IPPEs than those schools located in states that did not permit students and interns to do so: 64/74 (86.5%) vs. 0/5 (0%) ($p<.001$). The majority of schools indicated that they began offering IPPEs in which students engaged in immunization-related activities during the first year of the PharmD program; however, the most common year these opportunities were

offered was the second year. Seventeen (26.6%) schools indicated offering IPPEs during all three IPPE levels, within which students were afforded the opportunity to apply the vaccination skills learned in class. Nearly all (92.3%) responding schools indicated offering APPEs in which students engaged in immunization. Schools located in states that permitted pharmacy students and interns to vaccinate more commonly offered immunization-related activities through APPEs than those schools located in states that did not permit students and interns to do so (71 [97.3%] vs 1 [20%], $p<.001$).

DISCUSSION

The results of this study indicate that the vast majority of US colleges and schools of pharmacy offer some type of immunization certificate training program, which aligns with ACPE standards and provides a way to meet ACCP and AACP recommendations.⁷⁻⁹ Furthermore, all of the schools offered education in immunization either through a certificate program or through required curricula. In 2009, Bain and colleagues reported that approximately 38% of US pharmacy colleges and schools provided education and training in immunization as part of their core curricula; however, these data were based on a personal communication with the APhA.¹⁷ More recently, Prescott and colleagues conducted a 2013 survey of US colleges and schools of pharmacy designed to characterize pediatric curricular content. This study revealed that immunizations were taught by 86% of schools.¹⁸ Based on the data presented here, the number of colleges and schools that integrate immunization-based content into their required curriculum has increased considerably during the past decade, coinciding with a notable increase in pharmacist involvement in vaccination services nationwide. Our study further confirmed that most immunization topics are covered by at least 80% of colleges and schools of pharmacy, but the data also suggest there are gaps in the teaching of certain immunization-related topics (eg, ethics of immunization, managing [not just preventing] accidental needle sticks). Topics that are not part of the APhA program (or other certificate program) or that are only covered superficially may need to be included in the schools’ required PharmD curricula. Although the pedagogy used to teach immunization in respondent schools’ didactic curriculum was not elicited through this study, because most schools offer an immunization certificate program (primarily through APhA which entails an application based component), the majority of students at US-based colleges and schools of pharmacy engage in case-based learning and are expected to demonstrate competence in vaccine administration. Immunization is designated as a tier 1 topic by ACCP;

Table 2. Immunization Topics Covered at US Colleges and Schools of Pharmacy that Responded to a Survey on Immunization Education

Topic	Required/Core Curriculum (n=69), No. (%)	Required/Core Curriculum or APhA Program (n=80), No. (%)
Foundational immunization-related topics		
Immunology	61 (88.4)	80 (100)
Role of pharmacists as immunizers	56 (81.2)	80 (100)
Epidemiology of vaccine-preventable diseases	51 (73.9)	79 (98.8)
Ethics of immunization ^a	43 (62.3)	43 (53.8)
Foundational vaccine topics		
Vaccine/immunization resources	65 (94.2)	80 (100)
Vaccine routes of administration	60 (87.0)	80 (100)
Vaccine storage	59 (85.5)	80 (100)
Vaccine indications	56 (81.2)	80 (100)
Vaccine precautions/contraindications	54 (78.3)	80 (100)
Vaccine adverse reactions/vaccine safety	53 (76.8)	80 (100)
Vaccine doses	47 (68.1)	80 (100)
Vaccine development ^a	30 (43.5)	30 (37.5)
Pharmacy management-based topics		
Documentation and record keeping of immunizations	47 (68.1)	80 (100)
Legal and regulatory issues related to immunization/vaccination	43 (62.3)	79 (98.8)
Procuring compensation for vaccination	28 (40.6)	78 (97.5)
Planning vaccination programs	28 (40.6)	77 (96.3)
Marketing vaccination program	25 (36.2)	77 (96.3)
Practice-based skill topics		
Utilizing immunization charts/schedules	60 (87.0)	80 (100)
Screening patients for vaccination (eg, identifying target populations)	58 (84.1)	80 (100)
Administration technique	56 (81.2)	80 (100)
Aseptic technique	56 (81.2)	80 (100)
Response to anaphylactic reactions (eg, epinephrine administration)	54 (78.3)	80 (100)
Disposal procedures	52 (75.4)	80 (100)
Patient education	49 (71.0)	80 (100)
Addressing concerns/misconceptions of vaccine hesitant patients	47 (68.1)	79 (98.8)
Cardio-Pulmonary Resuscitation (CPR)/Basic Life Support (BLS) ^a	47 (68.1)	56 (70.0)
Managing accidental needle sticks ^a	42 (60.9)	42 (52.5)

^a Topic not covered in the APhA Pharmacy-Based Immunization Delivery Program

therefore, students need to receive adequate instruction to prepare them to engage in collaborative, patient-centered care in this area upon graduation and licensure.⁸ The extent to which and the way in which immunization is being taught at US pharmacy schools appears to accomplish this goal.

Immunization content has been taught in a variety of ways at US schools of pharmacy: core and elective experiences using didactic education (in a traditional classroom, online, and using a blended-learning format), practical laboratory activities, high- and low-fidelity sim-

ulations, and immersive training through introductory experiential education.¹⁰⁻¹⁵ In addition to homegrown activities, several schools offer the APhA immunization training program, an approved certificate course for pharmacists who plan to administer vaccinations.¹⁶ Although the APhA program is not all-inclusive and the vast majority of schools continue to integrate immunization education into their required curricula, this certificate program now appears to be the standard way in which schools are educating students on the topic of immunization. The APhA program is overseen by experts in the

field, provides a standardized way in which pharmacists are trained, incorporates active-learning components, and requires demonstration of competency through a post-examination and via demonstration of vaccination technique. It is the opinion of the authors that US colleges and schools of pharmacy should require students to complete a certificate training program (such as the one mentioned above), or at a minimum, continue to provide students with an opportunity to do so. If a pharmacy school is unable to provide this type of program, immunization training that includes active learning and assessment of students' competence and skills should be implemented in order to provide students with the breadth and depth of training necessary to engage in collaborative, patient-centered care.

In terms of application of skills learned, the vast majority of colleges and schools provide opportunities for students to engage in immunization-related activities through IPPEs and APPEs. Most of these pharmacy schools equip students for these activities by providing immunization training early in their curriculum. Unfortunately, schools located in states that, at the time of this survey, did not permit pharmacy students and interns to vaccinate (New Hampshire, New Jersey, and New York) were unable to provide students with these immersive opportunities in their home state. Of the five responding schools located in states that did not permit students and interns to vaccinate, none provided opportunities for students to engage in immunization-related activities via IPPEs, and only one provided such an opportunity via APPEs. We speculate that this school provided its students with immersive opportunities in a state that permitted them to do so. Student education and patient care can be improved when pharmacy students are given the opportunity to engage in immunization-related activities.^{14,19-21} Not allowing pharmacy students to vaccinate can have the reverse effect, ie, these students may not engage in this activity until a time when they no longer have a pharmacy supervisor to model, coach, and facilitate the role of the pharmacist vaccinator. Fortunately, since this survey was conducted, new legislation has been passed in each of the above three states: pharmacy interns are now authorized to vaccinate in all 50 states.

The primary limitation of this study is the response rate of 62.5%, which is acceptable based on a target threshold of 60% but is below the 80% response rate recommended to generalize these findings to all US schools of pharmacy. As a result, nonresponse bias may be of concern when interpreting the results of this survey. That said, the distribution of the responding schools in terms of public/private status, regional distribution, and state legislation pertaining to pharmacists

as vaccinators seemed to be representative of pharmacy education as a whole, thus making the results applicable to other colleges and schools of pharmacy across the United States. Second, the survey was pretested by a single faculty member: a larger cohort of pre-testers could have strengthened the survey instrument. Third, we were unable to determine whether the schools of pharmacy that responded to the survey required students to complete the APhA program or if doing so was optional.

CONCLUSION

Immunization curricula at US colleges and schools of pharmacy appears to align with ACPE standards as well as AACP and ACCP recommendations, and nearly all schools are using the APhA Pharmacy-Based Immunization Delivery Certificate Program. Most schools offer IPPEs through which vaccination skills can be developed and almost all provide APPEs during which those skills can be further refined prior to graduation. Colleges and schools of pharmacy should continue to invest resources into training students to be proficient in immunization. Pharmacy educators should continue to provide pharmacy students with high-level immunization training that includes a certificate course, such as the APhA program, and required didactic curricula to ensure that the next generation of pharmacists is equipped to optimize preventative care.

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