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COMMENT

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New pedagogical tools for vaccine education: preparing future healthcare workers for the next pandemic

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Abstract

Vaccine hesitancy (VH) is an issue for healthcare students, influenced by safety concerns and misinformation. The need for better communication training and understanding sociocultural factors in VH was highlighted in a European University Alliance seminar. Practical exercises like simulation role-playing, interprofessional collaboration, and digital literacy may improve vaccine education.

Keywords Vaccine hesitancy, Vaccination, Healthcare students, Health education, Vaccine education, Simulation, eHealth literacy

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Introduction

In the context of the recent COVID-19 pandemic vaccine hesitancy (VH) has once again been brought to the forefront. In 2019, before the pandemic, WHO listed VH as one of the top ten threats to global health along with e.g., climate change. Since then, we have witnessed heated vaccine debates in the public. VH is the motivational state of being conflicted about, or opposed to, getting vaccinated [1]. One way to describe vaccine hesitant individuals is that they are located on a continuum between acceptance and refusal [2]. VH is influenced by factors such as 'complacency, convenience and confidence' [3]. These categories – the 3 C's – have framed a menu of survey questions to help understand and address VH [4]. More recently, additional domains including collective responsibility, calculation, social conformism and confidence in the wider system have been added to this multifactorial model, also referring to vaccine readiness or acceptance, rather than hesitancy [5, 6].

VH represents an urgent challenge for educators of health care (HC) professionals. Young HC students will become our future HC professionals who will meet, treat and advise patients on vaccination. In addition, they may also be engaged in the promotion of vaccines during vaccination campaigns. In the light of experiences drawn from an international, multidisciplinary network (the European University Alliance for Global Health) addressing challenges regarding VH among HC students, the aim of the present article is to document and to better understand VH in this population; and, then, to propose strategies for enhancing pedagogical tools in addressing VH in HC education.

Understanding VH among healthcare students

Addressing VH appears to be crucial for the protection of populations, particularly in the context of emerging infectious disease risks. This was illustrated during the COVID-19 pandemic: the vaccination campaigns began in a context of a rather low acceptance in the general population worldwide [7]. In this context, four systematic reviews focused specifically on vaccine acceptance / hesitancy among HC students during the pandemic [8–11]. In the systematic review by Patwary et al. (2022) including 31 observational studies, the mean VH rate among HC students was 25.8%. The studies included were conducted in USA, South America (Brazil), Europe (Italy, Poland, Slovenia, Romania), Middle East (Iraq), Africa (Uganda, Ethiopia, Egypt) and Asia (China, India, Kazakhstan). Overall, data on VH in European HC students remain scarce and did not concern nurses, midwives or physiotherapists. For instance, in France, VH was estimated at 45% among HC students at the beginning of the COVID-19 vaccination campaign in February 2021 [12]. Reasons given by HC students and professionals were

related to uncertainty around vaccine safety and lack of knowledge about the vaccination. In addition, there were substantial differences in VH between *curricula*, with a higher vaccination acceptance among medical students. These differences are reflected across HC professions and result in varying vaccination coverages, as can be observed with the seasonal flu vaccination coverage [13].

Exploring factors associated with VH among HC students, provide better insight into this multidimensional complex topic (socio-cultural, educational, professional, psychological, political, etc.). In the general population, major factors found to be associated with VH towards COVID-19 vaccines in different countries were concerns regarding vaccine safety, fear of side effects, low vaccine confidence and low trust in governments, HC professionals, vaccine production companies, and lack of vaccine information. Further, rumours and misinformation on COVID-19 vaccines that were spread through social media platforms contributed to increasing VH [14]. Similarly, COVID-19 vaccine intention among health care professionals in France was related to perceptions around the individual benefit-risk balance, the relation with the employer, and of vaccination as a collective action to stop the epidemic [15]. Reasons for VH among medical students follow these general patterns, and is reported to include concerns regarding vaccine efficacy and safety, beliefs in acquired immunity, social behaviour, misinformation, disbelief in public health experts and in the pharmaceutical industry [8, 11]. In the systematic review by Patwary et al., only one factor, i.e., concerns about potential side effects of vaccines, was significantly associated with lower acceptance rates [10].

In Sweden, a country with high vaccine uptake, it was reported that in 2020 the majority of vaccine-hesitant individuals were primarily young people who declared they would refrain from COVID-19 vaccination because they perceived their risk of severe illness to be low [16]. These findings, in the early stages of the epidemic, even before a vaccine was available, may have helped to emphasize the importance of societal solidarity in communicating the benefits of vaccination [17]. However, available publications did not capture the time variability of VH in relation to vaccination campaigns. Preference studies have shown that protecting patients and the private environment, but also epidemic control, are important vaccine motivation factors for HC professionals [18]. When reflecting on VH among HC professionals, it's also relevant to evocate trust in scientific evidence that may not be necessarily assured and perhaps not even among HC students [19].

Another aspect of vaccine uptake refers to the elusive matter of values. The belief in vaccines as an act of solidarity to maintain public health may collide with other beliefs and values, such as the individual right to make a

free choice. VH is about much more than distrusting vaccines; it signifies behaviours and attitudes comprising a social and cultural identity [20]. This identity is formed in particular milieus, comprising a sense of belonging to both online and offline communities. Certainty is to a large extent socially constructed; what the group to which one belongs consider to be true is true, or one chooses to believe so [21]. Social and cultural knowledge may of course be based on scientific evidences, but it is also based on group constructed faith and beliefs [22]. HC students belong to various cultural groups in everyday life, like everyone else. HC workers disbelief in vaccines are in fact based on similar arguments compared to other citizens' disbelief, where mistrust of pharmaceutical companies due to perceived financial interests, and the perceived lack of communication about side effects stand out as the most common [23]. Hence, what has been termed *vaccilocus* – locally, socially and culturally developed ideas about vaccines at a certain place at a certain time – may challenge the goals of vaccination [22, 24].

HC students, like others in society, may hesitate to vaccinate or promote vaccination for culturally and socially grounded reasons. During their studies, they are taught the scientific evidence supporting the value of vaccination for public health. Teaching is also expected to increase (1) positive vaccine attitudes among HC students; (2) students' knowledge about the social and cultural forces animating VH, as well as (3) students' knowledge of how to empathetically address such hesitancy in clinical contexts.

The role of the University is indeed to provide high quality training to enable HC students to fulfil this role in the future, enhancing pedagogical approaches. Regarding VH, these issues were addressed during a seminar held under the EUGLOH Alliance network in March 2023. The following questions were raised: What do students think about their teaching on COVID-19 and vaccines, and do they express needs for vaccine education? Do they express needs to detect rumours, misinformation (fake news) to increase their digital literacy? Do they express motivation for scenario training? Would interprofessional education be relevant in relation to this topic?

Addressing vaccine education needs

In the literature, only few studies investigated HC students' perceptions regarding their education on vaccination. In an online survey in France 2015–2016, approximately 60% of the HC students felt insufficiently prepared to communicate around topics such as fear of vaccine side effects and VH. Overall, lecture courses were considered insufficient [25]. In a cross-sectional study from Germany the majority of the students were dissatisfied with teaching dealing with vaccine scepticism,

communication strategies and COVID-19 vaccines [26]. The authors concluded that for teaching communication skills to medical students, a practice-oriented vaccine education is recommended. Prior to the seminar, HC students from different *curricula* (nurses, midwives, medical students) participated in a focus group aimed at gathering their perceptions and expectations regarding vaccination education within their respective programmes. Among the key takeaways, there was a consensus on the need to develop skills beyond theoretical knowledge. The students emphasized the importance of being able to identify misinformation (fake news) and to improve their communication skills about vaccination with patients. To achieve this, they expressed the need for practical exercises (such as simulation, role-playing) to be conducted in an interprofessional setting. This approach would not only enhance their knowledge and skills but also foster collaboration and understanding across different health disciplines that may cover different social and cultural backgrounds. In an article detailing a new approach to medical student education called “Argue-To-Learn,” medical students expressed their appreciation for engaging with opposing viewpoints and articulating their own perspectives within a secure and encouraging setting [27]. The exercise demonstrated how engaging in good faith with varying positions on vaccination helped students to think about how to productively address divergent beliefs in clinical encounters. In the following, we will focus on these three pedagogical approaches: digital literacy, the use of simulation, games, and storytelling, and the development of interprofessional education.

Leveraging digital literacy

The digital environment can be seen as a controversial place when addressing vaccination. For instance, most of the fake news concerning COVID-19 were spread through social media boosting VH [28]. However, new technologies offer plenty of solutions to support HC students in learning the benefits of vaccination, and knowing potential side effects to mitigate hesitancy. Digital tools like official health websites, pedagogic videos, and collaborating and sharing platforms, can engage HC students in vaccine-related education. In particular, webinars represent remarkable resources to train them in vaccination services [29].

Among the plethora of information which can be found on the Internet, it is essential that HC students learn how to navigate it, distinguishing between evidence-based information and incorrect data. In other words, HC students are asked to become digitally health literate. Also called eHealth literacy, this concept relates to “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” [30].

HC students can be guided in this process. In academia, HC students should have the chance to build their digital health literacy skills with formal learning from trained educators and online modules.

In addition, HC students will, in their future practice, be in a position where they have the opportunity to inform their patients how to find reliable information on health on the Internet and about official websites. They will also use new technologies for facilitating vaccinations, like apps and emails for recalls, proving that digital tools do not have only drawbacks.

Role of simulation, games and storytelling in vaccine education

HC professionals take an important position among influencers in the vaccine decision making pathway [31]. They are considered trustworthy information sources by parents [32] and can, therefore, be strong influencers. Some feel ill-equipped to engage in conversation around hesitancy [33]. If they are hesitant themselves, this impacts their patients.

The evidence regarding risks and benefits of vaccination is often embedded in technical, complex language. HC professionals and health policymakers may find it hard to detect the stories behind the evidence that are easier to grasp and worth sharing with parents. Providing professionals with storytelling techniques expands their communication toolset. An example of this can be found in “Perspectives on Vaccination”, a thematic overview of evidence and key points from peer-reviewed publications on vaccination, intertwined with a comic book narrative of a group of gardeners aiming to keep their gardens healthy [34]. For each of the 26 main themes around vaccination, the illustrated story provides the reader with a 1-page analogy of the relevant technical concepts that may help communicate such evidence to non-specialized target groups.

It is essential for HC students to understand the complex landscape surrounding vaccination, which involves a broad array of professional stakeholders, including ministries, national institutes, medical associations, HC managers, regulators, manufacturers, media, and patient organizations. To ensure the successful implementation of vaccination programmes, it is critical for these entities to collaborate effectively. HC students should also be aware of the importance of being intimately familiar with the various positions and dilemmas related to vaccination policy among these stakeholders. They should be trained to listen and understand why people resist vaccination, not just how to encourage them to vaccinate. This type of learning is expected to develop advanced communication skills and interpersonal empathy, which enhance HC students ability to connect with people across a range of vaccine practices and viewpoints [35].

The Vaccination Policy Dilemma Game “Play your part” brings stakeholders together to simulate policy choices in vaccination [36, 37]. The game mechanics simulate how different policy proposals might influence the Key Performance Indicators of the WHO Global Vaccine Action Plan 2011–2020.

Students aim to become the health professionals of the future. Challenging their creative thinking about dealing with the complexity of hesitancy and the stakeholders in that field may be achieved by learning games in the curriculum as seen on other health issues such as the collaborative epidemic response game FluFighters™ that is embedded in the curriculum of medical students at several Dutch, British and Austrian universities since 2018 [38].

Interprofessional education

In a scoping review of education interventions to address effective communication with vaccine hesitant patients, Lip et al. highlighted that the distribution of educational interventions did not adequately address nursing and pharmacy disciplines [39]. This finding raises the question about the need of interprofessional education approaches on this point. However, only a minority of the studies included in the review focused on HC students. In academia, health education programmes are often highly compartmentalized, yet the topic of vaccination calls for a more integrated approach. This integration could be facilitated by introducing new, shared courses that encourage dialogue among students from various health disciplines, fostering the development of shared understandings and perspectives. Such an interdisciplinary approach is vital for addressing the complex challenges of vaccination, as it promotes collaborative learning and a holistic view of HC challenges. Given the importance of this topic, the implementation of new pedagogical approaches cannot rely solely on the initiatives of educators from various disciplines but must be also supported by the institutional backing of the University as a whole. In health faculties, this particularly involves developing a university environment that fosters interprofessionalism as introduced by D'Amour et al. [40], and in accordance with existing guidelines [41].

Considering the previously mentioned challenges, such as the need to enhance digital literacy, promote interprofessional collaboration, and the advantages of simulation-based training, we propose translating these challenges into specific pedagogical objectives and corresponding strategies (Table 1). These pedagogical approaches are not exhaustive. Although we have discussed a wide range of approaches, a comprehensive review across the different healthcare study programmes, as well as in various contexts (particularly in different countries), could be

Table 1 Pedagogical objectives and approaches for a vaccination education programme among healthcare students

Pedagogical objectives	Pedagogical approaches / tools	Examples
Enhance theoretical knowledge about vaccination and public health*	Lectures and seminars	Interactive lectures covering immunology, vaccine development, and epidemiology
	Online learning modules	Online courses providing up-to-date information on vaccination schedules and public health impacts using platforms like Coursera or edX
	Case study analyses	Reviewing historical and contemporary case studies on vaccination programmes and their outcomes to understand real-world applications and challenges
Improve understanding of factors contributing to vaccine hesitancy	Role-playing and simulations	- Simulated patient interviews where students identify and address various reasons for vaccine hesitancy, such as cultural beliefs, past experiences, or misinformation - Role-playing exercises where students explore and confront their own hesitations or doubts about vaccination, fostering self-reflection and critical thinking
	Group discussions and reflective exercises	Facilitated discussions analysing psychological, social, and cultural factors and facilitators influencing vaccine acceptance, followed by reflective essays on strategies to build trust and confidence in vaccination
Develop effective communication skills regarding vaccination	Communication skills workshops	Workshops focused on motivational interviewing techniques and empathetic listening to effectively discuss vaccination with patients
	Storytelling and content creation exercises	Assignments where students create informative and relevant stories or multimedia presentations that convey the importance of vaccines to diverse audiences
	Interprofessional education (IPE) sessions	Collaborative sessions with medical, nursing, pharmacy, physiotherapy, and public health students... to practice and improve communication strategies across different healthcare roles
Strengthen ability to identify reliable information and counteract vaccine misinformation: leveraging digital literacy	Digital literacy training	Training sessions on evaluating the credibility of online sources and recognizing common patterns of misinformation
	Social media engagement and analysis	Activities involving analysis of vaccine-related reliable content on platforms like X (formerly Twitter), like the NEJM account (@NEJM), and YouTube, like Johns Hopkins Bloomberg School of Public Health channel, to better identify misinformation, followed by creating evidence-based responses or educational content
	Problem-based learning scenarios	Working through scenarios where students must develop strategies to address and correct misinformation circulating within a community or patient population

* This pedagogical objective serves as a prerequisite for training on vaccination and is not directly addressed in this article, which primarily discusses new pedagogical tools

conducted and would provide a complete overview of the pedagogical approaches to prioritize.

Conclusions

All these elements underscore the importance of tackling VH among HC students, particularly in anticipation of future pandemics, to adequately prepare them for their pivotal roles in HC workforce. It requires concerted efforts to educate HC students about VH, which entails providing them with a deeper understanding of social and cultural factors, along with enhancing their digital health literacy skills. Therefore, it is important that HC *curricula* incorporate effective teaching strategies, such as simulation-based learning and fostering interprofessional debates within a supportive environment. Achieving this objective needs interdisciplinary collaborations and research, the implementation of innovative pedagogical approaches, and subsequent evaluation of these tools and methods to ensure their effectiveness and adaptability.

Abbreviations

HC Healthcare
VH Vaccine hesitancy

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Data availability

No datasets were generated or analysed during the current study.

Declarations

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Competing interests

The authors declare no competing interests.

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References

- SAGE Group W. Summary WHO SAGE conclusions and recommendations on Vaccine Hesitancy [Internet]. <https://www.who.int/docs/default-source/immunization/demand/summary-of-sage-vaccinehesitancy-en.pdf>
- Larson HJ, Jarrett C, Eckersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. *Vaccine*. 2014;32(19):2150–9.
- MacDonald NE, SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. *Vaccine*. 2015;33(34):4161–4.
- Larson HJ, Jarrett C, Schulz WS, Chaudhuri M, Zhou Y, Dube E, et al. Measuring vaccine hesitancy: the development of a survey tool. *Vaccine*. 2015;33(34):4165–75.
- Oudin Dogliani D, Gagneux-Brunon A, Gauchet A, Bruel S, Olivier C, Pellissier G, et al. Psychometric validation of a 7 C-model of antecedents of vaccine acceptance among healthcare workers, parents and adolescents in France. *Sci Rep*. 2023;13(1):19895.
- Betsch C, Schmid P, Heinemeier D, Korn L, Holtmann C, Böhm R. Beyond confidence: development of a measure assessing the 5 C psychological antecedents of vaccination. *PLoS ONE*. 2018;13(12):e0208601.
- Mengistu DA, Demmu YM, Asefa YA. Global COVID-19 vaccine acceptance rate: systematic review and meta-analysis. *Front Public Health*. 2022;10:1044193.
- Geng H, Cao K, Zhang J, Wu K, Wang G, Liu C. Attitudes of COVID-19 vaccination among college students: a systematic review and meta-analysis of willingness, associated determinants, and reasons for hesitancy. *Hum Vaccin Immunother*. 2022;18(5):2054260.
- Lin GSS, Lee HY, Leong JZ, Sulaiman MM, Loo WF, Tan WW. COVID-19 vaccination acceptance among dental students and dental practitioners: a systematic review and meta-analysis. *PLoS ONE*. 2022;17(4):e0267354.
- Patwary MM, Bardhan M, Haque MZ, Sultana R, Alam MA, Browning MHEM. COVID-19 Vaccine Acceptance Rate and its factors among Healthcare students: a systematic review with Meta-analysis. *Vaccines (Basel)*. 2022;10(5):806.
- Venkatesan K, Menon S, Haroon NN. COVID-19 vaccine hesitancy among medical students: a systematic review. *J Educ Health Promot*. 2022;11:218.
- Gautier S, Luyt D, Davido B, Herr M, Cardot T, Rousseau A, et al. Cross-sectional study on COVID-19 vaccine hesitancy and determinants in healthcare students: interdisciplinary trainings on vaccination are needed. *BMC Med Educ*. 2022;22(1):299.
- Vaux S, Fonteneau L, Péfau M, Venier A-G, Gautier A, Altrach SS, et al. Vaccination against influenza, measles, pertussis and varicella in workers in healthcare facilities in France: a national cross-sectional study in 2019. *Vaccine*. 2023;41(3):812–20.
- Romate J, Rajkumar E, Gopi A, Abraham J, Rages J, Lakshmi R, et al. What contributes to COVID-19 vaccine hesitancy? A systematic review of the psychological factors Associated with COVID-19 vaccine hesitancy. *Vaccines (Basel)*. 2022;10(11):1777.
- Moirangthem S, Olivier C, Gagneux-Brunon A, Péllissier G, Abiteboul D, Bonmarin I et al. Social conformism and confidence in systems as additional psychological antecedents of vaccination: a survey to explain intention for COVID-19 vaccination among healthcare and welfare sector workers, France, December 2020 to February 2021. *Eurosurveillance* [Internet]. 2022 Apr 28 [cited 2024 May 24];27(17). <https://www.eurosurveillance.org/content/https://doi.org/10.2807/1560-7917.ES.2022.27.17.2100617>
- Lindvall J, Rönnerstrand B. Challenges for public-service delivery: the case of Covid-19 vaccine hesitancy. *J Eur Public Policy*. 2023;30(12):2601–22.
- Patzina A, Dietrich H. The social gradient in COVID-19 vaccination intentions and the role of solidarity beliefs among adolescents. *SSM Popul Health*. 2022;17:101054.
- Godinot LD, Sicsic J, Lachatre M, Bouvet E, Abiteboul D, Rouveix E, et al. Quantifying preferences around vaccination against frequent, mild disease with risk for vulnerable persons: a discrete choice experiment among French hospital health care workers. *Vaccine*. 2021;39(5):805–14.
- Hausman BL. *Anti/Vax: reframing the vaccination controversy*. Cornell University Press; 2019. p. 275.
- Goldenberg M. Vaccine Hesitancy: Public Trust, Expertise, and the War on Science. 2021.
- Hammarlin M-M, Kokkinakis D, Borin L. COVID-19 vaccine hesitancy: a mixed methods investigation of matters of life and death. *jdscr*. 2023;5(4):31–61.
- Hammarlin M-M. This is home: Vaccination hesitancy and the meaning of place. *Ethnologia Scand*. 2022;52:202–20.
- European Centre for Disease Prevention and Control (ECDC). Vaccine hesitancy among healthcare workers and their patients in Europe [Internet]. 2015 [cited 2024 May 24]. <https://www.ecdc.europa.eu/en/publications-data/vaccine-hesitancy-among-healthcare-workers-and-their-patients-europe>
- Larson HJ, de Figueiredo A, Xiaohong Z, Schulz WS, Verger P, Johnston IG, et al. The state of Vaccine confidence 2016: global insights through a 67-Country survey. *EBioMedicine*. 2016;12:295–301.
- Kernéis S, Jacquet C, Bannay A, May T, Launay O, Verger P, et al. Vaccine Education of Medical students: a Nationwide cross-sectional survey. *Am J Prev Med*. 2017;53(3):e97–104.
- Baessler F, Zafar A, Mengler K, Natus RN, Dutt AJ, Kuhlmann M, et al. A needs-based analysis of teaching on vaccinations and COVID-19 in German Medical Schools. *Vaccines (Basel)*. 2022;10(6):975.
- Foy AJ, Vrana KE, Haidet P, Hausman BL, Adams NE, Ropson I, et al. Student perceptions of a New Course using argumentation in Medical Education. *Adv Med Educ Pract*. 2023;14:989–98.
- Puri N, Coomes EA, Haghbayan H, Gunaratne K. Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. *Hum Vaccines Immunotherapeutics*. 2020;16(11):2586–93.
- Odono A, Gianfredi V, Sorbello S, Capraro M, Frascella B, Vigezzi GP, et al. The Use of Digital Technologies to support vaccination programmes in Europe: state of the Art and Best practices from experts' interviews. *Vaccines*. 2021;9(10):1126.
- Norman CD, Skinner HA. eHealth literacy: Essential Skills for Consumer Health in a Networked World. *J Med Internet Res*. 2006;8(2):e9.
- European Centre for Disease Prevention and Control (ECDC). Let's talk about protection: enhancing childhood vaccination uptake [Internet]. 2016 [cited 2024 May 24]. <https://www.ecdc.europa.eu/en/publications-data/lets-talk-about-protection-enhancing-childhood-vaccination-uptake>
- Smith LE, Amlöt R, Weinman J, Yiend J, Rubin GJ. A systematic review of factors affecting vaccine uptake in young children. *Vaccine*. 2017;35(45):6059–69.
- Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine hesitancy and healthcare providers. *Vaccine*. 2016;34(52):6700–6.
- Bosman A. Publish Online [Internet]. [cited 2024 May 24]. <https://www.transmissible.eu/services/public-health-storytelling-2>
- Hausman BL. Against misinformation, on education Journal for research and debate [Internet]. 2020 [cited 2024 May 31];3(8). https://www.pedocs.de/frontdoor.php?source_opus=23071
- Bosman A. Play Your Part-Vaccination – PANDEMOS [Internet]. [cited 2024 May 24]. <https://pandemos.eu/portfolio/play-your-part-vaccination/>
- European Health Forum. EHFG 2019 Conference Report. 2019;34.
- Bosman A. FluFighters™ – PANDEMOS [Internet]. [cited 2024 May 24]. <https://pandemos.eu/portfolio/flufighters/>
- Lip A, Pateman M, Fullerton MM, Chen HM, Bailey L, Houle S, et al. Vaccine hesitancy educational tools for healthcare providers and trainees: a scoping review. *Vaccine*. 2023;41(1):23–35.
- D'Amour D, Oandasan I. Interprofessionalism as the field of interprofessional practice and interprofessional education: an emerging concept. *J Interprof Care*. 2005;19(Suppl 1):8–20.
- Zorek JA, Ragucci K, Eickhoff J, Najjar G, Ballard J, Blue AV, et al. Development and validation of the IPEC Institutional Assessment Instrument. *J Interprofessional Educ Pract*. 2022;29:100553.

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