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RESEARCH ARTICLE

Development and evaluation of a simulation-based vaccination training course for pharmacy students

Aurore Gaspar[1], Anne-Lise Delwaide[1], Nadège Dubois[2], Anne-Françoise Donneau[3], Alexandre Ghuysen[2,4], Sophie Klenkenberg[3], Alice Lallemand[1], Frédéric Lecomte[1], Geneviève Philippe[1]

[1] Centre for Interdisciplinary Research on Medicines (CIRM), Department of Pharmacy, University of Liege, Liege, Belgium
[2] Medical Simulation Centre, University of Liege, Liege, Belgium
[3] Biostatistics and Research Methods Centre (B-STAT), University of Liege, Liege, Belgium
[4] Department of Emergency, University Hospital of Liege, Liege, Belgium

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Correspondence
Aurore Gaspar
Center for Interdisciplinary Research on Medicines (CIRM)
Department of Pharmacy
University of Liege
Liege
Belgium
aurore.gaspar@uliege.be

Abstract

Background: Community pharmacists are frontline healthcare professionals who became authorised to administer COVID-19 and influenza vaccinations in Belgium post-pandemic. To prepare students for this role, a vaccination simulation training program was developed at the University of Liege. This article outlines the training process for final year pharmacy students and evaluates the simulation-based course. **Methods:** Master's pharmacy students used online training, procedural simulations, and relational simulations with simulated patients. Students' satisfaction, interest and self-confidence in vaccination-related skills were measured by pre-/post-questionnaires. Vaccination skills were evaluated through an Objective Structured Clinical Examination assessment. **Results:** Statistically significant improvements were observed in all interest and confidence scores. The most notable increase was in the perception of vaccination as a healthcare professional role, with a median gain of 8.3 (0.0–10.7) points out of 100. Confidence in addressing misinformation, managing concerns, and performing vaccine preparation and administration increased by 25 points each. Finally, 80 out of 86 students (93.02%) achieved the required skills to pass the OSCE station, with a success threshold set at 80/100. **Conclusion:** This simulation-based vaccination training course helps students develop essential skills and confidence in administering vaccinations. It adds to pharmacy education literature and offers ideas for creating engaging teaching activities for future public health interventions, particularly in vaccination.

Introduction

The World Health Organisation (WHO) stated in 2019 that "*vaccination is one of the most effective public health interventions, preventing two to three million deaths annually and morbidity from around twenty diseases*". Vaccination plays a crucial role in achieving the Sustainable Development Goals (SDGs) by 2030, particularly SDG three, "*Ensure healthy lives and promote well-being for all at all ages*" (WHO, 2020).

Community pharmacists are frontline healthcare professionals who are accessible and available (Tsuyuki *et al*., 2018; Valliant *et al*., 2022). By collaborating with other healthcare professionals, they could contribute to increasing vaccine coverage and reducing healthcare system overload by enhancing accessibility to this service and reducing vaccine hesitancy (Ecarnot *et al*., 2019; Murray *et al*., 2021; Shen & Tan, 2022; Crunenberg *et al*., 2023). Vaccination also enables better management of chronic patients, helping to prevent various comorbidities (Rodrigues & Plotkin, 2020).

The COVID-19 pandemic overwhelmed healthcare systems worldwide, exposing critical gaps in public health infrastructure and highlighting the need for expanded healthcare services. In response, legislative changes were introduced in several countries, including Belgium, to enhance the role of pharmacists in vaccination efforts. A new law now authorises Belgian

pharmacists to administer COVID-19 vaccines, reinforcing their position as accessible healthcare providers. However, this shift required targeted educational strategies to equip pharmacists with the necessary clinical training. In Belgium, pharmacists must complete an 8-hour vaccination training course led by a physician or nurse to qualify for this role. To prepare students for these evolving responsibilities and address workforce demands (Bushell *et al*., 2020; Patanwala *et al*., 2022), a vaccination training programme was developed for the master's students in pharmacy at the University of Liege. This initiative aimed to ensure that future pharmacists are adequately trained to contribute effectively to public health vaccination efforts. Beyond technical expertise, pharmacists must also develop essential non-technical skills such as communication, patient counselling, and interprofessional collaboration to provide optimal patient-centred care. Simulation-based education (SBE) offers a realistic yet controlled learning environment where students can practice both technical and non-technical skills through simulated clinical scenarios (Korayem *et al*., 2022). This method complements traditional learning methods, such as ex-cathedra courses, in the development of professional skills as pharmaceutical expertise, and non-technical skills such as communication, medication counselling and interprofessional collaboration. Simulation-based training was found to be an efficient method of teaching non-technical skills for patient-centred care and interprofessional exchanges in pharmacy education (Gaspar *et al*., 2024). Simulation was found to be an efficient method of teaching non-technical skills for patient-centred care and interprofessional exchanges in pharmacy education programmes (Gaspar *et al*., 2024). It is also used as a tool for transferring some learning experiences into the professional context (Barry Issenberg *et al*., 2005; Gaba, 2007; McGaghie *et al*., 2010). Thus, incorporating SBE into pharmacy education is crucial to equipping future pharmacists with the competencies needed to meet the expanding demands of their profession and contribute effectively to public health initiatives.

The public health response to the COVID-19 pandemic forced healthcare system to rapidly adapt to build a pharmacy workforce to support vaccination hubs. Building on similar developments in Australia, United States, and New South Wales (Bushell *et al*., 2020; Carroll *et al*., 2020; Patanwala *et al*., 2022), this paper describes the process used for training pharmacy students to support and administer vaccination in Belgium. This study also focuses on the evaluation of a simulation-based vaccination training course for pharmacy students, aiming to contribute to increasing the engagement of future pharmacists in their profession and in response to healthcare needs.

Methods

Study design, context, and participants

This study is a pre- and post-experimental observational study involving final-year master's students in pharmaceutical sciences (n=88). The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) initiative developed recommendations on what should be included in an accurate and complete report of an observational study. The guidelines for good practice in writing observational studies were followed for this study (Von Elm *et al*., 2007). The study took place at the University of Liege, between March and June 2023, as part of a dedicated course on Pharmaceutical practice.

Students were recruited based on a written consent form. The study was approved by the Hospital-University Ethics Committee of Liege (Nr: 2023/084). All data were collected in a pseudonymous manner and analysed anonymously. Informed consent was given in writing in accordance with the study protocol approved by the Hospital-University Ethics Committee of Liege (Nr: 2023/084).

The grades of students who did not participate in the study were not affected. All final-year pharmacy master's students at the University of Liege provided informed consent (n=88). The grades of students who did not participate in the study were not affected. The number of students who agreed to participate is 88, which is equivalent to the number of potential participants. The participation rate is therefore 100%.

Educational framework

The content of the vaccination training course was defined based on legal themes outlined in Belgian law, Belgian Standard Operating Procedure (SOPs) (Belgian Pharmaceutical Association (Association Pharmaceutique Belge, 2023), and models from other French-speaking university programmes in France (Legifrance, 2024), Switzerland (PharmaSuisse, 2023), and Canada (Quebec National Institute of Public Health, 2023; Ministry of Health and Social Services, 2023). This course adhered to the Simulation Best Practices guidelines of the International Nursing Association for Clinical Simulation and Learning (Boese *et al*., 2013; McDermott *et al*., 2017; Watts *et al*., 2021).

Activity design

The training was divided into three modules (Figure 1), developed in collaboration between the Department of Pharmacy, the Department of General Medicine, and the Medical Simulation Centre at the University of Liege. The educational objectives of Module 1 are to cover theoretical aspects using a 2-hour online training. It also includes access to an interactive video "Sauve une vie" (meaning “Save a life” in English), (Medical Simulation Centre of the University of Liège *et al*., n. d.) and a video featuring "*Feedback from General Practitioners*". This is followed by a 6-hour session of two practical modules (Modules 2 and 3) under the supervision of physicians and nurses. The educational objectives of Modules 2 and 3 are the acquisition of skills relating to vaccination. The educational approach of these two modules is learning through simulation.

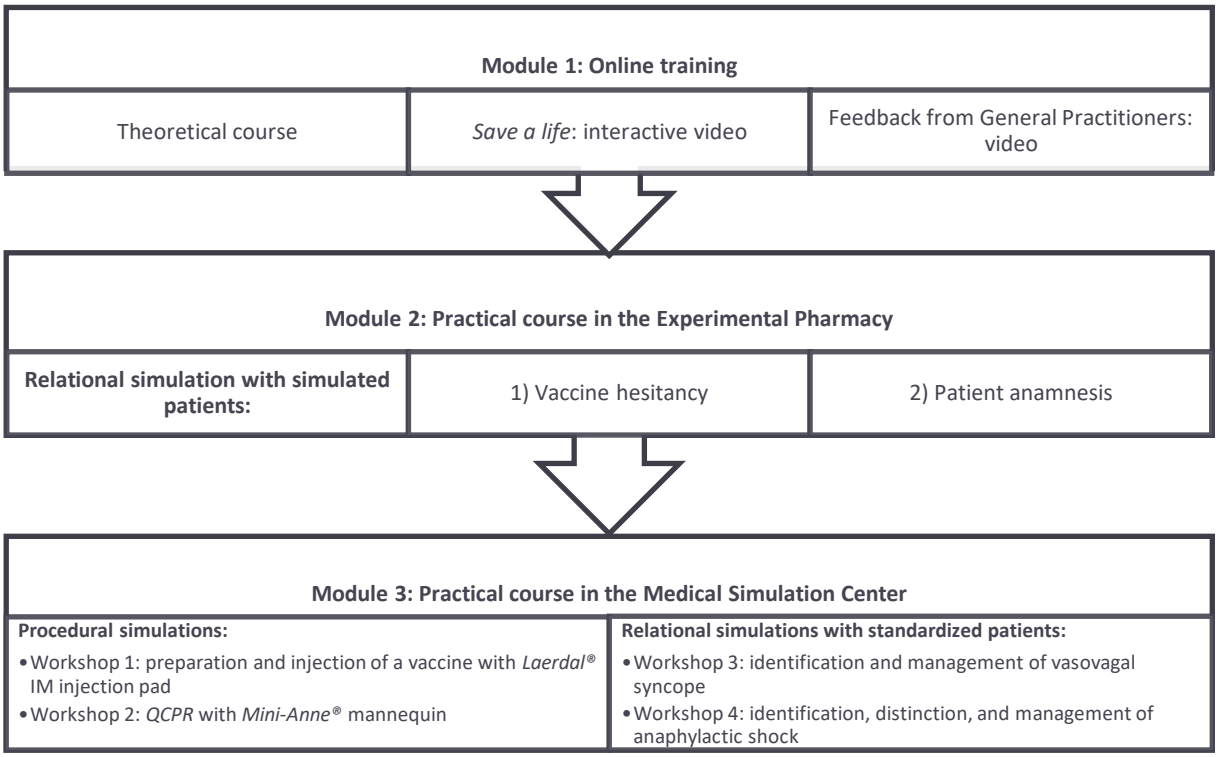

Figure 1: Three modules of the vaccination training course for pharmacy students

Within Module 2, students participate in a relational simulation at the Experiential Laboratory focusing on communication regarding vaccine hesitancy and patient anamnesis at the counter with simulated patients. In Module 3, students engaged in four simulation workshops at the Medical Simulation Centre, based on the legal requirements related to the preparation and injection of vaccines and the management of adverse effects. Two procedural simulations covered the preparation and injection of vaccines using a Laerdal® intramuscular injection pad (Workshop 1) and cardiopulmonary resuscitation using a Mini-Anne QCPR® mannequin (Workshop 2). Additionally, two relational simulations with standardised patients focus on the identification, differentiation, and management of vasovagal syncope (Workshop 3) and anaphylactic shock (Workshop 4). During the practical training, students were divided into groups of four to five participants. Simulation activities last 20 to 25 minutes.

The measurement of the achievement of educational objectives was carried out by means of an Objective Structured Clinical Evaluation-type assessment (OSCE assessment).

Questionnaire design

One week before the practical training, students were given access to the online training. Subsequently, students who consented to participate in the study were invited to respond to a pre-training evaluation questionnaire. After completing the practical training, the same students were asked to respond to post-training evaluation questionnaires (Figure 2). The questionnaires were written in French, the language of pharmacy teaching in this region of Belgium.

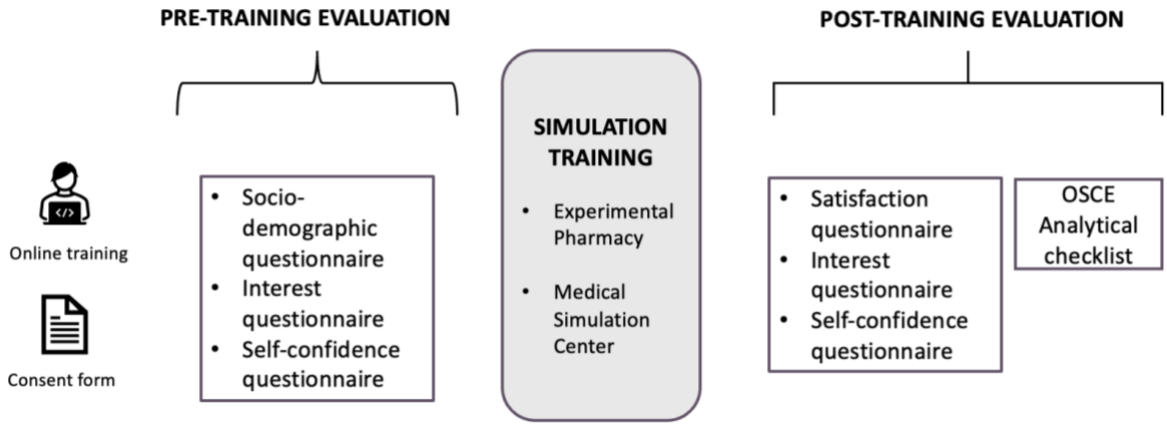

Figure 2: Flowchart of student assessment during simulation vaccination training

The questionnaires were developed based on scientific literature and levels 1, 2a, and 2b of Kirkpatrick's model. The Kirkpatrick Model is a well-established framework for evaluating training effectiveness, originally developed by Donald Kirkpatrick in 1959 and later expanded (Kirkpatrick, 1996). The Kirkpatrick Model assesses training effectiveness across four levels: (1) Reaction: Evaluates participants' satisfaction and engagement with the training; (2) Learning: Measures improvements in knowledge, skills, or attitudes; (3) Behaviour: Assesses how participants apply their learning in the workplace; (4) Results: Reviews the training's impact on organisational outcomes (La Duke, 2017; Reio *et al*., 2017; Heydari *et al*., 2019). These questionnaires were adapted to the Belgian pharmaceutical vaccination context and were then validated according to the Delphi method by medical, pharmaceutical, and educational experts at the University of Liege (Hentzen *et al*., 2022). The variable evaluated for level 1 of Kirkpatrick's model was satisfaction with the training concerning the use of medical simulation tools and the expected pedagogical objectives (Appendix A) (Simoneau *et al*., 2011). For level 2a, the questionnaire was divided into three sub-themes and assessed the perception of the training's interest in a public health context, within the pharmacy curriculum, and the use of simulation in training (Appendix B) (Moreau *et al*., 2012; Comboroure & Mueller, 2014; Carroll *et al*., 2020; Danilov *et al*., 2023). For level 2b, the questionnaire was divided into four sub-themes and assessed the self-confidence to address vaccine hesitancy at the counter, communicate during the vaccination process, prepare and administer a vaccine, and identify, distinguish, and manage vasovagal syncope and anaphylactic shock (Appendix C) (Feret *et al*., 2015; Rizzolo *et al*., 2015; Vyas *et al*., 2018; Bushell *et al*., 2020; Carroll *et al*., 2020).

Each questionnaire item was evaluated on a 5-point Likert scale ranging from 0 (completely disagree with the statement) to 4 (completely agree). The use of a 5-point Likert scale is justified by its reliability and ease of interpretation in assessing attitudes and perceptions. It balances sufficient response options with simplicity, reducing cognitive load (Revilla *et al*., 2014). Research suggests that scales beyond five points do not necessarily improve reliability and may introduce respondent fatigue (Preston & Colman, 2000). Including a neutral midpoint prevents forced choices, reducing measurement errors. This approach aligns with best practices in survey design, ensuring interpretability and statistical robustness in social and health sciences research (Joshi *et al*., 2015). Since the questionnaires were divided into sub-themes with varying numbers of items, these sub-themes were summarised by the mean scores of their constituent items, re-expressed over a total of 100 points.

Objective Structured Clinical Evaluation (OSCE)

Four weeks after the practical training, students underwent an OSCE featuring a scenario assessing vaccination skills acquired during the training. The scenario, validated by University of Liege Medicine faculty members and refined in focus groups with general practitioners, pharmacists, and therapeutic education specialists, involved a realistic pharmacy setting for a COVID-19 vaccination reminder. Each participant simulated a pharmacy-based vaccination, faithfully executing the procedures for vaccine preparation and injection on a Laerdal® intramuscular injection pad attached to a standardised patient's arm. Following this, participants addressed knowledge questions on adverse effects posed by the patient.

Throughout the scenario, external examiners (physicians or nurses) observed actions and

expressions, using an analytical checklist based on the Belgian SOPs for evaluation (Association Pharmaceutique Belge, 2023). The checklist focused on procedure execution, assigning points for each theme: eight for vaccine preparation, nine for injection, six for adverse effects knowledge, and six for communication during vaccination. The total possible score for each theme was converted into percentages (Appendix D). Students had to obtain an 80% success rate on the sum of the four themes to pass the station. The OSCE station lasted seven minutes, with evaluators and trained standardised patients rotating every ten participants.

Statistical analysis

Qualitative variables were summarised using percentages for each modality. Regarding the student sociodemographic data, quantitative variables with a normal distribution were summarised by their mean and standard deviation. Skewed distributed quantitative variables were presented using their median and interquartile range (P25–P75). The normality of distributions was assessed graphically using histograms and quantile-quantile plots and tested using the Shapiro-Wilk normality test. Moreover, since most of the interest, self-confidence and satisfaction variables exhibited skewed distributions, they were summarised by their median and interquartile range, and analyses involving these variables were conducted using non-parametric techniques.

The changes in various scores were analysed using paired Wilcoxon tests, and effect sizes were estimated using rank-biserial correlations. Missing data were not imputed, and the analyses were conducted on the entire set of available data. Results were deemed significant at the critical threshold of 5 percent (p-value < 0.05), and unless explicitly stated otherwise, all tests were two-tailed. The statistical software employed was R version 4.1.1

Results

Socio-demographic data and satisfaction with the training

Out of 88 participants, complete data suitable for analysis were collected from 79 students. The recorded data at times T0 (pre-training evaluation) and T1 (post-training evaluation) were successfully paired for 79 students. The other nine final-year students, whose data could not be matched due to a coding error, were still able to be assessed with the OSCE certification exam, and this assessment was in no way impacted by their withdrawal from the first part of the study.

Table I presents descriptive statistics for the socio-demographic data of the 79 students who underwent the training, as well as their satisfaction with the training. The satisfaction scores range from 0 to 10.

Table I: Descriptive statistics (n=79)

Variable	Median (P25–P75)
Sex	
Female	64
Male	15
Other	0
Age	23.0 (22.0 - 24.0)
Elective course	
Erasmus (exchange programme)	7
Drug design	18
Pharmacy management	10
Pharmacy practice	44
Number of weeks of internship	21.0 (17.0 - 25.0)
Satisfaction with the training	83.3 (75.0 - 92.9)

Most students were female (81.01 %), with a median age of 23 years (22–24). Slightly over half of the students were enrolled in the "*Pharmacy Practice*" elective course (55.70 %). The median number of weeks of internship completed by these students at the time of the training was 21.0 out of the 26 legally required weeks of internship in a pharmacy to obtain the Belgian pharmacist diploma.

Evolution of self-confidence

Results indicated a significant increase in students' confidence to prepare and administer a vaccine (median increase of 25 points, $p < 0.001$) and to identify, distinguish, and manage adverse effects such as vasovagal reactions and anaphylactic shock (median increase of 33.3 points, $p < 0.001$).

Table II summarises the changes in interest and self-confidence scores between pre-training (T0) and post-training (T1) evaluation.

Table II: Evolution of interest and self-confidence between T0 and T1

Variable	T0 Median (P25–P75)	T1 Median (P25–P75)	Difference Median (P25–P75)	*p*-value (Wilcoxon)	Effect size (rank-biserial correlation)
Public health interest	87.5 (79.2–95.8)	91.7 (79.2–100)	0.0 (-4.2–8.3)	0.816	0.04
Interest in the training within the curriculum	91.7 (83.3–100)	100.0 (91.7–100)	0.0 (0.0–8.3)	0.016	0.31
Interest in simulation	85.0 (75.0–95.0)	90.0 (80.0–100)	0.0 (-10.0–15.0)	0.062	0.20
Self-confidence in addressing vaccine hesitation at the counter	66.7 (56.3–72.9)	77.1 (70.8–85.4)	12.5 (6.3–20.8)	**< 0.001**	**0.79**
Self-confidence in preparing and administering the vaccine	50.0 (12.5–75.0)	75.0 (62.5–87.5)	25.0 (0.0–50.0)	**< 0.001**	**0.71**
Self-confidence in managing adverse effects	45.8 (12.5–66.7)	75.0 (70.8–87.5)	33.3 (16.7–66.7)	**< 0.001**	**0.84**
Self-confidence in communicating during the vaccination procedure	56.3 (43.8–75.0)	75.0 (65.6–84.4)	15.6 (3.1–28.1)	**< 0.001**	**0.73**

Positive and statistically significant changes were observed for all self-confidence scores. The most substantial median gain was noted for managing adverse effects, which, among the self-confidence scores, had the lowest baseline value at T0 (median score at T0 was 45.8, median increase of 33.3 points, $p < 0.001$). Communication during the vaccination process also saw a significant increase. The least significant median gain was observed in the self-confidence score for addressing vaccine hesitancy at the counter, which presented the highest score before the training (median score at T0 was 66.7, median increase of 12.5 points, $p < 0.001$). Effect sizes measured by rank-biserial correlations for all self-confidence scores were around 0.8, reflecting large induced by training.

About the interest scores, particularly for public health interest and interest in simulation, no significant change was observed for these two scores. Indeed, most students already reported high scores at T0. Regarding the interest in the training within the curriculum, a significant positive change was noted, although it is less pronounced than the changes in self-confidence scores, as shown by the effect size, which is just over 0.3.

OSCE evaluation

All final-year pharmacy students (n=88) agreed to participate in the study, and all students participated in the OSCE station dedicated to the vaccination procedure (n=88). Out of the 88 participants, complete data necessary for analysis were collected from 86 students. The skills required to obtain the successful completion certificate were developed by 93.02 percent of students (80 out of 86 students).

Table III presents the descriptive statistical analyses of the variables assessed during the OSCE. The scores range from 0 to 100. Out of 86 students, 80 (93.02%) developed the necessary skills to pass the OSCE station. Success threshold was set at 80 points out of 100.

Table III: Descriptive statistics of the OSCE evaluation

Variable	Median (P25–P75)
Vaccine preparation	75.0 (62.5-87.5)
Vaccine administration	88.9 (77.8-88.9)
Adverse effects knowledge	100.0 (100.0-100.0)
Communicating during the vaccination procedure	100.0 (100.0-100.0)
Total skills score for the OSCE station	87.93 (79.31-93.10)

Discussion

An innovative vaccination training programme, centred on simulation, was successfully integrated into the pharmacy curriculum at the University of Liege. This study aimed to assess students' perceptions and the

competencies developed during the training. Specifically, it focused on individual perceptions of competency, including self-confidence and self-efficacy in performing technical vaccination-related tasks. The OSCE was used to evaluate post-training technical skills, while the other part of the study assessed pre- and post-training perceptions.

With the recent authorisation for Belgian pharmacists to vaccinate, students were initially unaware, when they registered for pharmacy studies, that they would need to perform this type of clinical procedure, including injection and adverse effect management, as well as having physical contact with a patient. This training significantly improved their confidence to prepare and administer the vaccine as well as manage adverse effects.

This increase in students' self-confidence highlighted the ability students gained through this training to manage emergency situations and physically interact with patients, which is uncommon for a pharmacist. This observation is also consistent with the results of a randomised study that integrated a high-fidelity simulation of emergency cases into the vaccination training course for pharmacy students (Sayyed *et al*., 2023). This study demonstrated that high-fidelity simulation (HFS) significantly enhanced pharmacy students' vaccination skills compared to low-fidelity injection pads, with HFS participants showing greater improvement in both vaccination techniques and the management of adverse reactions.

Performance and motivation, which determine future engagement in an activity, are closely linked to self-confidence in one's abilities and a sense of self-efficacy (Bandura *et al*., 1999). However, students' involvement in their future profession and the success of the training do not rely solely on self-confidence to accomplish a task; it is necessary to have underlying reasons for performing vaccination and thus promoting engagement: intrinsic and extrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000; Eccles & Wigfield, 2002; Schunk & DiBenedetto, 2020). Intrinsic motivation is based on interest and appreciation of the activity, emphasising engagement in the activity, while extrinsic motivation depends on the expected outcome. Interest in vaccination training in the context of public health was already high before its implementation and remained high after the training. Students seemed to have already been informed of current vaccination issues during their pharmacy curriculum, such as vaccination coverage deficits, healthcare system saturation during certain periods of the year and collaboration with other healthcare professionals in vaccination-related initiatives.

Students expressed satisfaction with the simulation-based vaccination training. Moreover, satisfaction with the training was even more reinforced when this experience culminated in earning a successful completion certificate (Eccles & Wigfield, 2002). The extrinsic motivation, in this specific case, was to develop the necessary skills and obtain the training completion certificate (Deci & Ryan, 2000; Eccles & Wigfield, 2002). Although communication skills are not legally required, they seemed crucial for performing a quality vaccination act, as demonstrated by two studies that also evaluated a simulation-based vaccination training course in the pharmacy curriculum (Bushell *et al*., 2020; Carroll *et al*., 2020; Pantawala *et al*., 2022).

Limitations and perspective

This study has several limitations. Conclusions may not fully translate to real-life situations, as students may react differently due to stress and other unforeseen factors. The OSCE-style assessment setting could significantly influence outcomes, potentially reducing students' self-confidence, as observed in previous studies. Additionally, subjective evaluation is a key component of this study. Assessments of interest, self-confidence, and satisfaction rely on individual perceptions, introducing potential bias. Finally, the study is based on a single cohort, reflecting the innovative nature of this activity. These limitations should be considered when interpreting the results.

It is also important to note that the assessment of this skill was limited to polite communication aspects related to the vaccination act, excluding communication related to vaccine hesitancy or building trust with the patient. A more in-depth development of this skill would be necessary for community pharmacists, as addressing vaccine hesitancy contributes to increasing vaccination coverage and reducing healthcare system overload (Dubé *et al*., 2013; Ecarnot *et al*., 2019). Current barriers to pharmacists' engagement in addressing vaccine hesitancy lie in the lack of self-confidence resulting from a deficiency in training and education (Carroll & Hanrahan, 2021; Cassidy *et al*., 2021). It is important to note that while these factors of engagement (interest, self-confidence, satisfaction, and skills) were identified, the complete extent of their impact on engagement cannot be definitively proven, as other factors influencing engagement were not evaluated. Moreover, Levels three and four of Kirkpatrick's model could not be addressed within our study, as assessing behavioural changes in professional practice (Level 3) and the overall impact on healthcare outcomes (Level 4) requires a larger-scale experimental protocol and long-term follow-up. These aspects are more challenging to measure but could be explored in future research.

Conclusion

Community pharmacists in Belgium are increasingly involved in preventive and public health promotion activities, such as vaccination. The combination of an eight-hour training programme in three modules, consisting of various learning methods (online training, procedural simulation, and relational simulation with simulated or standardised patients), has satisfied students and increased their self-confidence in preparing and administering vaccines as well as identifying, distinguishing, and managing adverse effects. This training has also enabled the development of skills relevant to the preparation and injection of a vaccine, assessed during an OSCE. The present study suggests that satisfaction with simulation training, increased interest in vaccination and education, and strengthened self-confidence may contribute to enhanced student engagement in new pharmaceutical services and health promotion efforts. This paper could contribute to the literature on pharmacy education and increase students' engagement in future public health interventions, particularly in vaccination.

Ethics approval

Students were recruited based on a written consent form. The study was approved by the Hospital University Ethics Committee of Liege (Nr: 2023/084). All data were collected in a pseudonymous manner and analysed anonymously.

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Appendix A: Satisfaction questionnaire

Instructions: To assess the use of teaching practices, we ask you to complete the questionnaire below. There are no right or wrong answers. What we want to know is your level of agreement or disagreement with the statements below.

Use the following rating scale to evaluate teaching practices:

TD - 1- Strongly disagree with the statement
D -2- Disagree with the statement
I -3- Undecided – You neither agree nor disagree with the statement.
A -4- Agree with the statement
TA -5- Strongly agree with the statement

Learning by doing	**TD**		**D**		**I**		**A**		**TA**
1. During the clinical simulation activity, I was able to discuss with the professor and other students about the ideas and concepts presented in the course.	□	1	□	2	□	3	□	4	□ 5
2. I actively participated in the debriefing session that took place after the clinical simulation.	□	1	□	2	□	3	□	4	□ 5
3. The debriefing session allowed me to provide more comprehensive feedback.	□	1	□	2	□	3	□	4	□ 5
4. The clinical simulation provided enough opportunities to determine whether I understood the material.	□	1	□	2	□	3	□	4	□ 5
5. I learned from the feedback given by the professor throughout the clinical simulation.	□	1	□	2	□	3	□	4	□ 5
6. If necessary, I was offered clues during the clinical simulation.	□	1	□	2	□	3	□	4	□ 5
7. I was able to discuss the goals of the clinical simulation with my professor.	□	1	□	2	□	3	□	4	□ 5
8. I was able to discuss ideas and material taught during the clinical simulation with my professor.	□	1	□	2	□	3	□	4	□ 5
9. The professor was able to meet the individual needs of the students during the clinical simulation.	□	1	□	2	□	3	□	4	□ 5
10. Clinical simulation activities made my learning time more productive.	□	1	□	2	□	3	□	4	□ 5

	TD	D	I	A	TA
Collaboration					
11. I had the opportunity to work with my peers* during the clinical simulation.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
12. During the clinical simulation, my peers* and I had to work together on the clinical situation.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Diversity of learning styles					
13. The clinical simulation offered different opportunities to learn the subject matter.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
14. This clinical simulation offered different opportunities to assess my learning.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Expectations					
15. The objectives of the clinical simulation activity were clear and easy to understand.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
16. My teacher explained to me the expectations and objectives of the clinical simulation.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

*Peers: other students, colleagues.

Satisfaction with Learning (ESEA)	TD	D	I	A	TA
1. The teaching methods used in this clinical simulation were useful and effective.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. The clinical simulation included various teaching tools and activities to enhance our learning in the nursing program.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. I liked the way my instructor led the clinical simulation activity.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. The learning tools and activities used in this clinical simulation were motivating and helped me learn.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. The way my instructor led the clinical simulation exercise suited my learning style.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix B: Interest questionnaire

Instructions: This questionnaire consists of a series of statements. Specifically, we will ask you about your interest in vaccination training in a public health setting, in your pharmacy curriculum, and in simulation (didactic pharmacy and medical simulation center) versus classroom courses. There are no right or wrong answers. You may agree with some of the statements, but not with others. Please indicate your personal feelings about each statement by checking the number that best describes your opinion. Please state your honest, straightforward thoughts. This questionnaire is anonymous, and the results will be tabulated based on the group, not on individual respondents.

Use the following rating scale to evaluate teaching practices:

TD - 1- Strongly disagree with the statement
D -2- Disagree with the statement
I -3- Undecided – You neither agree nor disagree with the statement.
A -4- Agree with the statement
TA -5- Strongly agree with the statement

General information	
1. How old are you?	……. years
2. What is your gender?	☐ Male ☐ Female ☐ Other
3. What is the chosen focus for your master's degree?	☐ Master's degree with a specialized focus in pharmacy practice, pharmaceutical advice and monitoring ☐ Master's degree with a specialized focus in pharmacy management and professional prospects ☐ Master's degree with a specialized focus on drug design and development ☐ Master's degree with an advanced focus
4. How many weeks of internship have you already done in a pharmacy?	…… weeks

General information					
Interest of vaccination training in a public health setting	**TD**	**D**	**I**	**A**	**TA**
5. Through this training, I realize that the pharmacist, by collaborating with other health professionals, could increase vaccination coverage.	□ 1	□ 2	□ 3	□ 4	□ 5
6. Through this training, I realize that the pharmacist, by collaborating with other health professionals, could help combat the overload of health care during an epidemic or pandemic.	□ 1	□ 2	□ 3	□ 4	□ 5
7. Through this training, I realize that the pharmacist is a front-line player who can act in the prevention of certain diseases through vaccination.	□ 1	□ 2	□ 3	□ 4	□ 5
8. I intend to practice vaccination in my future practice, if the legal context allows it.	□ 1	□ 2	□ 3	□ 4	□ 5
9. I think that the pharmacist should focus on his area of expertise, namely medication.	□ 1	□ 2	□ 3	□ 4	□ 5
10. I believe that clinical acts are not consistent with the profession of pharmacist.	□ 1	□ 2	□ 3	□ 4	□ 5
Interest of vaccination training in the pharmacy curriculum	**TD**	**D**	**I**	**A**	**TA**
11. I think that this training is essential in the pharmacy curriculum, if the legal framework allows vaccination by the pharmacist.	□ 1	□ 2	□ 3	□ 4	□ 5
12. I think that this training is well placed in the pharmacy curriculum, in parallel with the internship.	□ 1	□ 2	□ 3	□ 4	□ 5
13. I think that there should be more simulation in the pharmacy curriculum, whether in the form of role-playing in the didactic pharmacy or at the Medical Simulation Center.	□ 1	□ 2	□ 3	□ 4	□ 5
14. For me, vaccination training allowed me to:					
a) Learn to perform technical procedures	□ 1	□ 2	□ 3	□ 4	□ 5
b) Learn to manage my stress	□ 1	□ 2	□ 3	□ 4	□ 5
c) Learn to communicate in a team	□ 1	□ 2	□ 3	□ 4	□ 5
d) Learn to communicate with the patient	□ 1	□ 2	□ 3	□ 4	□ 5
e) Link theory with practice	□ 1	□ 2	□ 3	□ 4	□ 5
f) Learn to recognize my shortcomings and limitations	□ 1	□ 2	□ 3	□ 4	□ 5
g) Learn to provide solutions to a problem	□ 1	□ 2	□ 3	□ 4	□ 5
h) Others:	□ 1	□ 2	□ 3	□ 4	□ 5
15. Among the above points, what seemed most important to me?	□ A □ B □ C □ D □ E □ F □ G □ H				
16. What would I have liked the training to address or explore in depth?	....				

Interest of simulation compared to theoretical courses	**TD**	**D**	**I**	**A**	**TA**
17. I find that simulation allows for faster assimilation of theoretical learning.	□ 1	□ 2	□ 3	□ 4	□ 5
18. I find that simulation allows for easy practical application of theoretical learning.	□ 1	□ 2	□ 3	□ 4	□ 5
19. I find that simulation offers more fun learning.	□ 1	□ 2	□ 3	□ 4	□ 5
20. I find that simulation improves self-decision skills.	□ 1	□ 2	□ 3	□ 4	□ 5
21. I find that simulation improves collaborative skills (communication and teamwork).	□ 1	□ 2	□ 3	□ 4	□ 5

Appendix C: Self-confidence questionnaire

Instructions: This questionnaire consists of a series of statements. Specifically, we will ask you how confident you are about vaccine hesitancy at the counter, when preparing and injecting a vaccine, and when managing adverse events following vaccination. There are no right or wrong answers. You may agree with some of the statements, but not with others. Please indicate your personal feelings about each statement by checking the number that best describes your opinion. Please say what you think honestly and without beating around the bush. This questionnaire is anonymous, and its results will be tabulated based on the group as a whole, not individual respondents.

Use the following rating scale to evaluate teaching practices:

TD - 1- Strongly disagree with the statement
D -2- Disagree with the statement
I -3- Undecided – You neither agree nor disagree with the statement.
A -4- Agree with the statement
TA -5- Strongly agree with the statement

Self-confidence in terms of vaccine hesitancy ***"If a patient comes to me at the counter with the aim of getting vaccinated:"***	**TD**	**D**	**I**	**A**	**TA**
1. I feel able to explain the benefits of vaccination.	□ 1	□ 2	□ 3	□ 4	□ 5
2. I feel able to counter preconceived ideas about vaccination.	□ 1	□ 2	□ 3	□ 4	□ 5
3. I feel able to express the potential risks of vaccination.	□ 1	□ 2	□ 3	□ 4	□ 5
4. I feel able to popularise the terms related to the vaccination act.	□ 1	□ 2	□ 3	□ 4	□ 5
5. I feel able to determine the eligibility criteria.	□ 1	□ 2	□ 3	□ 4	□ 5
6. I feel able to refer the patient to the general practitioner if necessary.	□ 1	□ 2	□ 3	□ 4	□ 5
7. I feel able to obtain the patient's informed consent by explaining and answering questions.	□ 1	□ 2	□ 3	□ 4	□ 5
8. I feel able to identify the reactions of my interlocutor and react to them appropriately.	□ 1	□ 2	□ 3	□ 4	□ 5
9. I feel able to create a relationship of trust with the patient (gaze, communication, empathy, etc.).	□ 1	□ 2	□ 3	□ 4	□ 5
10. I feel able to manage my verbal communication with the patient when faced with incomprehension or conflict.	□ 1	□ 2	□ 3	□ 4	□ 5
11. I feel able to manage my non-verbal communication and my emotions when faced with incomprehension or conflict.	□ 1	□ 2	□ 3	□ 4	□ 5
12. I feel able to conduct a structured interview.	□ 1	□ 2	□ 3	□ 4	□ 5
Self-confidence in preparing and injecting a vaccine ***If I have to vaccinate today:***	**TD**	**D**	**I**	**A**	**TA**
13. I feel able to prepare a vaccine according to the recommendations (dilute and draw).	□ 1	□ 2	□ 3	□ 4	□ 5
14. I feel able to inject the patient into the arm.	□ 1	□ 2	□ 3	□ 4	□ 5
15. I feel able to manage my stress when performing the vaccination procedure.	□ 1	□ 2	□ 3	□ 4	□ 5
16. I feel able to manage the patient's stress before being vaccinated.	□ 1	□ 2	□ 3	□ 4	□ 5
17. I feel comfortable touching the patient to perform the vaccination procedure.	□ 1	□ 2	□ 3	□ 4	□ 5
18. I feel able to communicate with the patient during the vaccination procedure.	□ 1	□ 2	□ 3	□ 4	□ 5

Self-confidence in managing adverse events (AEs) potentially occurring after vaccination	**TD**	**D**	**I**	**A**	**TA**
19. I feel able to recognize vasovagal syncope.	□ 1	□ 2	□ 3	□ 4	□ 5
20. I feel able to manage vasovagal syncope.	□ 1	□ 2	□ 3	□ 4	□ 5
21. I feel able to recognize anaphylactic shock.	□ 1	□ 2	□ 3	□ 4	□ 5
22. I feel able to manage anaphylactic shock.	□ 1	□ 2	□ 3	□ 4	□ 5
23. I feel able to inject Epipen® into the patient.	□ 1	□ 2	□ 3	□ 4	□ 5
24. I feel able to distinguish vasovagal malaise from anaphylactic shock.	□ 1	□ 2	□ 3	□ 4	□ 5
25. I feel able to act as a team during an IE.	□ 1	□ 2	□ 3	□ 4	□ 5
26. I feel able to manage my verbal communication when an IE occurs.	□ 1	□ 2	□ 3	□ 4	□ 5
27. I feel able to manage my nonverbal communication and my emotions when an IE occurs.	□ 1	□ 2	□ 3	□ 4	□ 5
28. I feel able to call for help adequately.	□ 1	□ 2	□ 3	□ 4	□ 5

Appendix D: OSCE analytical checklist

Situations	Expected student behaviours/responses	Max	Points *	Patient comments
Reception of the patient	- Hello Madam/Sir - [Patient identity check = bonus] - Explain how the vaccination procedure will take place: o Perform the injection in the arm o Monitor for 15 minutes after vaccination - Choose the appropriate arm and/or the one chosen by the patient to perform the injection	/3		[Hello, yes, it's me. I'm here for my booster dose.] How will the vaccination take place? I am right-handed (→ the student is expected to offer to inject on the left)
Preparation of the Covid-19 vaccine	- Hand hygiene - Homogenization of the Pfizer® vaccine vial (vertical) - Visual inspection of the appearance of the liquid: clarity, absence of particles - Disinfects the rubber cap with the alcohol swab (30 sec) Takes 0.3 mL of Pfizer® vaccine dose while respecting hygiene and asepsis - Recaps the syringe, taking care not to prick yourself - Identifies the syringe with a label that he fills out correctly (name of the vaccine, batch number, expiration time) - Prepares and places all the equipment necessary for the vaccination procedure in a kidney-shaped basin	/8		
Injection of the Covid-19 vaccine	- Hand hygiene - Take the injection marks (4 fingers from the acromion or inverted triangle) - Uncap the syringe, taking care not to prick yourself - Stretch the skin - Prick at 90° with a sure and rapid movement - Quickly inject the product (if necessary, stabilize the syringe) - Correctly dispose of the needle and syringe in the yellow container - Compress with a dry swab - Put on the dressing	/9		Calm and reassured patient *"I'm not stressed, you know, everything went well for my previous doses."*
General communication with the patient	- Communicates adequately throughout the vaccination procedure - Warns the patient of the actions to be taken - Remains calm	/3		
Knowledge about side effects	- Investigate: ask what AEs occurred - Note that the patient is confusing the AEs - Can explain vasovagal malaise: clammy skin, paleness, blurred vision, feeling dizzy and feeling hot - Can explain anaphylaxis: sudden onset: Rash, hot and red skin, wheezing, oedema, massive hypotension - Can explain vasovagal malaise management: Lay the patient on their back, raise the patient's legs and monitor the patient - Can explain anaphylaxis management: lay the patient on their back with their legs raised, call 112, Epipen® injection	/6		During post-vaccination monitoring, the patient wonders about the adverse effects. - "*My sister had an allergic reaction after her 2nd dose of vaccine, she suddenly became very hot and fainted*." - "*And how should we react in these cases?*"