

Teaching undergraduate medical students how to communicate with vaccine-hesitant patients: A scoping review

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Abstract

Introduction: Vaccine hesitancy poses a challenge to healthcare professionals. Prior to graduation, medical students may not be fully equipped with the knowledge or skills to manage interactions with vaccine-hesitant patients. The aim of this scoping review was to identify and evaluate the characteristics of educational interventions that improve medical students' skills in communicating with vaccine-hesitant patients.

Methods: EMBASE, OVID Medline, CINAHL and ERIC databases were searched with keywords related to “vaccine hesitancy” and “undergraduate medical education”. One hundred and fourteen primary studies were identified, and seven articles were included for review. Data extraction included the characteristics of educational interventions, such as the modality, duration, frequency and assessment methods.

Results: There is limited literature describing educational interventions that help medical students develop skills to communicate effectively with vaccine-hesitant patients. This makes it difficult to draw conclusions on the effectiveness of different pedagogical approaches. Although the included studies generally reported an increase in student self-reported confidence to communicate with vaccine-hesitant patients, none assessed whether the interventions led to changes in student clinical practice or improvements in patient outcomes.

Conclusion: Additional research into the identification of educational interventions that establish persistent changes in students' knowledge, attitudes and skills to communicate with vaccine-hesitant patients is required. An evidence-based medicine component of an education program, which can adapt to evolving contributors to vaccine hesitancy and the variety of concerns across different vaccines, may present a potential solution. Educators would be better directed with further research that aligns health outcomes with teaching, assessment and evaluation of a proposed vaccine-hesitancy curriculum.

Keywords: vaccine hesitancy; undergraduate medical education; curriculum; teaching

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Introduction

Despite the enormous health and societal benefits resulting from the advent of vaccination, vaccine hesitancy (VH) has long remained a significant public health challenge since the introduction of the smallpox vaccine in 1796 (Riedel, 2005). VH is defined as the delay in acceptance, or refusal, of vaccination despite availability of vaccination services (MacDonald, 2015). The reasons for VH are complex, and factors including past experiences with health services, moral or religious convictions, risk perceptions and political and socio-cultural context have been identified as contributors (Dubé et al., 2013). Faced with this challenge, healthcare providers (HCPs) are often tasked with navigating conversations around VH. Recommendations from HCPs have been shown to be a key determinant in vaccine acceptance (Lau et al., 2012; Moss et al., 2016; Rosenthal et al., 2011; Smith et al., 2006; Ylitalo et al., 2012). Multiple studies exploring how best to equip medical graduates with vaccine-hesitancy counselling skills have been reported (Dempsey et al., 2018; Morhardt et al., 2016; Pahud et al., 2020; Real et al., 2017), and these broadly demonstrate that targeted interventions can increase practitioner vaccine knowledge and self-confidence to engage with vaccine-hesitant patients and may directly improve vaccine uptake. However, teaching these skills post graduation is arguably too late, as medical students report both feeling insufficiently prepared for questions about vaccination, especially for communicating with patients on side effects, and lacking strategies to respond to VH (Coleman & Lehman, 2017; Kernéis et al., 2017; Onello et al., 2020).

The COVID-19 pandemic has presented an enormous challenge to healthcare systems worldwide (Haldane et al., 2021; Kaye et al., 2021; Phiri et al., 2021; Tessema et al., 2021), together with proliferation of anti-vaccination discourse (Burki, 2020) and the increasing politicisation of vaccination (Bolsen & Palm, 2022). Confronted with overwhelming demand and staff shortages, there have been increasing calls for medical students to join the medical workforce in a variety of pandemic-related clinical (i.e., frontline) and non-clinical roles (Bahethi et al., 2021; Khamees et al., 2020; Miller et al., 2020; Rasmussen et al., 2020; Soled et al., 2020; Stachteas et al., 2021). Given this trend towards potentially earlier exposure to VH attitudes, and in preparation for medical students' engagement with patients' VH immediately upon graduation, it is important to consider how medical educators can best ensure adequate teaching on VH communication. By initiating teaching at the undergraduate level, medical educators would be able to target all medical specialities and ensure future physicians are more competent at communicating with vaccine-hesitant patients before practice patterns are established. Despite this need to upskill medical students, there has not been an authoritative consensus regarding the development of VH communication skills in medical curricula, nor the optimal means of delivering such learning. This raises the question: what evidence and research can medical educators utilise to develop and implement VH curricula for medical students?

A preliminary search of the medical literature identified a clear gap in student outcomes related to VH training (Baessler et al., 2022; Bralic & Pivalica, 2019; Dybsand et al., 2019; Kernéis et al., 2017; Pelly et al., 2010; Vorsters et al., 2019; Vorsters et al., 2010). Kernéis et al. (2017) conducted a survey of French final-year medical students and reported that 58% of respondents felt insufficiently prepared to address VH in patients. A more recent survey of German medical students revealed that 75.84% and 68.15% of respondents were dissatisfied with teaching related to VH and vaccine communication strategies, respectively (Baessler et al., 2022). The preliminary search failed to identify any reviews that have investigated VH communication teaching in the medical curricula.

We conducted this scoping review of primary studies to identify and evaluate the different approaches medical educators have taken to teach VH communication skills to undergraduate medical students. The specific research questions we sought to answer were:

1. How do medical schools teach students to communicate with vaccine-hesitant patients?
2. To what extent do such educational interventions impact medical students' ability, approach and confidence regarding this communication?

Furthermore, this review also evaluated interventions described in the included studies using the Kirkpatrick Hierarchy for Assessing Educational Outcomes (Bates, 2004; Kirkpatrick & Kirkpatrick, 2016; Ragsdale et al., 2020).

Methods

This study implemented the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) reporting protocol (Tricco et al., 2018).

Search strategy

Electronic databases EMBASE, Ovid Medline, CINAHL and ERIC were searched for primary studies that described educational interventions to assist undergraduate medical students to develop knowledge and/or skills in counselling vaccine-hesitant patients. Additional papers were identified through a hand search of the reference lists of articles identified through the database search.

Inclusion and exclusion criteria

The search was not limited by publication date and only full-text articles in English were assessed. The inclusion criteria were primary studies reporting on targeted educational interventions designed to assist medical students in communicating with vaccine-hesitant patients. Studies in which medical students formed a proportion of the healthcare student participants were included, though studies that focused exclusively on non-medical healthcare students (for example, pharmacy or nursing students) were excluded. Studies

focused on medical graduates were excluded. Articles that only reported on medical student vaccination knowledge, attitudes towards vaccines or vaccination status were excluded. Studies that did not clearly describe the characteristics of an educational intervention (for example, teaching methods, outcome assessment, etc.) were excluded, as were articles about proposals for curricula without implementation and evaluation. Literature reviews (narrative or systematic) were excluded, as were conference abstracts.

Key terms and Boolean operators

The key search terms and Boolean operators used are described in Figure 1.

Figure 1

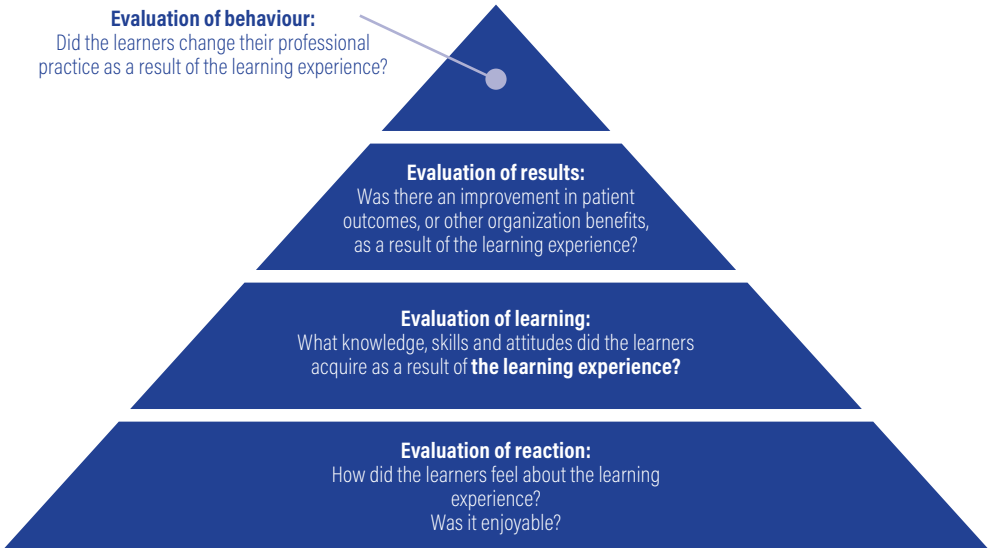
Keyword Search Strategy With Combined Search Terms

#	Keyword Search Strategy
1	("medical student*" or "medical education" or "medical training" or "medical course*" or "medical curricular*" or "medical school")
2	("teaching activit*" or "learning activit*" or "educational intervention" or "educational course" or "teach*" or "university" or "experience" or "encounter" or "simul*" or "program*" or "modul*" or "exercise")
3	("vaccin*" or "immunisation" or "immunization")
4	("hesitan*" or "vaccine-hesitan*")
5	1 and 2 and 3 and 4

Data extraction and synthesis of results

Data extraction was performed using predetermined categories: author and year, participant characteristics, study aims, description of the intervention, duration and frequency of the intervention, instructor backgrounds, methods utilised to measure the outcomes of the intervention, timing of outcome measurement, main findings and study limitations.

The impact of the educational outcomes was rated using the Kirkpatrick Hierarchy for Assessing Educational Outcomes (Figure 2), a well-recognised tool for the evaluation of medical education interventions (Bates, 2004; Kirkpatrick & Kirkpatrick, 2016; Ragsdale et al., 2020). The first level assesses learners' satisfaction with, or response to, the intervention; the second level assesses modification of learners' attitudes and perceptions (Level 2a) and/or the knowledge and skills learned (Level 2b); the third level assesses changes in health professionals' behaviour or an institution's practice; and, at the top of the hierarchy, the fourth level assesses changes in patient healthcare outcomes.

Figure 2*Kirkpatrick's Hierarchy of Educational Outcomes*

Note: Adapted from Kirkpatrick & Kirkpatrick, 2016

Synthesis of results

The included studies were described according to the data extraction categories. Analysis of the extracted data was conducted to identify commonalities between the included studies. No inferences were made about teaching, learning and assessment approaches if they were not explicitly stated. As a scoping review, critical evaluation of the included literature was not performed, and no determination as to the quality of the evidence/outcomes reported in each included study was made. Literature searching, title and abstract screening, full-text review, data extraction and charting, and rating of educational outcomes with Kirkpatrick's hierarchy were undertaken by the first author (EN). Where there was any uncertainty, these articles were reviewed independently by the second author (JB) and then discussed until consensus was reached between both authors. The second author independently reviewed the data extraction and charting results and educational outcomes ratings once this process was completed by the first author.

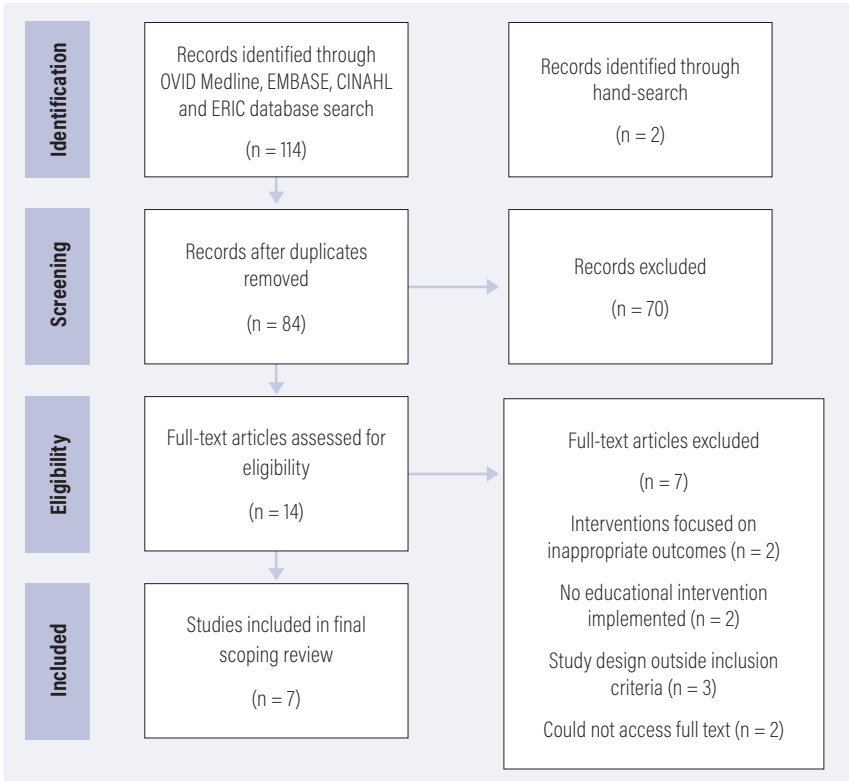
Results

The primary search, conducted between May and July 2022, yielded 114 articles (see Figure 3)—73 from EMBASE, 38 from Ovid Medline, three from CINAHL and zero from ERIC. After removal of duplicates, 82 articles remained. Following title and abstract screening, 12 articles remained for full-text review. Seven articles were excluded for the following reasons: no intervention implemented ($n = 2$), opinion or conference report

($n = 3$) or the intervention focused on outcomes not relevant to this review ($n = 2$). A total of five articles met the inclusion criteria. A hand search of the reference list of all articles that underwent a full-text review yielded two additional articles that met the inclusion criteria. Details of included studies are summarised in Table 1.

Figure 3

PRISMA Diagram



Types of interventions

Studies included in this review were conducted in the United States of America ($n = 5$), France ($n = 1$) and Finland ($n = 1$). The structure of interventions varied widely. In four studies (Afonso et al., 2014; Kelekar et al., 2022; Lepiller et al., 2020; Onello et al., 2020), the educational interventions were mandatory, with the remaining interventions (Coleman & Lehman, 2017; Koski et al., 2018; Schnaith et al., 2018) voluntary. Most studies (Afonso et al., 2014; Coleman & Lehman, 2017; Kelekar et al., 2022; Koski et al., 2018; Lepiller et al., 2020; Onello et al., 2020) were directed at a single student year level, though this varied from first-year to third-year medical students. Schnaith and colleagues (2018) invited medical students of all year levels, with the majority of participants being preclinical (63%).

Table 1
Vaccine Hesitancy Communication Teaching in Undergraduate Medical Education

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Coleman & Lehman (2017)	Third-year clinical medical students from the University of California, Los Angeles, David Geffen School of Medicine (USA) An exact number of students was not provided. The authors estimate that the number of participants was approximately 120.	To increase student knowledge about vaccines and vaccine-preventable disease to allow students to feel more comfortable discussing vaccines with patients	<i>Video podcast</i> To be viewed prior to the workshop. Provided a brief overview of vaccine-preventable diseases, the impact of vaccines on reducing disease burden, the safety of vaccines, the recommended vaccine schedule and commonly expressed concerns about vaccines. <i>Case-based discussion workshop</i> Small groups of students (n = 4–5) were assigned a vaccine hesitancy scenario, list of potential online resources and specific questions to answer before presenting the case.	<i>Video Podcast</i> 25 minutes <i>Case-based discussion workshop</i> 90 minutes	Medical school faculty staff	2a	Pre-intervention survey delivered at commencement of 3rd year to measure baseline knowledge, attitudes and confidence in counselling families about vaccines. Post-intervention survey administered to provide anonymous evaluation of video podcast and in-person workshop.	Immediately post intervention during the workshop itself	Statistically significant improvement in self-reported student confidence in discussing vaccines with patients. 87% of students reported having experienced vaccine hesitancy in their clinical work during their 3rd year.	Low response rate to pre-intervention survey (46%) Significant minority of students (32%) did not watch the video podcast ahead of class.
Schnaith et al. (2018)	Medical students at the University of Minnesota (USA) (n = 101/132, 77%) Preclinical (n = 83) and clinical (n = 13) students participated. Some did not specify their level (n = 5) All medical students were invited—participants (n = 132) made up 14% of the total student body.	To determine if an HPV curriculum increased HPV vaccine awareness, likelihood to recommend and comfort level in medical students conversing with vaccine-hesitant parents	Voluntary multi-modal curriculum: <i>Presentation</i> Epidemiology of HPV associated disease, basic science of HPV virus and vaccine, treatment and prognosis of HPV-related cancers. <i>Video</i> Implementing the presumptive method and the C.A.S.E (corroborate, about me, science, explain/advise) approach with vaccine-hesitant patients. <i>Simulated role-play</i> Students role-played 3 separate scenarios, rotating through roles of provider, patient and observer.	Unclear—study ran on a single day, but the length of each component and the overall duration is unclear.	Initial presentation delivered by board-certified gynaecologic oncology physician. It is unclear who the other elements were delivered by.	2a	Anonymous pre-intervention survey to assess student gender, personal vaccination status, likelihood of recommending the HPV vaccine to varying age groups/genders and comfort conversing with HPV vaccine-hesitant parents. Anonymous post-intervention survey administered using the same questions with the addition of questions designed to assess student opinion of the C.A.S.E approach.	Immediately post intervention	Statistically significant increase in self-reported likelihood to recommend the HPV vaccine and in self-reported comfort conversing with HPV vaccine-hesitant parents/patients. > 90% of students found the C.A.S.E approach useful not only to talk about vaccine hesitancy but also to discuss other medical concerns.	Absence of comparison intervention No longitudinal follow-up of student attitudes Health disparities were not addressed in this study Focus on single vaccine

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Kelekar et al. (2022)	All 2nd year preclinical medical students at the Oakland University William Beaumont School of Medicine (USA) (n = 20/126, 16%)	To develop a curricular intervention to improve student knowledge and skills when communicating with vaccine-hesitant patients	<p>Mandatory intervention consisting of multiple interventions</p> <p><i>Self-study pre-reading module</i> Vaccine hesitancy myths about MMR and autism, the retracted Wakefield study and resources from the CDC, including information sheets for HPV, MMR and VZV vaccines</p> <p><i>Patient panel</i> Panel with parents who had lost children due to vaccine-preventable illnesses and subsequently dedicated themselves to spreading awareness about vaccines</p> <p><i>Didactic lecture & interactive workshop</i> Vaccine hesitancy misconceptions, use of motivational interviewing skills with vaccine-hesitant patients and parents and guidelines for documentation of vaccine refusal and waiver</p> <p><i>Simulated encounter with vaccine-hesitant patients using standardised patients and scenarios</i> 1 of 3 scenarios: (1) Parent with concerns about HPV vaccines (2) Young mother with MMR concerns who has not approved any vaccinations for her child. (3) Older adult questioning the need for a "shingles" (VZV) vaccine.</p>	Not reported	Medical school faculty staff, standardised patients for simulated encounter, parents who had lost children due to vaccine-preventable illnesses	2b	<p>Pre- and post-intervention surveys designed to measure confidence in students' knowledge of and ability to address vaccine hesitancy</p> <p>For the simulated encounter with the standardised patient (Rasmussen et al., 2020), students were assessed by observing faculty staff and the standardised patient on their communication skills, as well as their knowledge and accuracy of clinical information.</p> <p>OSCE (objective structured clinical exam) with a history on a patient presenting with back pain who also had concerns about the influenza vaccine</p>	<p>Post-intervention survey administered 2 weeks after intervention</p> <p>Student feedback and scores on simulated patient encounter provided immediately following intervention</p> <p>OSCE conducted 1 year post intervention during the 3rd year mid-year assessments</p>	<p>Statistically significant improvement in students' self-reported knowledge about vaccine hesitancy and ability to communicate with vaccine-hesitant patients</p> <p>Students assigned the VZV case for the simulated encounter scored significantly lower marks compared to the other stations. There was a correlation between knowledge of the vaccine and ability to communicate medical information.</p> <p>73% of students elicited vaccine-hesitancy concerns, and 36% counselled appropriately for the OSCE.</p>	<p>Only a single practice session with simulated patients was provided.</p> <p>Low response rate to the pre- and post-intervention survey (16% of matched pairs)</p> <p>Time constraints during the OSCE. Furthermore, vaccine hesitancy was not the primary focus of the encounter.</p>

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Onello et al. (2020)	All first-year preclinical medical students at the University of Minnesota Medical School Duluth Campus (USA) across 5 years from 2013 to 2017 (n = 178/307, 58.0%)	To evaluate the effects of targeted immunisation-related content embedded in a mandatory medical school course	Interventions embedded in a mandatory 7-week course on immunology, haematology, and oncology <i>Problem-based Learning (PBL)</i> Measles case in an unvaccinated toddler returning to US from abroad with vaccine-hesitant parents (Duration: 5 hours) <i>Interactive Panel Discussion</i> Interprofessional panel of clinicians who work with vaccine-hesitant patients: school nurse, international travel clinic nurse practitioner, infectious disease physician, pharmacist (Duration: 3 hours) <i>Assigned Readings</i> Vaccine hesitancy, ethical concepts of vaccine mandates & refusal (Duration: 1 hour) <i>Lecture</i> Thimerosal, vaccine safety, vaccine injury compensation program (VICP) (Duration: 1 hour)	Total of 10 hours of content was delivered across the 7-week course—specific details on the order and schedule of the different elements was not reported.	Medical school faculty staff, school nurse, international travel clinic nurse practitioner, infectious disease physician, pharmacist	2a	Pre- and post-intervention surveys designed to assess whether curricular experiences altered student perceptions about vaccinations and their ability to counsel vaccine-hesitant patients Pre-intervention survey administered at the start of the 7-week course.	At the end of the 7-week course into which the intervention was embedded	Statistically significant increase in the number of students who felt comfortable talking to patient about vaccination choices. 78.8% of participants reported they had encountered people who decline vaccinations.	Surveys were not anonymous. Lower response rate for both pre- and post-intervention surveys (58%) compared to that of the pre-intervention survey alone (75.6%) Variation between content delivery each year with lecture updates & different discussions held by the interprofessional panel

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Koski et al. (2018)	Third-year clinical medical students at the University of Tampere (Finland) (n = 9)	To explore the use of a video case, group discussion and writing exercise as a means to expand students' understanding of health beliefs behind vaccine hesitancy and stimulate students' ability to encounter the patients as whole persons	<p><i>Arts-based video and PBL sessions</i> A video on conversations with vaccine-critical parents was viewed in two parts across two PBL sessions and followed by a group discussion after each viewing.</p> <p><i>Writing Exercise</i> Students responded to seven of the parents' questions presented in the video, playing the role of a physician. This writing exercise was to be completed at home between the two PBL sessions.</p>	Two PBL sessions were 4 days apart. The video ran in 2 parts (9 and 7 minutes) across the two sessions, and structured group discussions (45 and 30 minutes) followed the video viewing.	Medical school faculty staff	Unable to determine	There was no formal post-intervention assessment. Students were invited to share their experiences in a short concluding conversation. A descriptive analysis of themes raised by students was conducted.	N/A	For the written exercise, 6/9 students utilised the suggested "I-You" dialogue model designed to address the patient as a whole person (i.e., a "you") from the perspective of an individual physician (i.e., an "I"). 3/9 students either ignored the patient as a whole person or their own professional role.	<p>Small sample size</p> <p>Written assignments and PBL modules were not marked.</p> <p>The intervention only compares the two learning modalities within with each other but does not involve a control group.</p>

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Lepiller et al. (2020)	Healthcare workers in the Franche-Comté region (Kernéis et al., 2017) enrolled in the <i>Service Sanitaire des Etudiants en Santé (SSES)</i> , a mandatory health promotion learning program (n = 874). This cohort included 3rd year preclinical medical students (n = 167/213, 78%). Healthcare students came from medicine, pharmacy, midwifery, physiotherapy and nursing curricula.	To characterise the perceptions concerning vaccination among healthcare students, particularly the feeling of preparedness to address patient concerns about vaccines and the evolution of their perceptions before and after having performed a primary prevention project	Mandatory intervention <i>Videos</i> History of vaccination (10 slides), its principles and mechanisms of action (12 slides), various types of vaccines (15 slides) and the main controversies surrounding vaccination in the general population (20 slides) <i>Group Project</i> Interdisciplinary groups of 4–5 students prepared and managed a primary prevention intervention on one of three topics: "nutrition & physical activity", "vaccination and hygiene" or "addiction".	Health promotion learning program ran across 8 months, but it is unclear exactly when vaccination specific videos were viewed. The duration of the videos is not reported. The primary prevention intervention project was organised across 4 sessions. The duration of each session and time in between sessions is unclear. The interventions took place during 1 week, 7 months into the SSES program.	Background of online video presenters not reported Primary prevention intervention project supervised by two tutors who are healthcare workers, the specific discipline(s) was not specified.	2a	Anonymous pre- and post-intervention surveys designed to assess the determinants of vaccine hesitancy and included questions designed to explore the perceptions of students concerning vaccination, as well as the perceived preparedness to address vaccination concerns with patients	Pre-intervention survey administered at the start of the SSES program Post-intervention survey administered 1 month following the completion of the SSES program	Post-intervention survey was not broken down by healthcare discipline. As such, there is no specific data for medical student responses. For all healthcare students (regardless of the intervention project topic chosen), there was a statistically significant increase in student agreement with the two statements: <i>"I feel capable of helping patients to sort through the information in the media about vaccines"</i> . <i>"I feel capable of helping patients to adopt a critical perspective towards the arguments of vaccination opponents"</i> .	Unable to stratify post-intervention survey data by healthcare discipline

Reference	Participants	Aims	Education Approach/ Intervention	Duration and Frequency	Instructor's Background	Kirkpatrick Rating	Outcomes Assessment	Timing of Post- Intervention Outcome Measure	Main Finding	Limitations
Afonso et al. (2014)	All 1st preclinical year medical students at the Oakland University William Beaumont School of Medicine (USA) (n = 97/125, 78%)	<p>To determine influenza vaccination rates among entering medical students</p> <p>To assess the attitudes and perceptions of incoming medical students towards annual influenza vaccination</p> <p>To evaluate the change in these attitudes and perceptions following an educational intervention combined with hands-on training and administration of influenza vaccine to classmates</p>	<p>Mandatory intervention</p> <p><i>Interactive workshop</i> Students generated questions or myths patients may have regarding influenza and the influenza vaccine, using those questions as a starting point to search for online education materials that could be used for counselling patients.</p> <p><i>Presentation</i> Epidemiology of influenza, practical aspects of patient counselling, impact of influenza for patients, public health implications of influenza and the influenza vaccine, including effectiveness, safety and adverse events</p> <p><i>Practical component</i> Voluntary vaccination component where students were able to practise vaccine administration techniques and permitted to administer an influenza vaccine to each other under supervision. All present students participated in the vaccination program.</p>	2-hour, single one-off instance	<p>Initial activity guided by a librarian</p> <p>An infectious disease physician ran the presentation.</p> <p>The vaccination component was run by occupational health nursing staff, with members of the leadership of the medical school and hospital also participating.</p>	2a	<p>Anonymous pre and post interventions designed to determine: (1) vaccination status for influenza in the previous year (2) recommendations made by the students' own healthcare providers for influenza vaccination (3) motivating factors for accepting or rejecting the vaccine (4) views on mandatory vaccination for all HCWs (5) comfort levels with counselling and administration of the influenza vaccine</p>	<p>Pre-intervention survey administered 6 weeks prior to the intervention</p> <p>Post-intervention survey administered 2 months after the intervention</p>	<p>Statistically significant increase in number of students who felt comfortable counselling about the influenza vaccine</p>	<p>Relatively small sample size</p> <p>Conducted at a single medical school</p> <p>Survey data was self-reported.</p>

The duration of interventions also varied. Three studies (Afonso et al., 2014; Coleman & Lehman, 2017; Schnaith et al., 2018) utilised a one-off, single teaching session of 90 minutes (Coleman & Lehman, 2017), 120 minutes (Afonso et al., 2014) or unspecified duration (Schnaith et al., 2018). Conversely, three studies (Koski et al., 2018; Lepiller et al., 2020; Onello et al., 2020) delivered teaching across multiple sessions. Koski et al. (2018) conducted two sessions, 4 days apart, whilst Onello et al. (2020) incorporated teaching into a 7-week long, mandatory immunology, haematology and oncology course. Similarly, Lepiller et al. (2020) integrated teaching into an 8-month program of health promotion learning. The remaining study (Kelekar et al., 2022) did not report the duration or frequency of the teaching intervention.

A diverse range of teaching modalities were utilised, including self-directed learning ranging from assigned readings to online videos/video podcasts (Coleman & Lehman, 2017; Kelekar et al., 2022; Lepiller et al., 2020; Onello et al., 2020), didactic lectures or presentations (Afonso et al., 2014; Kelekar et al., 2022; Schnaith et al., 2018), case-based discussion or problem-based learning scenarios with role-playing (Coleman & Lehman, 2017; Koski et al., 2018; Lepiller et al., 2020; Onello et al., 2020), simulation encounters with standardised vaccine-hesitant patients (Kelekar et al., 2022) and panel discussions with either parents (Kelekar et al., 2022) or HCPs who work with vaccine-hesitant patients (Onello et al., 2020).

Three studies included a unique approach. Afonso and colleagues (2014) included a practical component where students practised vaccine administration techniques on each other under supervision. The rationale for this was to help demonstrate the practical aspects of vaccination, allowing students to play an active and early role as HCPs. Koski et al. (2018) included authentic vaccine-critical patients in an art-based video scenario that involved interviews about their experiences of the healthcare system and perspectives on immunisation. Lepiller and colleagues (2020) utilised a longitudinal learning activity where, over four sessions, interdisciplinary groups of students prepared a primary prevention intervention on a variety of topics, including “vaccine and hygiene”.

There were clear similarities regarding the content delivered to students. All studies addressed common VH concerns, for example, the need to vaccinate against uncommon diseases, the purported link between vaccines and autism and concerns regarding the scheduling and large number of vaccines given to children, amongst others. Other topics included history and safety of vaccines (Afonso et al., 2014; Coleman & Lehman, 2017; Lepiller et al., 2020; Onello et al., 2020) and learning about vaccine-preventable diseases (VPDs) (Afonso et al., 2014; Coleman & Lehman, 2017; Kelekar et al., 2022; Onello et al., 2020; Schnaith et al., 2018). Two studies provided teaching on sourcing reliable vaccine education resources (Afonso et al., 2014; Coleman & Lehman, 2017), and two studies discussed communication techniques, either motivational interviewing (Kelekar et al., 2022) or the C.A.S.E (corroborate, about me, science, explain/advise)

approach (Schnaith et al., 2018). Interestingly, Schnaith and colleagues (2018) and Afonso et al. (2014) delivered interventions based on specific vaccines, HPV and influenza, respectively. The remaining studies did not cite a specific vaccine of focus and appear to have adopted a generalised approach to addressing VH.

Intervention outcomes

Six studies (Afonso et al., 2014; Coleman & Lehman, 2017; Kelekar et al., 2022; Lepiller et al., 2020; Onello et al., 2020; Schnaith et al., 2018) utilised pre- and post-intervention surveys to measure subjective changes in student attitudes using self-reported Likert scales. All six studies reported statistically significant improvements in students' self-reported ability to communicate with patients about vaccination choices. Only one study (Kelekar et al., 2022) employed an objective assessment of learning by evaluating student performance during the standardised-patient encounter included in the intervention and, subsequently, during an objective structured clinical examination (OSCE). The remaining study (Koski et al., 2018) did not formally assess student attitudes or performance pre or post intervention, focusing instead on a descriptive analysis of themes raised by students in response to exposure to vaccine-hesitant patient perspectives.

The timing of post-intervention assessments varied. Two programs (Coleman & Lehman, 2017; Schnaith et al., 2018) employed surveys immediately after the teaching session, whereas Kelekar et al. (2022) and Afonso et al. (2014) administered surveys 2 weeks and 2 months post intervention, respectively. Onello et al. (2020) administered their survey after a 7-week course, though it was unclear when individual VH teaching elements were administered during this period. Similarly, Lepiller et al. (2020) administered their survey 1 month following an 8-month health promotion program. Kelekar et al. (2022) was the sole study to offer a longitudinal assessment of student learning outcomes; retention of VH counselling skills was assessed 1 year after the intervention, utilising an OSCE, during which 73% of students elicited VH concerns but only 36% counselled appropriately. It is important to note, however, that VH was not the primary focus of this OSCE.

Assessment of learning outcomes

Kirkpatrick Hierarchy for Assessing Educational Outcomes (Bates, 2004; Kirkpatrick & Kirkpatrick, 2016; Ragsdale et al., 2020) was used to assess the learning outcomes of each included study (Table 1). Five studies were rated a Level 2a outcome, as they considered a change in student attitudes through self-reported evaluations (Afonso et al., 2014; Coleman & Lehman, 2017; Lepiller et al., 2020; Onello et al., 2020; Schnaith et al., 2018). A single study, by Kelekar et al. (2022), was rated a Level 2b outcome, as it assessed student skills and knowledge. No program was rated a Level 3 or Level 4 outcome. One study could not be assessed due to lack of information included (Koski et al., 2018).

Discussion

The aim of this scoping review was to report on how, and in what contexts, medical students are taught to communicate with vaccine-hesitant patients. The review demonstrates an emerging interest in this area, with six of the seven included studies published in the last 5 years and three published since 2020. This is perhaps unsurprising given the increasing interest in VH, particularly in the context of the COVID-19 pandemic (de Albuquerque Veloso Machado et al., 2021), and represents an increasingly urgent need for HCPs to develop the necessary skills to address VH (Lambert & Podda, 2018).

The data presented in this review suggests significant variation in the educational approaches used to assist students to develop skills in communicating with vaccine-hesitant patients, and there appears to remain an unmet need for VH teaching in undergraduate medical education. Although there have been proposals in the literature for vaccinology curriculum (Lambert & Podda, 2018; Vorsters et al., 2010), there is limited consensus on the expected skills and competencies of medical students at graduation. The following discussion amalgamates the key findings of this review, with the overall objective of contributing to the development of best practice approaches for VH education.

Intervention design

The duration and timing of teaching varied considerably across the included studies. Apart from Schnaith and colleagues (2018), who delivered teaching to both preclinical and clinical students, all other interventions ran during either preclinical (Afonso et al., 2014; Kelekar et al., 2022; Lepiller et al., 2020; Onello et al., 2020) or clinical (Coleman & Lehman, 2017; Koski et al., 2018) year(s). It can be argued that scheduling any intervention during clinical years ensures the teaching is more relevant and readily practicable. Coleman and Lehman (2017), for example, reported that 87% of respondents, who were clinical students, had encountered VH during their clinical placements. However, Onello and colleagues (2020), who focused on preclinical students, reported that 78.8% of respondents had already encountered people who decline vaccinations. As none of the included studies assessed the degree to which graduating students retained their ability and/or increased confidence in communicating with patients about vaccination choices, the optimal timing of VH teaching within the medical degree cannot be determined, and this may represent a potential avenue of research.

It is clear that the included studies favoured experiential learning compared to purely didactic interventions. All studies included a delivery method designed to enhance student engagement, including case-based discussions or problem-based learning scenarios (Coleman & Lehman, 2017; Koski et al., 2018; Onello et al., 2020), workshops (Afonso et al., 2014; Kelekar et al., 2022), role-plays (Schnaith et al., 2018), patient simulations (Kelekar et al., 2022) and group projects (Lepiller et al., 2020). These modalities appear

to reflect student preferences. A survey of French final-year medical students reported that interactive approaches, such as case-based instruction and small-group teaching, were perceived as more effective than didactic lecture courses for vaccination-related training (Kernéis et al., 2017). Interestingly, the same survey found that practical teaching during clinical placements was perceived as the most effective means of teaching. However the practicalities of finding authentic vaccine-hesitant patients and the difficulty in standardising this type of teaching would most likely make the approach unfeasible. Two studies did, however, incorporate an aspect of realism—Koski and colleagues (2018) used an arts-based video of authentic vaccine-hesitant patients, whilst Kelekar and colleagues (2022) utilised standardised simulation patients. In the case of Koski and colleagues, students indicated that the video element made the scenarios more authentic, emphasising the likelihood of encountering such patients in future practice. Regardless of the specific modalities, almost all studies reported a significant increase in students' ability to counsel patients about vaccination choices, though it is worth noting these were self-reported subjective assessments. As the included studies only rated Kirkpatrick's Level 1 and 2 outcomes, it is difficult to comment upon the benefit of any single teaching approach without an assessment of translatability to clinical practice and impacts on patient outcomes, which would require Level 3 and 4 outcomes, respectively.

Although most studies (Coleman & Lehman, 2017; Kelekar et al., 2022; Koski et al., 2018; Lepiller et al., 2020; Onello et al., 2020) took a generalised approach to VH communication, two studies (Afonso et al., 2014; Schnaith et al., 2018) narrowed their focus to a specific vaccine. Schnaith and colleagues (2018) focused on the HPV vaccine, where the consequences of refusal can be tangibly linked to increased risk of cervical cancer, potentially providing a compelling argument for vaccination. Such an approach, however, may not be applicable for VPDs that are considered mild, have largely been eradicated and/or for which there is high vaccine complacency (Kumar et al., 2016). Additionally, the bioscientific approach favoured by most studies (Afonso et al., 2014; Coleman & Lehman, 2017; Kelekar et al., 2022; Onello et al., 2020; Schnaith et al., 2018), which addressed the characteristics of VPDs, may not be pragmatic to implement across the broad range of VPDs. This is because the quantity of curriculum material that would potentially need to be reviewed and amended for each VPD in response to updated treatment guidelines, research, vaccination schedules and safety data would be extensive. It also important to acknowledge that all the included studies were from the pre COVID-19 pandemic period. At this point, it is not possible to determine if pandemic vaccination is a distinct issue and whether COVID-19 VH is analogous to other VH. This remains an area for further exploration.

Incorporating broader skills, such as communication techniques (Kelekar et al., 2022; Schnaith et al., 2018) and sourcing reliable vaccine information resources to counsel patients (Afonso et al., 2014; Coleman & Lehman, 2017) might provide an alternative framework that permits students to approach any type of vaccine hesitancy. Indeed,

Schnaith and colleagues (2018) reported that over 90% of participants found the C.A.S.E approach useful not only for VH but also other medical concerns. It may be worth exploring other literature that describes behavioural training interventions for medical students, for example, behaviour change for addictive substances and training for conversations around belief change (D'Urzo et al., 2020; Edwards et al., 2022; Jacobs et al., 2021; Purkabiri et al., 2016; White et al., 2007). Successful interventions in these areas may be able to be adapted for VH.

By developing skills to source and appraise vaccine resources, the plethora of myths surrounding individual vaccines need not be directly addressed. Rather, students can learn to seek out appropriate resources and information to tailor their approach to specific patient concerns. This approach aligns closely with the model of evidence-based medicine (EBM), though none of the programs included in this review specifically utilised this approach. In designing a sustainable VH program, curriculum developers should consider the need for constant review as new vaccine safety data becomes available and the factors contributing to vaccine hesitancy evolve. The recent politicisation of COVID-19 vaccines is a prime example of this need (Bolsen & Palm, 2022). The EBM teaching model represents a potential solution, where generic skills such as patient communication and critical analysis of literature can provide students with the necessary tools to adapt to a broad range of VH concerns.

Assessment of education & learning outcomes

All programs, excluding one (Koski et al., 2018), included pre- and post-intervention student surveys designed to assess student satisfaction and change in attitudes, specifically regarding student confidence levels discussing VH with patients (Afonso et al., 2014; Coleman & Lehman, 2017; Kelekar et al., 2022; Lepiller et al., 2020; Onello et al., 2020; Schnaith et al., 2018), a Kirkpatrick's Level 2a outcome. Kelekar and colleagues (2022) was the only study that evaluated modification of student skills and knowledge (Kirkpatrick's Level 2b) and the only study to include an objective assessment of learning. Overall, the lack of Kirkpatrick Level 3 and 4 outcomes renders it difficult to evaluate the actual impact and benefits of the interventions described.

Limitations

There are several limitations to this review. Relevant articles may have been omitted due to the adopted search strategy and inclusion criteria. The risk associated with excluding non-English articles is acknowledged, but the decision to do so was pragmatic and reflected that most scientific research is published in English. Given the breadth of the search strategy, including four indexed databases and handsearching of reference lists, it is likely that no articles have been missed or inappropriately excluded. Several related studies were excluded as either no clear intervention was implemented (Afonso et al., 2017; Baessler et al., 2022; Caruso Brown et al., 2017; Dybsand et al., 2019; Kernéis et al., 2017; Pelly et al., 2010; Vorsters et al., 2010) or the intervention and objectives focused

on improving vaccine knowledge rather than VH communication (Bechini et al., 2019; Marotta et al., 2017). Within the included studies, several (Kelekar et al., 2022; Koski et al., 2018; Lepiller et al., 2020; Schnaith et al., 2018) did not report outcomes of interest, including teaching duration, instructor background or outcome assessment, potentially influencing the outcomes reported in this review. Several studies reported a small sample size (Afonso et al., 2014; Koski et al., 2018), and none assessed students at multiple institutions. Furthermore, several studies reported low response rates (Coleman & Lehman, 2017; Kelekar et al., 2022; Onello et al., 2020). One study (Lepiller et al., 2020) included students from multiple healthcare disciplines, where certain data relevant to medical students was non-extractable. None of the studies included longitudinal prospective assessment and, thus, could not correlate patient outcomes to teaching interventions.

Conclusions

This review establishes that interventions designed to equip medical students with the knowledge and skills required to appropriately communicate with vaccine-hesitant patients are well-received by students and can produce a measurable change in students' attitudes even if delivered at a single time point. However, with the breadth of learning approaches, lack of longitudinal assessment and relative dearth of research conducted in this domain, there is no single recommended educational approach identified as a model standard or any that were directly demonstrated to produce positive patient outcomes. It remains the case that medical educators must design curricula that aim to equip students with the necessary VH counselling skills to generate a measurable improvement in patient outcomes and retention and application of such skills post graduation. This is an undoubtedly challenging task and an area for further exploration, where it may be useful to review how similar interventions are delivered at a postgraduate education level (Dempsey et al., 2018; Morhardt et al., 2016; Pahud et al., 2020; Real et al., 2017).

Although the concept of an EBM approach appeals as a potential solution to creating a sustainable and adaptable teaching curriculum, there is a lack of evidence to demonstrate whether this would impact patient outcomes. Educators should direct further research to ascertaining whether development and implementation of a VH curriculum results in changes in student clinical practice and, ultimately, patient health outcomes, allowing future doctors to address the challenge of VH.

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