Title: A Systematic Review of Immunization Administration Training for African Pharmacists and Student Pharmacists.

Authors: Kimberly C. McKeirnan, a BS, PharmD; Ilse Truter, a DCom, BPharm, MSc, PhD; Teri-Lynne Fogarty, a BPharm, MPharm, PhD.

a Nelson Mandela University Pharmacy Department
South Campus Building 12
PO Box 77000
Gqeberha, 6031, South Africa
Kimberly McKeirnan: s228368189@mandela.ac.za; Teri-Lynne Fogarty: teri-lynne.fogarty@mandela.ac.za; Ilse Truter: ilse.truter@mandela.ac.za

Corresponding author: Kimberly McKeirnan
Nelson Mandela University Pharmacy Department
South Campus Building 12
PO Box 77000
Gqeberha, 6031, South Africa
Kimberly McKeirnan: s228368189@mandela.ac.za

Permanent address: Washington State University College of Pharmacy and Pharmaceutical Sciences
412 E Spokane Falls BLVD
Spokane, WA 99202-2131
Kimberly.mckeirnan@wsu.edu

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Abstract:

Objectives: Recent calls to action have encouraged African pharmacists to become trained to administer immunizations with the goals of developing a strong pharmacy vaccination workforce, addressing a shortage of vaccinators, and improving vaccination access. However limited availability of training programs for pharmacists and student pharmacists to learn to administer immunizations may restrict the ability of African pharmacists and student pharmacists to meet these goals. This work sought to systematically identify literature published regarding immunization administration training for pharmacists and student pharmacists in Africa.

Findings: Nine-hundred and forty articles were identified from six databases and grey literature. After eligibility criteria were applied, a total of eight studies from seven African countries were included, representing Democratic Republic of Congo, Ethiopia, Nigeria, Senegal, South Africa, Uganda, and Zimbabwe. Three studies described immunization administration training programs for pharmacists and one described training for student pharmacists.

Summary: This literature review identified that there are limited publications describing immunization training for pharmacists and student pharmacists in Africa. Training pharmacists to immunize could make a meaningful impact in increasing immunization access and reducing the spread of vaccine-preventable diseases in Africa. Expansion of available immunization administration training is needed for African pharmacists and student pharmacists if calls to action are to be met.

Keywords: pharmacist immunization training, Africa, pharmacy education, pharmacy-based immunizations.

Abbreviations

PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyzes

1. Introduction

Pharmacy-based immunizations have been beneficial in increasing access to vaccinations for patients around the world, even before the Coronavirus 2019 (COVID-19) pandemic. For patients in many
countries, pharmacy-based immunization services have expanded access to vaccinations, particularly in rural areas. Offering immunizations in pharmacies has also demonstrated value in reducing health disparities and benefiting medically underserved populations. However, many of the countries benefitting from pharmacist-administered vaccinations are developed, or high-income countries such as the United States, Canada, Australia, and most European countries. Conversely, developing, or low- and lower-middle-income countries (LMICs) often have the lowest vaccination rates and healthcare systems that are not adequate to address the vaccination needs of their populations. Of the 54 countries on the African continent, seven are considered upper-middle-income and only one, Seychelles, is considered high-income. In most African countries, the role of the pharmacist in administering immunizations is limited. In some African LMIC countries, such as Ethiopia, and Senegal, pharmacists are involved in the vaccination process as educators and advocates since immunization administration is not included in their scope of practice. In LMICs such as the Democratic Republic of Congo, pharmacy-based immunization services are offered but other types of healthcare providers, commonly nurses, must be present to administer the immunizations.

In addition to having limited opportunities for pharmacists to be involved in immunizing, many African countries also have the lowest global vaccination rates and highest need to expand immunization access. 12.7 million children in Africa have missed routine vaccinations and approximately 500,000 die annually from vaccine-preventable diseases. UNICEF estimates that 8.7 million children in Africa are considered zero-dose children, meaning they have not received any doses of any vaccine. Beyond the loss of life, vaccine-preventable diseases can also negatively impact general community health, disrupt healthcare systems, lead to learning losses among children, and have substantial economic impacts.

Recent calls to action have encouraged African pharmacists to become trained to immunize with the goals of developing a strong vaccination workforce, addressing a shortage of vaccinators, and improving vaccination access. Although the scope of practice of pharmacists does not explicitly include immunization administration and/or injection technique in many African countries, others do not
specifically exclude pharmacists from immunizing\textsuperscript{24} or have amended regulations\textsuperscript{25} in recent years to create processes allowing pharmacists to immunize. In South Africa, for example, although immunization administration authority is not explicitly stated in the pharmacist scope of practice, but pharmacists can apply for a permit through the Department of Health allowing them to immunize after completing an accredited program.\textsuperscript{25} However, the lack of availability of training programs to teach injection technique and other skills needed to administer immunizations may inhibit pharmacists and student pharmacists in Africa from becoming vaccinators. In high-income countries such as the United States, vaccination training is a required part of pharmacist education.\textsuperscript{26} However, in some African countries where pharmacists administer immunizations, such as Nigeria, pharmacy curricula do not require immunization administration competencies.\textsuperscript{23} For African pharmacists to become a meaningful immunizing workforce, they must first be trained to administer immunizations. This work sought to systematically identify literature published regarding immunization administration training for pharmacists and student pharmacists in Africa.

2. Methods

2.1 Study Design

A systematic literature review was conducted utilizing methods from the Cochrane Handbook for Systematic Reviews\textsuperscript{27} and the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA)\textsuperscript{28} reporting guidelines. The methods for this review were approved by the Nelson Mandela University Faculty Postgraduate Studies Committee and found to be exempt from the need for review by the Research and Ethics Committee.

2.2 Eligibility Criteria

A literature search was conducted in October 2023 using PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, Embase, and Medline. Articles identified by the literature search were reviewed for
eligibility based on several criteria. First, to be included in the study articles had to involve pharmacy personnel, namely pharmacists or student pharmacists. Articles describing pharmacy-based immunization services with immunizations administered by another healthcare provider type were excluded. Articles involving pharmacy technician education would have also been included, but none were identified. Second, articles had to include immunization administration. Articles describing immunology or vaccinology education but not including administration of vaccines were excluded. Thirdly, articles were required to involve education or training. Articles describing pharmacy immunization services but not including the education or training involved were excluded. Education or training could be conducted as part of curricular education for student pharmacists as well as practice-based training or continuing professional development for working pharmacists. Articles describing curricular vaccination training in a Bachelor of Pharmacy (BPharm), Master of Pharmacy (MPharm), or Doctor of Pharmacy (PharmD) were all acceptable for inclusion. There is variation in terminal pharmacy practice degrees and types of pharmacy practice degrees offered among African countries, so any degree allowing the graduate to be qualified to practice as a pharmacist in that country were acceptable for inclusion. Fourth, articles had to involve pharmacists or student pharmacists in Africa. Training programs developed elsewhere but taught to student pharmacists or pharmacists in or from African countries were eligible for inclusion, but all articles had to involve training those who intended to administer immunizations in African countries. Lastly, articles were acceptable for inclusion if available English and published before October 2023. All peer-reviewed article types were included. Consideration was given to limiting the search to only research articles, but the limited number of publications on this topic led the authors to accept all types if other eligibility criteria were met.

2.3 Search strategy

Search keywords included combinations and variations of pharmacist, pharmacy, student pharmacist, vaccination, vaccinate, immunize, immunization, education, training, learning, teaching, Africa, and individual names of African countries. Medical Subject Heading (MeSH) terms and term abbreviations
(i.e. “immuniz* or pharmac*) were utilized where available. After the keyword search and review for eligible articles was completed, an additional manual search of the references of the retrieved articles was also conducted. A separate online search for grey literature, defined by Cochrane27 as “reports published outside of traditional commercial publishing” was conducted using the study search terms to reduce the risk of publication bias and to identify as many relevant articles as possible. In this case, the authors were aware of at least one article in an African pharmacy society journal that was not indexed in the literature search engines used in this project. By conducting an online grey literature search, the authors wanted to determine whether additional articles could be found. A pharmacy research librarian was also consulted to confirm that no additional search strategies were recommended.

2.4 Study selection

After duplicates were removed, article titles were screened for relevance and eligibility criteria. The abstracts for the remaining articles were retrieved and then reviewed by all three authors independently. Discrepancies regarding inclusion were addressed through group discussion regarding article relevance and eligibility criteria. A full-text review was conducted of the remaining articles by all three authors independently. Author agreement for article selection was also evaluated using the Fleiss’ Kappa coefficient.29

2.5 Data extraction

The full-text review of the articles attempted to extract several prespecified items. First, the authors attempted to identify which topics were included in the immunization training. Specifically, the authors sought to identify whether the training included: using a recommended immunization schedule; patient communication, education and counseling; obtaining patient consent; addressing vaccine hesitancy and misinformation; record keeping and documentation; vaccine storage and handling, including cold-chain management; medical management of adverse reactions to vaccines; identifying appropriate injection sites; intramuscular and subcutaneous injection technique; and adverse event reporting and
pharmacovigilance. These topics were selected based on items included in the South Africa Pharmacy Council (SAPC) competency standards\textsuperscript{25} for pharmacists who provide immunization services and the American Pharmacists Association’s Pharmacy-Based Immunization Delivery Certificate Training Program\textsuperscript{30}, which is used by many US schools and colleges of pharmacy to meet immunization training accreditation requirements in the United States. Additionally, researchers sought to identify the length of training, whether the training included a live face-to-face practical portion, and a hands-on injection technique assessment. In the United States, the Public Emergency Readiness and Preparedness (PREP) Act enacted during the COVID-19 pandemic required pharmacists to attend a training that was a minimum of 20 hours in length and included a live, hands-on injection technique evaluation.\textsuperscript{31} Finally, researchers sought to identify whether the immunization training offered in Africa was available to practicing pharmacists, student pharmacists, or both, and if offered to students, which degree program was it included in (BPharm, MPharm, or PharmD).

3. Results

The search strategy identified 558 unduplicated articles. After 391 duplicates were removed, 558 titles were screened and 534 did not meet eligibility criteria. Abstracts were reviewed for the remaining 24 articles. After eligibility criteria were applied, a total of eight studies\textsuperscript{10,20,23,32-36} were included in the review: two articles from Nigeria, one from Zimbabwe, four from South Africa, and one included six African countries: Democratic Republic of Congo, Ethiopia, Nigeria, Senegal, South Africa, and Uganda. Articles meeting eligibility criteria included three commentaries, one systematic literature review, two review articles, one mixed qualitative and quantitative method research article, and one survey research article. Author-agreement regarding article inclusion was calculated to be 0.86 using the Fleiss’ Kappa coefficient, showing a very high level of agreement.\textsuperscript{29} The search strategy and study selection methods PRISMA\textsuperscript{28} is shown in Figure 1. A brief summary of the articles included in the review is included in Table 1.

3.1 Immunization administration training and education for pharmacists and student pharmacists
Only one study described training involving student pharmacists as part of a pharmacy curriculum\textsuperscript{34} and three described training for practicing pharmacists,\textsuperscript{20,33,34} as shown in Table 2. The articles by Yemeke and colleagues,\textsuperscript{10} Wada and colleagues,\textsuperscript{23} and Meyer and colleagues\textsuperscript{35} did not mention specific immunization training programs already in existence but rather advocated for the expansion of the training and discussed topics that should be included. Chiutsi and colleagues\textsuperscript{33} and Oseni and Afolai\textsuperscript{36} did not describe implementation of immunization administration training, but instead conducted other research that included immunization administration training in the results.

Khan and colleagues described the efforts of faculty at the University of the Witwatersrand in South Africa to develop an immunization training program for both practicing pharmacists and to be imbedded as part of their BPharm curriculum.\textsuperscript{34} The training developed by the University of the Witwatersrand faculty was designed during the COVID-19 pandemic to meet the training stipulations from the SAPC so that participant pharmacists could apply for a permit to provide immunization and injection services in the community.\textsuperscript{34} Perumal-Pillay also described efforts from separate organizations and universities in South Africa working to offer training programs for practicing pharmacists who wanted to become immunizers during the COVID-19 pandemic.\textsuperscript{20} The article by Baker, published before the pandemic, was also from South Africa but took a different approach to describing the role of the pharmacist in vaccination.\textsuperscript{32} Baker reported that a Travel Medicine Course was available from the South African Society of Travel Medicine and that pharmacists could participate, but only if they were supervised by a physician who had either already completed the course or would take it with them. The Travel Medicine Course includes training to administer yellow fever vaccine and covers many topics that are unrelated to administering immunizations. Pharmacists completing the Travel Medicine Course would also be limited to administering only travel vaccines prescribed by the physician overseeing them.\textsuperscript{32} Details of the immunization training included in the Travel Medicine Course were not included in the published article.

Only the article by Khan and colleagues included details about the topics included in the immunization training and the format of the training and assessment.\textsuperscript{34} The training offered by the University of the
Witwatersrand included a combination of online lecture videos and live in person training, which is similar to the training offered by APhA in the US. The in-person training included injection technique and anaphylaxis management with an injection technique skills assessment. Participants were also required to complete a written skills assessment and administer both intramuscular and subcutaneous injections under the supervision of a trained immunizer to be certified. Additionally, for the version of the training imbedded in the University of the Witwatersrand BPharm program, students completed an allergy and anaphylaxis high fidelity simulation. The student training was described as a combination of four hours of online training and four hours of live training followed by the simulation. This was intended as an accelerated training program so that students could administer COVID-19 vaccinations under the supervision of practicing pharmacists and does not meet the requirements from the SAPC for them to immunize independently. The article did not include details about whether patient education and consenting, addressing vaccine hesitancy and misinformation, recordkeeping and documentation, vaccine storage and cold-chain management, and adverse-event reporting and pharmacovigilance were included. Notably, all three articles describing immunization training for pharmacists and student pharmacists were from South Africa and were published before legislature in South Africa in 2021 changed to give pharmacists the authority to administer immunizations was in place.

Although Meyer and colleagues did not describe a specific training program, it provided guidance on skills that must be learned by pharmacists in order to safely administer immunizations. These included safe and sterile injection practices, reconstitution of vaccines, preventing needle-stick injuries, understanding immunization schedules and administration requirements for individual vaccines, addressing anaphylactic reactions and syncope, and maintaining cold chain stability, screening for contraindications and precautions, addressing patient misinformation about vaccines, reporting adverse events, and documenting vaccinations appropriately.

3.2 Revising BPharm education to include immunization administration
Four studies did not include details about skills to include in immunization training but did report requests from pharmacists from multiple African countries that immunization training programs be developed and made widely available.\textsuperscript{10,23,33,36} Both the survey study by Oseni and Afolai\textsuperscript{35} and the qualitative interview study by Chiutsi and colleagues\textsuperscript{32} reported that pharmacists who were participating in other types of training and studies specifically included requests to obtain immunization training as future directions for those works. Oseni and Afolai described the development of a health promotion training for Nigerian community pharmacists and surveyed participants.\textsuperscript{36} Although this training did not include immunization administration, the study reports that 13\% of pharmacists surveyed indicated immunization administration as an area of interest for future programs\textsuperscript{36} Wada and colleagues also emphasized the need for pharmacists in Nigeria to become trained to administer immunizations.\textsuperscript{23} This commentary recommended engaging with the Pharmacists Council of Nigeria to develop continuing professional development (CPD) for practicing pharmacists and revising pharmacy school curricula to include immunization competencies.\textsuperscript{22} Wada and colleagues suggested pharmacists are already well-trained and easily accessible to the public, so adjusting the BPharm curricula to include immunization training could utilize the huge network of community pharmacists in Nigeria to increase vaccination coverage nationwide.\textsuperscript{23}

Like Oseni and Afolai\textsuperscript{36} and Wada and colleagues\textsuperscript{23}, the study by Chiutsi and colleagues\textsuperscript{33} mentioned revising BPharm education and discussed the opportunities and limitations of this degree. Chiutsi and colleagues interviewed practicing Zimbabwean community pharmacists who had graduated from a BPharm program to gather perceptions regarding their education and practice roles. Pharmacists interviewed indicated that they were interested in administering vaccinations, but that additional training beyond the required BPharm education would be needed. Two pharmacist participants commented on immunization educations: “With the current curriculum pharmacists are obviously not equipped to administer injections but with appropriate training they can effectively administer immunizations and vaccines just like village health workers…” and “A three-day course is enough to recap and educate pharmacists on how vaccines and immunizations can be administered.”\textsuperscript{33} Similarly, Perumal-Pillay
reported in 2021 that the BPharm curriculum in South Africa already included training for vaccine-preventable diseases, logistics of vaccine transport and cold chain management, and information about routine and travel vaccines, so expansion into immunization administration would not be difficult.\textsuperscript{20} Meyer and colleagues explained that most pharmacists in South Africa receive basic vaccinology training, so access to additional training is a key in expanding vaccination services by pharmacists.\textsuperscript{35}

3.3 The potential for immunizing pharmacists to address vaccination gaps in LMICs

All eight articles included in this review emphasized pharmacists could have a substantial impact on addressing vaccination gaps in African countries.\textsuperscript{10,20,23,32-36} The article by Meyer and colleagues\textsuperscript{35} and the systematic literature review of pharmacists’ work in vaccination-related services in LMICs globally by Yemeke and colleagues\textsuperscript{10} specifically highlighted future opportunities and activities already being undertaken by African pharmacists.

Meyer and colleagues described the opportunity for pharmacists to become more involved in childhood vaccination efforts in South Africa.\textsuperscript{35} Access to routine immunization services is among the biggest challenges of immunizing children in South Africa,\textsuperscript{10,36} and pharmacists can address this through mobilization to improve vaccination coverage.\textsuperscript{10} Pharmacists can also improve outreach activities by tailoring them to meet the needs and characteristics of particular communities, addressing factors such as level of literacy and education, socio-economic status, prior knowledge about immunizations, and culture.\textsuperscript{35,37}

The article by Meyer and colleagues was published in 2018, before the 2021 SAPC standards for the accreditation of courses that train pharmacists to immunize were enacted. Prior to administering immunizations, pharmacists already played important roles in vaccination advocacy and patient education. As easily accessible healthcare providers in South Africa,\textsuperscript{38} pharmacists promoted routine immunization and addressed misinformation among patients.\textsuperscript{39,40} Yemeke and colleagues described similar work being done in 25 LMICs globally, which included Democratic Republic of Congo, Ethiopia,
Nigeria, Senegal, South Africa, and Uganda.\textsuperscript{10} Results from the article by Yemeke and colleagues showed that at the time of publication, pharmacists in these six countries were involved in several vaccine services that did not include administration, such as education, advocacy, storage of vaccines, and pharmacovigilance.\textsuperscript{10} Pharmacists in some LMICs, including Nigeria and South Africa, have also been responsible for reporting vaccine adverse events to national pharmacovigilance programs.\textsuperscript{10,35,32}

4. Discussion

Pharmacists are successfully administering immunizations in many countries worldwide.\textsuperscript{1,10} Administering immunizations in community pharmacies has increased access to vaccination services, improved vaccine equity, increased vaccination rates in rural and underserved areas, and reduced workload in other healthcare entities.\textsuperscript{1} In many LMICs pharmacists are not trained to administer immunizations, despite these countries exhibiting some of the greatest vaccination needs.\textsuperscript{11} Results from this literature review demonstrate that evidence of immunization administration training available to practicing pharmacists and student pharmacists in Africa in the literature is limited. The small number of studies identified in this literature review highlights opportunity to expand immunization training access to meet the calls to action for pharmacists to become trained to immunize.\textsuperscript{19,22,23,32,33}

The authors hypothesized that the small number of published articles about immunization training for African pharmacists and student pharmacists could be due to multiple factors. First, there may simply be a limited number of immunization training programs available for pharmacists in Africa. A brief online search was conducted by the authors to determine whether training was available for currently practicing pharmacists in Africa. Only a handful of short course programs were identified, all only available in South Africa to train practicing pharmacists to administer immunizations.\textsuperscript{41}

The authors also hypothesize that the dearth of articles published about pharmacist immunization training in Africa may be due to pharmacist faculty and research workload during the pandemic. Training may be occurring, but researchers and trainers have not yet evaluated programs or published the results. The brief
online search also identified a Nigerian national conference press release from 2022 stating that “thousands of pharmacists across the nation” were undergoing immunization training, but information about the how to access the training was not available and there were no peer-reviewed publications about this work.\textsuperscript{42} It is possible that there are other immunization training programs available for practicing pharmacists, interprofessional programs offered to multiple healthcare provider types, or programs being added to pharmacy school curricula but that information about them has not yet been published. Anecdotally, the authors are also aware of immunization administration training offered to pharmacists in Ghana in collaboration with a team from the US, but research from that project has not yet been published (personal communication).

Another factor that may contribute to the limited access for immunization administration training for African pharmacists is the limited access to pharmacy education in general. According to the International Pharmaceutical Federation World List of Pharmacy Schools\textsuperscript{43}, there are 81 schools of pharmacy in Africa serving a population of nearly 1.5 billion people.\textsuperscript{44} For context, the United States, with a population of 340 million, has 140 fully accredited schools of pharmacy at the time of this writing.\textsuperscript{45,46} Additionally, the BPharm degree is the only available pharmacy degree program in many countries. Adje and colleagues evaluated public health curricular areas in schools of pharmacy in Nigeria in 2018.\textsuperscript{47} Of the 14 schools evaluated in the study, only one offered a PharmD degree. The study also identified deficiencies in BPharm public health content, including the topics of infectious disease, health policy, and nutrition.\textsuperscript{47} PharmD programs are available in some African countries such as South Africa, Nigeria, and Botswana, but the BPharm is the most common degree available to student pharmacists in Africa. With PharmD education, the learner enrolls in the program with undergraduate knowledge of basic sciences, which can be built upon during the PharmD courses, and provides a good foundation for immunology and vaccine science. Undergraduate BPharm students often do not have any college-level education prior to enrollment. The articles in this literature review described BPharm education as having more basic
content for vaccine-related topics, such as storing and transporting vaccines and background information about infectious diseases, which may limit the opportunity for including more advanced skills.

Additional challenges persist beyond access to immunization education and training. Regulatory restrictions provide yet another challenge to widespread implementation of pharmacists as immunizers in many African countries. However, substantial evidence exists from other nations demonstrating the positive impact vaccinating pharmacists can have on communities. If pharmacy advocates can demonstrate that pharmacists are well-trained to immunize and build on the success seen in other countries, that may provide a convincing argument to regulators that pharmacists are capable of safely administering immunizations.

In order for pharmacists in Africa to administer immunizations, pharmacy infrastructure for vaccination would also need to be addressed. Pharmacists would need to ensure they have access to vaccine storage refrigerators and freezers to maintain the cold-chain, safe methods of disposing of needles, supplies to manage vaccination-related medical emergencies, and technology for patient registration, immunization record-keeping, and reporting adverse events. Access to reliable electricity to maintain vaccine temperatures is another issue in some areas and would also need to be resolved before immunization services could be offered.

There are many barriers that must be addressed before pharmacists in Africa can safely and effectively administer immunizations, but the overwhelming public health need suggests the effort would be worthwhile. Lack of access to vaccinations can result in loss of life, illness, reduced education, and have widespread social and economic impacts. Despite the challenges, involving pharmacists in the immunizing workforce in Africa could have far-reaching benefits.

4.1 Strengths and limitations

This systematic review summarized published articles about immunization administration training available to pharmacists and student pharmacists in Africa. Although there are many articles with calls to
action for pharmacists in African countries to become involved in administering immunizations, this review included only articles with published information about existing immunization training or those that described a need for training implementation. Additionally, the search methods included several databases supplemented with a manual online search to identify as many relevant articles as possible. However, only articles available in English were included, which could be a limitation.

It was the authors’ intent to evaluate the topics covered in African immunization training programs for pharmacists to identify whether training was comprehensive and included topics similar to training offered in the United States. This was not possible to achieve due to the lack of information available in the published literature. This literature review was the first step in a larger project designed to implement immunization training for pharmacists and student pharmacists in multiple African countries where they are not currently immunizing. The results of this review confirmed that there is a gap in published literature on this topic. Further work is needed to evaluate opportunities for offering immunization training to African pharmacists.

5. Conclusion

Pharmacists are administering immunizations in many countries. This literature review identified that there are limited publications describing immunization training for pharmacists and student pharmacists in Africa. Although the studies described herein demonstrate ongoing efforts to expand immunization training, greater efforts are needed. Training pharmacists to immunize could make a meaningful impact in increasing immunization access and reducing the spread of vaccine-preventable diseases in Africa. Expansion of available immunization administration training is needed for African pharmacists and student pharmacists if calls to action are to be met.

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CRediT authorship contribution statement

Kimberly McKeirnan: Conceptualization, Formal Analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing

Ilse Truter: Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing

Teri-Lynne Fogarty: Conceptualization, Formal Analysis, Investigation, Methodology, Supervision, Writing – review & editing

References:


Table 1. Articles Identified for Inclusion in a Systematic Review of Immunization Education for African Pharmacists and Student Pharmacists in Published Literature.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Title</th>
<th>Journal</th>
<th>Country</th>
<th>Study design</th>
<th>Relevant key findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker</td>
<td>2018</td>
<td>The Role of Pharmacists in Travel Medicine in South Africa</td>
<td>Pharmacy</td>
<td>South Africa</td>
<td>Review</td>
<td>South African pharmacists can already provide yellow fever vaccine after this training, providing opportunity to expand services to include other vaccines.</td>
</tr>
<tr>
<td>Chiutsi and colleagues</td>
<td>2022</td>
<td>Extending Pharmacist Roles in Pharmacy</td>
<td>Pharmacy</td>
<td>Zimbabwe</td>
<td>Qualitative interview research</td>
<td>Zimbabwean B Pharm graduates interviewed expressed interest in</td>
</tr>
<tr>
<td>Authors and Year</td>
<td>Year</td>
<td>Title</td>
<td>Journal</td>
<td>Country</td>
<td>Section</td>
<td>Summary</td>
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<tr>
<td>Khan and colleagues</td>
<td>2021</td>
<td>Empowering pharmacy students and practising pharmacists to become vaccinators during the COVID-19 pandemic and beyond</td>
<td>South African Pharmaceutical Journal</td>
<td>South Africa</td>
<td>Commentary</td>
<td>Immunization administration training is available for pharmacists in South Africa and student pharmacists at University of Witwatersrand to become certified to immunize.</td>
</tr>
<tr>
<td>Meyer and colleagues</td>
<td>2018</td>
<td>Childhood vaccination and the role of the pharmacist</td>
<td>South African Pharmaceutical Journal</td>
<td>South Africa</td>
<td>Review</td>
<td>Opportunity exists for pharmacists to become more involved in immunization administration for children, but pharmacy education must evolve to include paediatric immunization education.</td>
</tr>
<tr>
<td>Oseni and Afolai</td>
<td>2020</td>
<td>Development and Evaluation of Health Promotion Training Program for Community Pharmacists in Oyo State, Nigeria</td>
<td>Pedagogy in Health Promotion</td>
<td>Nigeria</td>
<td>Survey research</td>
<td>Health promotion training for community pharmacists in Nigeria does not include immunization administration training, but some survey participants have requested that it be added for future courses.</td>
</tr>
<tr>
<td>Perumal-Pillay</td>
<td>2021</td>
<td>Pharmacists as vaccinators in South Africa - addressing COVID-19 and beyond</td>
<td>South Africa Journal of Science</td>
<td>South Africa</td>
<td>Commentary</td>
<td>Training is available for pharmacists in South Africa to become certified to administer immunizations.</td>
</tr>
<tr>
<td>Wada and colleagues</td>
<td>2021</td>
<td>Increasing coverage of vaccination</td>
<td>Public Health in Practice</td>
<td>Nigeria</td>
<td>Commentary</td>
<td>Immunization administration training is needed for practicing</td>
</tr>
</tbody>
</table>
pharmacists and student pharmacists in Nigeria to become immunizers.

Yemeke and colleagues 10

A systematic review of the role of pharmacists in vaccination services in low- and middle-income countries (LMICs)

Research in Social and Administrative Pharmacy

Democratic Republic of Congo, Ethiopia, Nigeria, Senegal, South Africa, Uganda

Systematic review

Pharmacist roles in immunization in LMICs are limited and greater efforts are needed to extend pharmacist immunization administration training to all LMICs.

Abbreviation used: LMICs: low- and low-middle income countries.

Table 2. Immunization Education offered to African Pharmacists and Student Pharmacists Described in Published Literature.

<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Population Studied or Discussed</th>
<th>Immunization Training Offered</th>
<th>Training Participants</th>
<th>Type of Course</th>
<th>Length of Course</th>
<th>Training Organization and Assessment</th>
<th>Assessment</th>
<th>Who Can Be Immunized and With Which Vaccine After Training/Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker 3 2018</td>
<td>Practicing pharmacists in South Africa</td>
<td>Travel Medicine Course offered by the South African Society of Travel Medicine</td>
<td>Practicing pharmacists may only apply to take the course if they have a medical practitioner overseeing them who has done the course or will do it with them.</td>
<td>Travel medicine course that includes administration of yellow fever vaccine</td>
<td>Information not included in article</td>
<td>Information not included in article</td>
<td>Information not included in article</td>
<td>May administer yellow fever vaccine to patients of travel medicine clinics if vaccine is prescribed by physician</td>
</tr>
<tr>
<td>Khan and colleagues 34 2021</td>
<td>BPharm students and Pharmacists in South Africa</td>
<td>Immunisation and injection technique course offered by the University</td>
<td>Available to pharmacists established in practice and final-</td>
<td>Immunisation and injection technique course</td>
<td>Four-hours of online videos and lectures, 4 hours of A combination of online training and a face-to-face</td>
<td>Completion of a written assessment and assessment of injectio</td>
<td>Information not included in article</td>
<td></td>
</tr>
</tbody>
</table>

22
year students at University of Witwatersrand; met 2021 SAPC requirements for immunizing pharmacists\(^{19}\) in person practical component technique

| Perumal-Pillay\(^2\) | 2021 | Practicing pharmacists in South Africa | Online Higher Certificate in Vaccinology Programme offered by the South African Vaccination and Immunisation Centre and Health Science Academy | Requires participants to be registered as pharmacists | Immunisation and injection technique course | Information not included in article | Information not included in article | Information not included in article | Information not included in article |

Abbreviation used: SAPC: South African Pharmacy Council.

**Declaration of Competing Interest**

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: