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Key factors in complex public health interventions to address vaccine hesitancy using a multidisciplinary approach: the VAX-TRUST project

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Abstract

The VAX-TRUST project addresses vaccine hesitancy in seven European countries with a systematic and evidence-based approach. Interventions, targeting healthcare professionals, draw from behavioural and social theories. A checklist, inspired by the TIDieR (Template for Intervention Description and Replication), ensures a detailed description of actions, transparency and replicability. The intervention development process begins with collaborative meetings and systematic revisions, concluding with external evaluations for replicability in diverse public health contexts. This study aims to provide valuable insights for future complex interventions in public health, based on lessons learnt to reduce the risk of vaccine-preventable diseases. The analysis of educational interventions within the VAX-TRUST project has led to the definition of precise guidelines to ensure their replicability and adaptation to various contexts, attempting to establish a universally applicable approach. Active participant engagement and consideration of local social dynamics, beyond information transmission, have emerged as key factors to improve intervention effectiveness. Various educational tools and collaboration with academic institutions have contributed to strengthening credibility.

Introduction

In public health, designing and implementing complex interventions require a structured and well-defined approach based on the interconnection of heterogeneous elements, often of an interdisciplinary nature, shaping the course of these interventions and providing targeted guidance to address the specific challenges of the healthcare sector [1, 2]. In Europe, vaccine hesitancy represents a critical challenge that hinders the promotion of vaccination and public health protection, manifesting as mistrust or reluctance towards vaccinations, fuelled by concerns about safety, efficacy or the origin of vaccines [3].

The VAX-TRUST project (Project No. 965280, H2020-SCI1-2020-Single Stage-RTD), involving seven European countries (Belgium, Finland, Italy, Poland, Portugal, Czech Republic and the United Kingdom), was conceived as a response to this concerning trend. It aims to systematically address, on the basis of evidence, vaccine hesitancy in Europe, involving a collaborative and multidisciplinary approach that brings together researchers, healthcare professionals, policymakers and other stakeholders [4]. Its main objective is the development and implementation of innovative strategies and practical solutions to tackle vaccine scepticism, adapting to the specific contexts of each country involved [5]. The different interventions are aimed at raising awareness and developing reflexivity in health workers working in the field of immunization, developing effective interaction and communication with parents and children, building trust between health workers and parents and deconstructing the paternalistic approach [6, 7].

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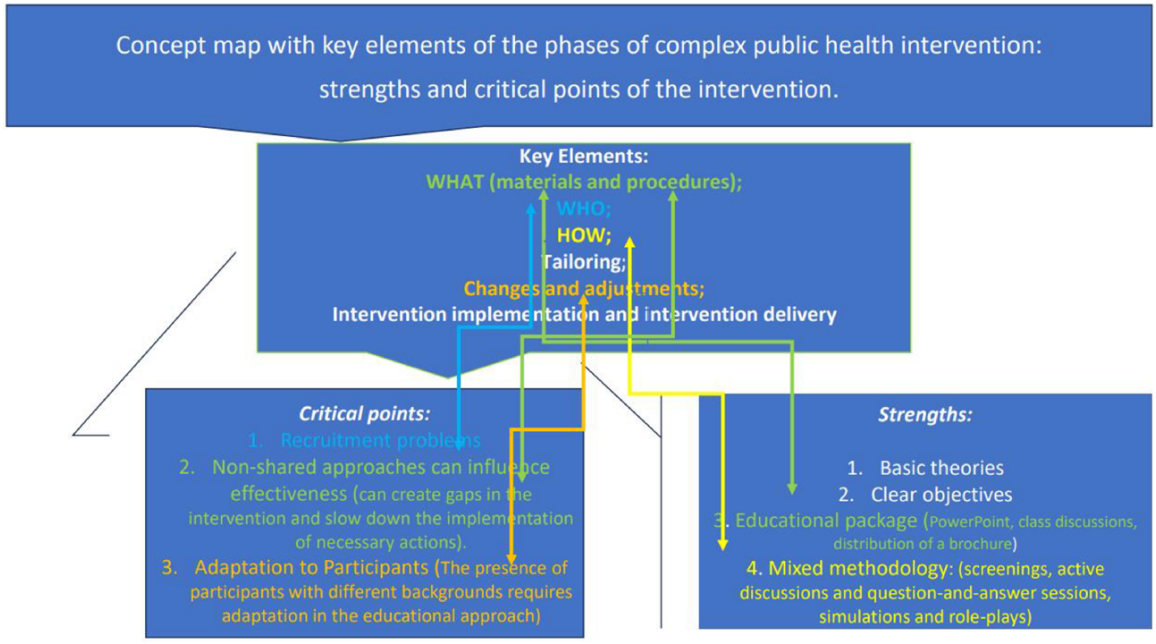

Fig. 1. Concept map with key elements of the checklist for the phases of a complex public health intervention.

The main goal of this article is to produce a comparative synthesis of interventions designed and implemented in the VAX-TRUST project, providing an in-depth analysis of the behavioural and social theories that guided the implementation of complex public health interventions against vaccine hesitancy. Furthermore, it intends to identify and discuss the challenges faced in the implementation of these interventions, with the ultimate goal of providing a model for complex public health intervention against vaccine hesitancy, promoting a more widespread and informed vaccination culture in Europe. In line with the assumptions of the VAX-TRUST project, the general recommendations developed helped to consolidate a proposed planning model presented in the form of a lesson learnt. This will contribute to strengthening public health and reducing the risk of vaccine-preventable diseases.

Materials and methods

The design of interventions targeting healthcare professionals was developed following ethnographic research that analysed national contexts related to vaccine hesitancy, including public perceptions, existing policies and social dynamics surrounding vaccination [8–10]. Concurrently, a systematic review (January–May 2021) mapped the latest initiatives aimed at healthcare professionals addressing vaccine hesitancy and promoting vaccine adoption among patients [11]. Behavioural and social theories such as social worlds theory [12–14], ADKAR [15] and Motivational Interviewing (MI) [16, 17] were identified to tailor interventions to specific contextual needs, complemented by a grey literature review (March–June 2021) from each country. A thorough analysis of available tools led to the creation of a 'Checklist' (July–December 2021), inspired by the TIDieR (Template for Intervention Description and Replication) [18]. This standardized tool facilitates detailed intervention descriptions, enhances transparency and promotes replicability in research within social and health sciences. Adapted to the cultural, social and economic contexts of each country, the checklist serves as a practical guide, enabling a targeted and structured approach to critical aspects of complex public health interventions [1].

During the development process, meetings were organized with all teams in Italy (in Cassino in May 2022 and in Rome in November 2022) to discuss partner intervention plans aligned with the checklist and to outline a shared methodology regarding the goals to achieve, the tools to use and the type of effectiveness evaluation to adopt. Following the Rome meeting, each partner submitted their intervention plan to the team leader (checklist designer) and the evaluation team for review regarding checklist compliance, evaluation methods and tools. Subsequently, intervention designs were finalized, ensuring adherence to the checklist and methodologies specific to contexts and targets.

Once interventions were implemented, adjustments and customizations were made to fit contexts and target groups, including necessary programme changes to achieve intervention goals and enhance efficacy. All teams conducted pre- and postintervention surveys to assess intervention effectiveness and participant satisfaction, primarily using quantitative methods such as knowledge, attitudes and behaviours (KAB), MI, change readiness assessment and pre- and postintervention questionnaires, supplemented by qualitative methods like ethnographic approaches. Finally, an external evaluation by a specialized team was conducted to ensure the replicability of results in public health settings [19, 20].

Results

From the analysis of the country reports and the summary classification of items selected earlier, we can derive some shared issues between the interventions in the different target countries and the choices of the different teams.

We therefore found that some interventions were inspired by specific theories such as social worlds theory (Finland and Belgium) and the ethnographic approach (Italy and Portugal). Other interventions were built on intervention models such as ASPIRE (https://www.nottingham.ac.uk/helmopen/) (Belgium and the United Kingdom) and ADKAR (Portugal) according to the achievable goals. Significant tools that yielded effective results were also adopted, such as World Café and Nominal Group (Italy) [21], KAB (Czech Republic and Poland) and MI (Belgium and Portugal).

Two out of seven partner regions used mixed methods of intervention: Finland and the Czech Republic used in-person educational sessions and asynchronous online methods. The group format offered a platform for reflexive discussions and was chosen to support collaborative and peer-to-peer learning in in-person sessions. The educational intervention aimed to provide something novel and unique to the Finnish context in the form of comprehensive in-person sessions that were missing from existing interventions.

Belgium and the United Kingdom implemented their intervention with a hybrid method using both asynchronous educational sessions and digital reusable learning object (RLO) tools. This methodology required collaboration with vaccination health agencies (Belgium) and with university and professional organizations (United Kingdom) and, above all, expert and reliable technical support.

The Italian and Portuguese teams implemented interventions only in-person interventions but accompanied them with educational tools and methods such as the World Café and the Nominal Group (Italy) and focus groups, role play and graphic medicine (Portugal). These two teams applied the ethnographic approach to the educational intervention, working in depth and with a significant involvement of the participants.

The Polish team adopted only asynchronous learning sessions, which they considered most effective for their context where health professionals are few in number compared to the needs of the population and are therefore overworked.

Professionals involved in the educational interventions were predominantly Health Care Professionals (HCPs) but differently distributed with respect to professions and numbers (Fig. 2). The highest involvement of professionals was achieved by Finland in six intervention sessions (235 nurses and a small number of graduate nursing students) and Poland in six sessions (271 nurses and students of Master's programme in nursing, who are already practising the profession).

Intervention in Portugal involved 66 HCPs (17 HCPs involved in the vaccination strategy, 39 HCPs involved in the ethnographic study and 10 students of Master's programme in community nursing). The educational intervention was divided into two sessions.

The Czech Republic team set up three mixed-method intervention sessions, involving 51 HCPs (40 general practitioners for children and adolescents and 11 nurses).

The Italian team involved 36 HCPs (13 doctors, 17 nurses, 4 health visitors and 2 administrative staff members) in one in-person intervention session, combining participatory activities (based on both group and plenary sessions) and lectures. Group activities are shown to be useful for sharing and discussing critical aspects of working/relational practices, as well as solutions to manage them and to overcome the barriers to interacting and communicating effectively.

The Belgian intervention (asynchronous and RLO) was attended by 35 general practitioners and nurses. The Belgian team created the content for the RLO in collaboration with experts from the vaccination agency 'Kind en Gezin'. They determined the topic of each module and created a content list of each module with an overview of the slides and their topic.

Due to factors beyond the team's control in the United Kingdom, the asynchronous educational intervention RLO was implemented later than the planned schedule. As a result, user interaction analysis data are partial (625 views with an average duration of 5 min), and only at the end of the intervention scheduled for late February 2024 will a more realistic overview of user activity be available.

To maximize participant engagement, materials were produced and made available online or in person (brochures, questionnaires, videos, presentations, vignettes, RLOs, etc.) and interactive activities such as role play, world café and focus groups were utilized.

	Finland (coordinating country)	Belgium	Czech Republic	Italy	Poland	Portugal	United Kingdom
Type of intervention Online / In-person	In-person educational sessions and asynchronous online learning material	Asynchronous educational online intervention with digital tools, reusable learning objects (RLO).	Asynchronous online survey and in-person intervention + brochure	In-person educational session	Asynchronous online learning session	In-person educational session with focus group, role play methodology and graphic medicine.	Asynchronous RLO and digital learning session
Main target group of intervention	Nurses, postgraduate nursing students	GP's and nurses	General Practitioners for Children and Adolescents (GPCA) and nurses	Doctors, pediatricians, nurses, administrative staff, health visitors	Nurses, students included	HCPs	GPs, GP nurses, health visitors
Implemented interventions (N)	6	3	3	1	6	2	3
Participants, total (N)	235 (169 face-to-face; 66 online)	35	51	36	271	66	625 page views of the RLO
Participants per intervention (N)	1. (15) 2. (56) 3. (62) 4. (35) 5. (67) 6. (8)	Not reported	40 GPCAs 11 nurses	36 HCPs 13 doctors 17 nurses 4 health visitors 2 members of the administrative staff.	Not reported	17 HCPs involved in the vaccination strategies. 39 HCPs involved in the ethnographic study. 10 Master students of Community Nursing	**Implementation ongoing**

Fig. 2. Number of intervention sessions and number of participants in VAX-TRUST target regions.

Discussion

Through a meticulous analysis of key elements present in checklists adopted and adapted by research team members in various countries involved, we employed a comparative and synthesized approach to the implemented educational strategies. Utilizing a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis [22], along with the results from KAB surveys conducted by researchers at the universities participating in the project, we gained a detailed understanding of similarities, differences, general trends, challenges and dynamics at play.

The direct connection between context analysis, the selection of sociological theories and the implementation of intentions has led to a targeted and adaptable design of complex public health initiatives against vaccine hesitancy within the VAX-TRUST project [11]. A tangible example of this connection was observed in the use of the 'social worlds theory', guiding a flexible and versatile approach that successfully combined asynchronous online learning with in-person sessions (hybrid method) and intervention customization, facilitating collective development on how to address vaccine hesitancy among healthcare professionals [11, 23, 24]. This method seems to have the advantage of combining the benefits of both approaches, allowing direct interaction among participants and continuous access to educational content. Our results align with scientific literature; studies focused on public health emphasize that hybrid learning approaches are associated with better learning outcomes and high user satisfaction [25, 26]. However, it should be noted that research in the field of public health is still limited in this context, with few studies exploring diverse course modalities. Therefore, our study aligns with a growing research context, contributing to emphasizing the value of the hybrid approach in the field of public health.

The innovative approach that combined asynchronous online learning resources with specifically designed RLOs to engage and train healthcare professionals (in Belgium and the United Kingdom) allowed to reach a large number of participants without requiring substantial resources [27]. It enabled users to navigate through proposed scenarios based on their preferences and needs, constituting true strengths. Additionally, the RLO format offers integration possibilities into prominent institutions' training programmes like the National Health Service or the Royal College of Nursing in the United Kingdom, requiring minimal resources, a feature that could amplify the impact and dissemination of educational materials. The advantage of a purely asynchronous intervention, as adopted in Poland, lies in its temporal flexibility, allowing participants to autonomously manage their time for online engagement and access a wide range of available materials and interactive resources. However, this type of intervention requires considerable technical skills and experience; without these, it may not yield the expected results. Moreover, the remote engagement of participants could be fragmented and less engaging.

The ethnographic approach [9, 10] facilitated active participant involvement and understanding of cultural dynamics related to vaccine hesitancy. In-person educational sessions allowed direct interaction among participants, fostering interactive discussions and activities that facilitated sharing key vaccine information and deepened the understanding of the healthcare professionals' ideas and approaches (often paternalistic and not well understood by undecided patients and parents). The participants responded positively to the intervention, demonstrating a favourable impact on

outcomes and confirming its effectiveness in engaging healthcare professionals, as highlighted by experiences in Finland, Portugal and Italy. However, though in-person sessions with participatory methods favoured active engagement, careful management of tensions during discussions on action strategies was necessary to ensure effective discussions. Approaches based on the 'ADKAR Change Model' and 'MI' focused on understanding and promoting changes in participants' attitudes and behaviours. While these approaches seem to have facilitated change, challenges like dropouts and motivation require targeted strategies for effective and continuous intervention. In this case as well, the results of systematic reviews conducted in healthcare professions support our findings, indicating equivalence in achieving learning objectives between online and in-person training [28–30].

Finally, the use of a Likert scale self-assessment questionnaire [31] by the involved countries allowed for a preliminary internal evaluation of the effectiveness of interventions against vaccine hesitancy, comparing participants' knowledge and attitudes before and after the intervention. This paved the way for subsequent assessments of real impact and replicability through external evaluation, within an evidence-based evaluation framework [32, 33]. From the analysis of largely positive results, obtained from internal and external evaluations, some weaknesses emerged, such as the diverse professional backgrounds of participants creating difficulties in planning and their full and continuous involvement, raising concerns about the overall effectiveness of interventions, which were sometimes left incomplete. These challenges have, therefore, guided the formulation of recommendations to improve healthcare professionals' vaccination training. Recommendations are based on the adoption of practical guides, visual resources and online modules focused on essential topics, as well as collaboration with industry experts for periodic updates of educational sessions. Other suggested actions include synchronous online workshops, the creation of a website with reusable materials, the production of thematic podcasts tailored to specific professional audiences and the optimization of educational objectives from the beginning, along with clear instructions for completing questionnaires. Sharing resources, such as informational flyers and a link to the publication of the final report, is equally essential.

Overall lesson learnt

From the analysis of the strengths and weaknesses of various initiatives, several fundamental lessons emerge for achieving effective interventions. It is clear that the success of any intervention hinges on a well-defined strategy. Careful planning, setting clear objectives and choosing the appropriate intervention model are crucial steps to make every aspect of educational interventions more targeted and to establish a solid foundation for effective implementation. Another important aspect is customization. Understanding the specific needs, concerns and knowledge level of the target audience is essential. Adapting interventions to address these factors makes them more relevant and impactful, thereby increasing their effectiveness and achieving more significant results. Regular monitoring of the intervention is also indispensable, as continuous oversight allows for timely adjustments, optimizing effectiveness as circumstances and needs evolve. Active participant engagement is another fundamental element. Encouraging their involvement through discussions, interactive activities and supportive communities not only boosts participant satisfaction but also amplifies the overall impact of the intervention, fostering genuine engagement and deep understanding. Additionally, ensuring accessibility to the intervention for all, overcoming linguistic, cultural and technological barriers, is crucial. To reach a broader audience and effectively respond to diverse needs, offering both online and in-person options and ensuring easy online access to materials are essential. Consulting experts in health sociology and public health further enriches the design and implementation of interventions. Leveraging their experience and best practices enhances intervention effectiveness by refining the adopted approach. Moreover, leveraging strengths identified during implementation is equally essential. By reinforcing positive aspects such as heightened awareness and active participant engagement, future interventions can be further improved, building upon past successes. Addressing weaknesses directly is also essential for continuous improvement. Recognizing challenges and implementing targeted strategies to overcome obstacles, such as improving participation rates or resolving logistical issues, ensure that interventions evolve and maintain their effectiveness over time. These lessons learnt confirm that achieving effective complex interventions in public health is highly challenging, underscoring the importance of strategic planning, customization, ongoing evaluation, active engagement, accessibility, expert consultation, leveraging strengths and addressing weaknesses to achieve a significant and enduring impact on public health initiatives.

Key elements in the checklist: final indications

From the critical analysis of the work done so far, it is clear how important it is to provide clear and detailed guidance to researchers who will be responsible for implementing complex public health interventions. This is crucial not only to ensure successful replication of the intervention by others but also to facilitate

Table I. Strength and weakness categories in the implementation of complex public health interventions

Category	Strengths	Weaknesses
WHAT (materials and procedures)	(i) Clearly defines intervention materials and procedures. (ii) Utilizes educational tools like PowerPoint, discussions and pamphlets for effective participant engagement.	(i) Rigidity in procedures may hinder adaptation to specific contexts or unforeseen changes.
WHO	(i) Clearly identifies target audience for personalized strategies. (ii) Involves stakeholders in development for increased adherence. (iii) Ensures a diverse skill mix within the team.	(i) Incorrect segmentation may exclude beneficial groups. (ii) Lack of necessary skills or unclear roles can affect implementation.
HOW	(i) Uses evidence-based methods to enhance effectiveness. (ii) Incorporates diverse approaches for participant engagement. (iii) Promotes interdisciplinary collaboration.	(i) Complexity and resource requirements may pose implementation challenges. (ii) Variability in professional perspectives may impact consistency.
Tailoring	(i) Adapts interventions to individual or contextual needs for improved relevance. (ii) Increases effectiveness and adherence.	(i) Personalization may demand additional resources and time. (ii) Requires careful planning to avoid overcustomization.
Changes and adjustments	(i) Flexibility in adjusting interventions based on feedback improves relevance over time. (ii) Allows for ongoing improvements and effectiveness.	(i) Frequent changes may cause instability and reduce intervention consistency. (ii) Requires a structured approach to manage changes effectively.

the sharing of best practices and advancements in the field of public health. Considering the strengths and weaknesses of the key elements in the checklist (WHAT, WHO, HOW, Tailoring, Changes and Adjustments) identified in the conceptual map (Fig. 1), it is essential to adapt the approach to the specific context to effectively address the implementation needs of complex interventions. The effective model of a complex public health intervention, focused on addressing vaccine hesitancy, represents the culmination of the work done so far. These guidelines will establish principles for designing and implementing targeted interventions based on data collected from the experiences of the involved countries and methodological guidance for effective implementation. Table I summarizes the strengths and weaknesses of each category identified in the implementation of complex public health interventions.

Conclusion

In conclusion, the analysis of VAX-TRUST intervention implementations reveals that the key to the success of complex public health interventions lies in providing precise and detailed guidance for those responsible. This is crucial to ensure the effectiveness of the intervention itself and its replicability. Replicability, in turn, is essential as it allows for the sharing of best practices and advancements in health education [34]. Particularly, addressing vaccine hesitancy is a complex challenge that demands a tailored approach for each context. The comparison of different intervention models to address vaccine insecurity in participating countries underscores the importance of adapting the intervention model to the specific context, confirming that there is no universally applicable approach [35].

The importance of actively engaging participants and studying local social dynamics highlights that the most effective interventions go beyond mere information transmission. They encourage personal reflection among healthcare professionals rather than relying on a traditional educational approach. The diversification of approaches, using various educational tools such as presentations, humorous videos, simulations and brochures, has proven to be particularly effective in creating an open and welcoming learning environment. This encourages participants to share their perspectives and concerns, engaging a diverse audience and catering to different learning styles, regardless of their baseline knowledge of vaccines or personal experiences [36]. Collaboration with academic institutions and professional organizations has amplified the credibility of interventions, emphasizing the key role of cooperation in overcoming challenges related to vaccine hesitancy [37].

Ensuring universal accessibility, regardless of technological resources, and managing tensions during

discussions have been identified as crucial elements for the success of educational efforts. These factors underscore the importance of an inclusive and attentive approach to local social dynamics to maximize the impact of interventions. The success of any intervention largely depends on the quality of the planning process, which must be based on fundamental assumptions and detailed recommendations for the design, implementation and evaluation of the intervention [20, 38]. Furthermore, referencing the considerations provided by the overall lesson learnt and the key element of the checklist is crucial to ensuring the replicability and effectiveness of interventions in various contexts [35].

This systematic reflection on past experiences provides a solid foundation for guiding future interventions, highlighting the importance of customizing interventions based on local specificities to maximize effectiveness. It promotes an evidence-based approach that can offer valuable insights for policymakers and researchers [39].

Limitations

Currently, research in the field of public health in this specific context is limited: few studies explore various intervention modalities or combinations of educational methods, and even fewer evaluate the impact of such approaches. This lack of evidence represents a critical phase in the process as effectiveness assessment is fundamental to addressing public health issues, such as vaccine hesitancy. Consequently, the generalization of our study's results may be constrained by the absence of similar research. However, it is important to emphasize that it provides a thorough analysis in the context of the growing research on the educational approach for healthcare professionals and could contribute to bridging this gap.

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Conflict of interest statement

None declared.

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