

Co-creating a WeChat Decision Support Intervention to Increase Influenza Vaccine Uptake for Chinese University Students in the UK

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Abstract—Addressing disparities in influenza vaccine uptake among ethnic minority groups requires culturally sensitive interventions and targeted outreach. The co-creation method is a promising tool for tailoring digital games and app interventions to enhance vaccine uptake, particularly among underrepresented groups, such as Chinese university students in the UK. This paper reports a co-creation process for a decision-support intervention aimed at improving influenza vaccine uptake. Through three focus group sessions involving 11 Chinese students, barriers such as knowledge gaps, language issues, and affordability concerns were identified. Participants expressed a preference for clear and factual information that was accompanied by personal experiences. They emphasized the importance of easy-to-follow guidance, as well as vaccination appointment reminders. Based on insights obtained, a co-created multi-component intervention was developed and delivered through WeChat official account at an optimal time agreed upon by the participants. The participants reported a high level of satisfaction, which confirms that the intervention was culturally appropriate and had useful content. This study addresses a literature gap by involving ethnic minority groups in co-designing interventions, resulting in an intervention that has the potential to improve vaccine uptake.

Keywords—co-creation, vaccine uptake, decision-support, intervention design

I. INTRODUCTION

Influenza not only affects individuals' health and lives but also strains the healthcare system and causes economic losses. In the flu season of 2022/23, excess deaths in England associated with flu infection (14,500) surpassed the five-year average (13,500), marking the highest figure in the last five years [1,2]. A modelling study estimated that 2.4 million working adults could contract influenza annually in the UK, leading to a loss of 4.8 million working days and a £644 million economic loss (0.04% of the GDP) [3]. Increasing influenza vaccination uptake is essential, even in seasons with suboptimal vaccine effectiveness, which significantly reduces the burden of illness and eases the strain on the healthcare system [4,5]. Nonetheless, vaccine hesitancy, influenced by a complex interplay of internal and external factors, such as cultural beliefs, trust, misinformation, and vaccine literacy, poses substantial challenges to attaining sufficient vaccine coverage [6–8]. Moreover, persistent disparities, notably among ethnic minority groups, contribute to lower vaccination coverage and increased vulnerability to influenza [5,9,10].

The challenge of increasing influenza vaccine uptake among ethnic minority groups is rooted in diverse socio-

cultural and systemic factors [5], such as language barriers hindering access to evidence-based information and cultural beliefs fostering vaccine hesitancy [11,9]. Limited access to healthcare services and financial constraints add further obstacles, perpetuating healthcare disparities and lower vaccination rates, thus reinforcing the "inverse care law" [12]. Addressing these challenges requires culturally sensitive interventions and targeted outreach efforts to ensure equitable access to vaccination.

Chinese university students studying in the UK (C-UK students) offer an appropriate case study due to their status as the largest cohort of international students in the country [13]. Despite their significant presence and active NHS promotion throughout the influenza season every year, influenza vaccine coverage among this population is comparably low, thus increasing the risk of influenza transmission within this community [14]. While students in the UK are active on social media platforms, there exists a risk of misinformation spreading, thus, tailored interventions are necessary to address this issue [15,16]. Existing studies on interventions to boost influenza vaccination coverage frequently fall short of comprehensively addressing the contextual factors influencing vaccination decisions among specific ethnic groups in the UK [17]. For instance, the Chinese character for influenza is similar to that for the common cold, leading to potential confusion in meanings. Consequently, individuals whose native language is Chinese may perceive influenza as having low severity, making them less likely to receive the influenza vaccine [18,19]. Moreover, current interventions lack consideration for personal preferences. Despite these needs, there remains limited knowledge regarding the specific needs and preferences of this demographic. Understanding these needs is crucial if we are to design user-centred interventions that motivate behaviour change and are both feasible and acceptable to the C-UK students.

Co-creation, as a collaborative strategy rooted in business management literature, offers valuable insights into intervention design processes, particularly among specific demographics [20–23]. Unlike community-based participatory research, it proves beneficial for smaller groups where engaging the entire community may be impractical [25–26]. This approach involves stakeholders capable of contributing to problem resolution and benefiting from innovative solutions, fostering collaboration and collective problem-solving [26]. It has been demonstrated in previous studies that co-creation is a successful approach for developing interventions that help maintain physical and

mental health, as well as promoting healthy behaviours [27]. It has advantages in early stakeholder engagement in real-world settings, enhancing potential dissemination, and facilitating the achievement of expected outcomes [28]. Further, this approach is especially crucial for under-represented groups, such as ethnic minorities, in health research, addressing social exclusion and health inequalities [27]. Thus, co-creation principles could add great value in shaping the research agenda in our case study for improving influenza vaccine uptake among C-UK students.

While co-creation has been predominantly used for designing communication strategies, studies show promising results in enhancing vaccination uptake. For instance, a study conducted in Colombia used a four-phase co-creation method to design a mobile phone intervention with an interactive voice response [29]. Similarly, in Ghana, a co-created infodemic management system supported COVID-19 vaccine rollout efforts [30]. Despite evidence supporting multi-component interventions' potential to influence vaccine behaviour, there's a notable gap in applying co-creation to the design process, highlighting an opportunity for future research to address vaccine hesitancy comprehensively [7, 31].

Hence, given the preceding evidence supporting user-centred design with co-creation, we opted to co-create a multi-component decision support intervention with Chinese university students studying in the UK. Prior knowledge was obtained by conducting a cross-sectional survey study [14]. WeChat, the Chinese social media platform, has been chosen as the primary mode of delivery due to its widespread popularity and supported functionality [32,33]. This paper aims to delineate a new framework for the co-creation process employed in the development of the intervention designed to support decision-making and ultimately improve influenza vaccine uptake within our specified target population.

II. METHODS

We utilized the co-creation approach in conducting focus groups to develop an intervention delivered through WeChat. The study was approved by the University College London Ethics Committee (ref no. 21647/001).

A. Participants

A sample of 11 Chinese University students was recruited by convenience sampling through WeChat. Enrolment criteria were verified through pre-chats to screen participants. Our inclusion criteria were (1) self-identified as Chinese, (2) a Mandarin native speaker, (3) aged 18 or above, and (4) currently an enrolled student at UK university. Three separate focus groups were conducted with the same participants, each lasting a minimum of two hours. Before participation, participants received an email outlining the purpose and objectives of the study. At the beginning of the first focus group, the study protocol was verbally explained, and participants were provided with paper consent forms to review and sign.

B. Co-creation Process

Both the focus groups and co-created intervention sessions took place in a university meeting room. Participants were surveyed to determine the most convenient dates and times for the meetings, and the schedule was adjusted to accommodate the maximum number of participants.

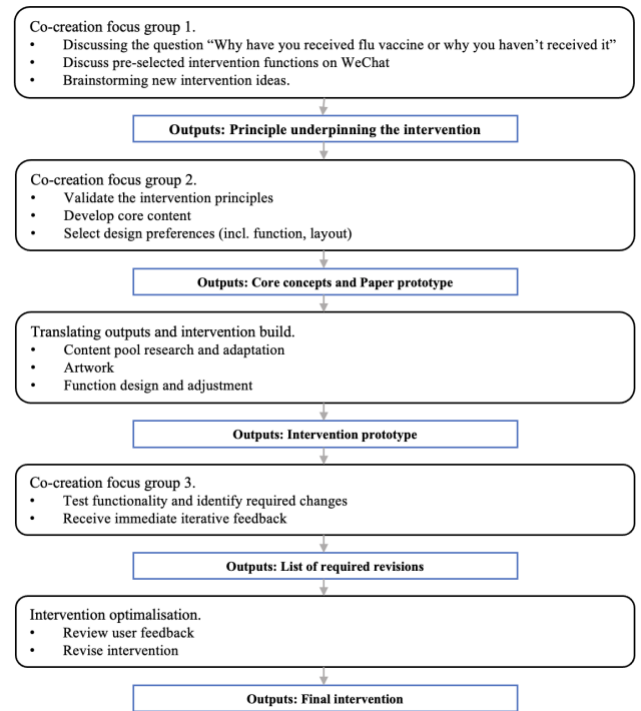


Fig. 1. Flowchart showing intervention design process, methods, and outputs

At the start of each session, the researcher provided introductory remarks, instructing participants to speak freely without using personal identifiers to maintain privacy. A graduate student research assistant was present to assist with note-taking and facilitate discussions. Participants were reminded, in line with the consent form, that the session would be audio-recorded. The co-created ground rules, including guidelines such as active listening, respect for differing opinions, maintaining confidentiality, and allowing equal participation, were established and adhered to ensure a constructive and respectful environment during each session. A data sheet was created to collect information about age, gender, education level, duration of stay in the UK, and influenza vaccine history. The focus group sessions were recorded using a digital voice recorder and notes were taken on paper. A graphic recorder was also present to visually capture the ideas expressed by the participants. To conduct the survey, a digital platform (wenjuanxing.com) was used, and the data collected was securely stored on a server. Fig. 1 illustrates the decision process that outlined the methods employed and outputs derived at each stage.

The initial group session started with a focus group question designed to elicit their personal opinions and considerations regarding the influenza vaccine participants - "Why have you received it or why you haven't received it". It was then moved to what they thought would be helpful for them to make decisions on the influenza vaccination. Subsequently, the researcher demonstrated a 15-minute introduction to the potential functions supported by WeChat, the main channel predefined by the cross-sectional survey [14]. Participants then discussed each function whether they liked it and what might be the challenges. In addition, screenshots of example content were demonstrated, and the participants were able to share their opinions on their preferences. Finally, we discussed the potential framing of the message, for example, whether the use of cartoons, charts, or

emojis would be helpful. Data analysis started after the first focus group, focusing on identifying key themes that informed subsequent sessions. Transcripts were checked for accuracy against audio recordings, and all transcribed data were anonymized, with audio files destroyed after verification. An initial list of themes was reviewed and confirmed by participants, guiding the discussion for the co-created intervention.

The researcher took field notes alongside audio recordings during the focus group sessions. Debriefings occurred after each session between the researcher and research assistant, reviewing field notes to pinpoint preferred content for an intervention. Common themes from field notes and direct observation were listed during the debriefing. The content of the intervention was validated through an iterative process and member fact-checking. In a follow-up session with participants, fact-checking was employed to test intervention components, and brainstorming was used to prioritize the list of preferred interventions.

Two weeks later, the same participants reconvened for a second focus group. The researcher presented an outline of co-created intervention principles, incorporating feedback and preferences from previous sessions. Brainstorming was employed to shape the component and content of the co-created intervention, with the top three recommendations from the group integrated into the intervention design. In addition, participants were queried about their preferences regarding the timing, duration, and format of the intervention. For instance, they were asked: "Do you prefer to receive information in text, graphical, or video format?" and "What types of information are necessary to support evidence-based decision-making on vaccination?". Insights and ideas expressed by participants during the focus groups were incorporated to shape the development of the intervention.

Following the second focus group, the researcher began developing a prototype of the intervention, which was subsequently reviewed with participants during the third focus group session. The third focus group was held one month later to test the functionality and identify required changes. Iterative feedbacks were collected to be addressed in the final optimisation. A satisfaction survey was conducted based on Bowen et al. Field's research [36]. Surveys were disseminated to collect data on participants' overall satisfaction with the intervention, their intention to use it in the future, its appropriateness, and cultural relevance. The questionnaire used a visual analogue scale, with responses ranging from 1 to 10 (very poor to excellent).

After each focus group, participants were given a WeChat Red pocket with a value of £10. Those who attended all three groups received a total of £30. In cases where a participant could not attend the second or third session, we provided the option of a one-on-one appointment with a research staff member lasting 30 minutes to ensure their preferences for the intervention content were considered.

C. Data Analysis

Demographic data were analyzed using R Studio. The audio recordings that were transcribed were verified independently by members of the research team. The lead author and the student assistant led these data analyses, engaging in independent coding before reconciling conflicts collaboratively. The coding results received consensus agreement from the research team. To ensure alignment with

participants' views, the research team, led by the lead author, identified the key themes emerging from the focus group sessions. These themes were then reviewed and approved by the students themselves, ensuring accuracy and relevance to their perspectives [34]. Content analysis, following Miles and Huberman's methods [35], was conducted using NVivo for coding. The research team reached a mutual agreement on the final themes, categories, and codes.

III. RESULTS

A. Social Demographic Details

Of the 15 Chinese students who were contacted by WeChat, 11 were enrolled. Of these participants, 54.5% were male and 45.4% female, with a mean age of 24.8 years and a homogeneous educational background - 18.2% pursuing undergraduate degrees, 63.6% master's degrees, and 18.2% PhD degrees. In terms of the duration of stay in the UK, 45.4% had lived in the UK for one year, 18.2% for 1-2 years, and 36.4% for 3-5 years, with none exceeding 5 years. Notably, 81.8% had never received an influenza vaccine. Eleven participants participated in the first focus group, 10 participated in the second, and 8 participated in the third due to availability. Intentions for future vaccination varied; 9.1% had high intention, 45.4% moderate, 9.1% low, and 36.4% unsure. All participants used WeChat daily, with 54.5% spending over 3 hours per day on the platform. Table 1 displays the demographic characteristics of the sample.

TABLE 1. SOCIO-DEMOGRAPHIC DETAILS OF THE PARTICIPANTS (N = 11)

Characteristics	n	Percentage
Gender		
Male	6	54.5%
Female	5	45.4%
Age (years): Mean (SD)	24.8(2.04)	
Education (currently pursuing)		
Undergraduate	2	18.2%
Master's degree	7	63.6%
PhD degree	2	18.2%
Duration of your stay in the UK		
Within one year	5	45.4%
1-2 years	2	18.2%
3-5 years	4	36.4%
5 years and above	0	
History of Receiving Influenza vaccination		
Yes, within a year	1	9.1%
Yes, a year ago	1	9.1%
Never	9	81.8%
Intention to receive influenza vaccine		
High	1	9.1%
Moderate	5	45.4%
Low	1	9.1%

B. Barriers and Solutions to the Influenza Vaccine

The focus group discussions in focus group 1 yielded six key themes outlining barriers to receiving the influenza vaccine, which have been categorized. For each identified barrier, corresponding solutions have been discussed and proposed by the co-creators. These solutions collectively form a set of intervention principles. Table 2 outlines the various themes related to barriers, proposed solutions accompanied by excerpts, and the linked intervention principles.

TABLE 2. THEMES OF BARRIERS AND SOLUTIONS AND CORRESPONDING INTERVENTION PRINCIPLES

Barriers	Excerpts		Intervention principles
	Barriers	Solutions	
Theme 1: Lack of awareness and understanding			
"Not everyone seems to know how important it is to get vaccinated, which means not many"	"Providing a variety of information is important; we prefer making decisions based on judging the information by ourselves."		Provide diverse, scientifically validated information about the importance of vaccination

people are doing it..."		
Theme 2: Access challenges "Getting to the places where you can get the shot can be a bit of a mission with limited access and weird hours."	"I need to know where I can get vaccinated, preferably with the option for someone to book it for me so I just need to show up."	Providing clear information on vaccination locations, booking appointments in engaging and digestible formats.
Theme 3. Perceived effectiveness "Some of my friends got vaccinated, but still got the flu."	"...any data available to demonstrate its effectiveness...". "Is there anyone else's experience I can refer to?"	Providing evidence of scientific validation and possibly sharing success stories.
Theme 4. Lack of motivation "I always think it (flu vaccine) is not necessary, so I don't have the motivation to take the risk." "Living alone here is tough..." "I always delay receiving it as I think it is not urgent"	"...does this vaccine have any other benefits? like herd immunity" "If getting vaccinated can help prevent illness, I would still want to get vaccinated." "A reminder would be helpful, especially with timeline showing the deadline"	Emphasize the broader benefits of vaccination to instill a sense of social responsibility and motivation. Using the scenario of sick alone may help increase motivation. Personal reminders would be helpful
Theme 5. Concerns about side effects "I'm not sure about the potential side effects, and that's something I'm concerned about."	"Explaining all the side effects clearly would be more helpful..."	Increase transparency by explaining potential side effects clearly
Theme 6. Financial barriers "Money is another thing – it's not always easy for me to shell out for healthcare, including vaccines."	"...discount information might be quite useful..." "Use the discount as the headline, so that people are more willing to click through."	Providing discount information and strategically using discounts to attract individuals, leveraging social platforms for promotion.

C. Co-design Intervention

1) Defining components

Based on the themes presented in Table 2, the focus groups led to the intervention focus on a multi-component approach to support vaccine decision-making. To combat the lack of awareness, strategies involved providing diverse, scientifically validated information on the importance of vaccination. Access challenges were mitigated by offering clear details on vaccination locations, enabling easy appointment booking, and presenting information in engaging formats. Concerns about vaccine effectiveness were addressed by sharing success stories and scientific evidence. To enhance motivation, interventions were suggested to highlight the broader societal benefits of vaccination, provide reminders, and revoke the live-alone fact. To alleviate financial barriers, the use of discount incentives and leveraging social platforms for promotion can encourage individuals to take up influenza vaccination. These were validated in the second focus group session. As a result, a paper-based prototype incorporating the

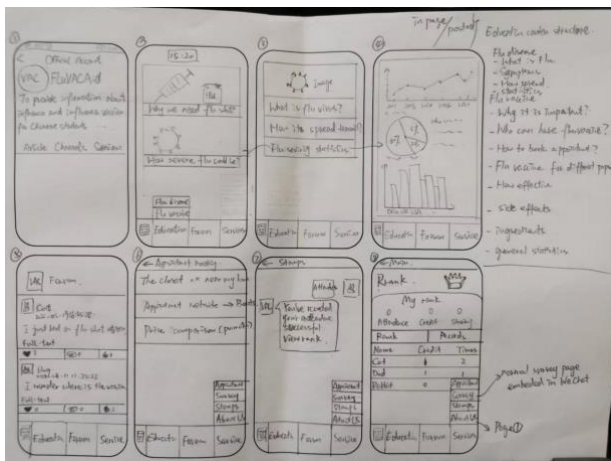


Fig. 2. Paper prototype incorporating intervention principles

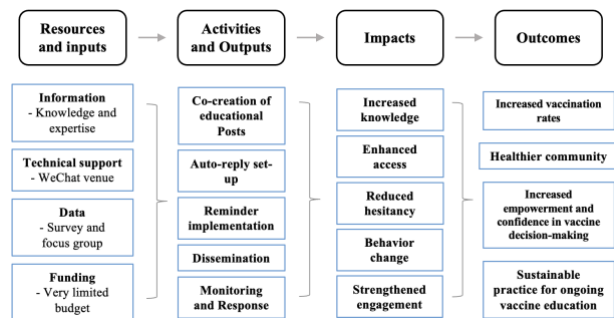


Fig.3. Logic model of the co-created intervention mechanism

principles was generated and discussed in the second focus group, as shown in Fig.2.

As a result, the co-creators identified three crucial components to be included in the intervention: (1) educational posts, such as factual information, vaccine discounts, and shared stories; (2) an auto-reply function to address access barriers by providing targeted information through interactive way, and (3) reminders to prompt action and reduce hesitancy and delays. A logic model, depicted in Fig. 3, was developed to illustrate the functioning of the co-created intervention.

a) Educational posts

The co-creators recognized the crucial role of education within the intervention, understanding that a lack of knowledge and targeted information serves as a primary barrier to awareness and the perceived necessity of the influenza vaccine. It was decided that educational posts would be essential in addressing this barrier, with a focus on providing key information related to vaccine access, such as the location of vaccination centres and booking procedures. Additionally, while direct financial support to overcome financial barriers was not feasible due to budget constraints, the inclusion of discount information in the posts was identified as a practical way to support behaviour change financially. Therefore, the educational component was designed to provide information to increase awareness and the importance of influenza vaccine while also addressing access and financial issues, ensuring a comprehensive approach to promoting vaccination uptake.

b) Auto-reply

The co-creators reached a consensus that implementing an auto-reply function would serve as a practical and efficient method to deliver personalized instructions and support decision-making regarding vaccination behavior. By pre-defining a set of keywords related to vaccination, such as "vaccine booking" or "pharmacy locations," the auto-reply system can swiftly provide tailored responses to users' inquiries or needs. However, the effectiveness of this approach relies heavily on the availability of accurate and up-to-date information. The co-creators emphasized the necessity of conducting prior research to compile a comprehensive list of pharmacies offering vaccination services, along with links to their booking pages and relevant support resources provided by the NHS. This preparation ensures that the auto-reply function delivers accurate and useful information to users, enhancing its overall efficacy in facilitating vaccine uptake.

c) Reminders

It was noted that with a range of academic and social commitments, vaccinations might be neglected by students.

Therefore, timely reminders can be helpful in prompting individuals to take proactive steps towards safeguarding their health. Additionally, the co-creators suggested incorporating educational content into the reminders, such as statistics on the hospitalization rate of influenza annually and research findings on the impact of influenza on university students. In this case, individuals are not only reminded of the importance of vaccination but also equipped with relevant knowledge to make informed decisions about their health. Furthermore, utilizing a graph to illustrate the optimal timeframe for vaccination can serve as a vivid persuasion tool, compelling individuals to take immediate action. This visual representation reinforces the urgency of vaccination and enhances the effectiveness of the reminders in motivating behavior change.

Notably, the other two pre-defined components, forum building and gaming, were decided to be excluded from the intervention following thoughtful consideration and input from the co-creators. They shared insights on the potential drawbacks of these components in promoting influenza vaccination uptake among the target population. Regarding forum building, the co-creators pointed out that building a forum might not yield meaningful engagement as individuals may be hesitant to share their opinions openly. Furthermore, there was a fear that such forums could inadvertently become breeding grounds for spreading anti-vaccine sentiments and rumours, ultimately undermining the intended purpose of the intervention. Similarly, the co-creators questioned the utility of incorporating gaming functionality into the intervention. They argued that while gaming can be an effective tool for promoting certain behaviours, such as physical activity or mental well-being, it may not be well-suited for encouraging vaccination behaviour. Unlike activities that require ongoing engagement and self-involvement, vaccination is typically a one-time action that individuals may not perceive as conducive to gamification. As such, the co-creators deemed the gaming component to be less attractive and potentially less impactful in the context of promoting influenza vaccination uptake.

2) Mode of Delivery of the Intervention

The focus group explored various avenues for dissemination through WeChat, including Shipinhao (a feature for sharing videos) and Xiaochengxu (a function providing API for personal program design). Tuisong (creating an official account in WeChat) was the preferred choice for most participants due to its popularity and high feasibility with low cost. Articles emerged as the primary form of information to be shared through the official account. Participants actively participated in choosing topics, layout details (such as colour and images), article length, content for reminders, and the desired number of articles. They also selected the preferred time of day for the delivery of interventions. Participants noted that students tend to check WeChat more frequently in the late afternoon after completing a day of lectures and seminars. However, their WeChat is often filled with new articles from various official accounts until around 5 pm, which is midnight in mainland China (with a +7 hour time difference). After that time, any new articles are more noticeable until bedtime. Participants expressed a preference for avoiding article dominance in the intervention. They sought more interactive features, including Q&A sections, to enhance engagement. Participants wanted the ability to ask and view others' questions to find peer support. They suggested a concise style with highlights and bullet

points for key messages, and they selected the use of emojis to start and transition the article to make it more attractive and interesting for students.

3) Defining Prioritized Topics

The researchers, in alignment with identified intervention principles, conducted research on relevant content to be included in the co-created intervention. By the end of the second focus group, the list of components and a content pool had been established, encompassing participants' suggestions and concerns. The content pool contains 12 articles distributed across three categories.

In category 1, which focused on factual information, the first article was based on charts and figures from credible sources such as government reports, academic papers, and WHO recommendations. It summarized the mortality rate of influenza in each population and provided reasons for why young adults need the influenza vaccine. Additionally, three articles containing content using Chinese cartoons drawn by another health educational team (WeChat official account: Hunzhi Health) were included. These cartoons aimed to explain why it is important to pay attention to influenza (distinguishing between cold and influenza), how the vaccine works in the human body, and its safety. Specific news regarding influenza in the UK was planned to be translated and included, with the research team monitoring the NHS news and BBC Health News website to add timely information to the intervention.

Category 2 focused on sharing experiences, one article provided information on what to do if catching influenza in the UK, aiming to offer easy-to-understand information on the UK health system to support students in preparing for influenza. Another article shared a student's story of receiving the vaccine recently, including her worries before receiving it and her feelings afterwards. Two articles containing common Q&As asked by the participants were also prepared.

Category 3 centred on guidance, included articles providing step-by-step guidelines with screenshots to navigate pharmacy websites for booking influenza vaccines, with Boots used as an example. Another article discussed how to choose a pharmacy, comparing them in terms of price, opening hours, and booking procedures. A third article recommended common and accessible medicines without prescriptions for influenza in the UK. Finally, an article provided instructions on checking university coupons for influenza vaccines and how to validate them.

4) Final intervention

After the second focus group, the student assistant assisted with the artwork and developed the final agreed components and contents in the WeChat official account. Fig. 4 offers an overview of the components of the intervention, while Fig. 5 visually displays the educational posts in a graphical format.

The components were carefully integrated to work synergistically, maximizing their effectiveness in prompting behavior change. Reminders were strategically paired with pre-designed educational posts to capture the audience's attention. Each educational post included a brief overview of how to utilize the auto-reply function, directing the audience to an interactive page. When the audience engaged with the auto-reply function by sending specific keywords, such as "Boots" (the pharmacy providing influenza vaccines), the



Fig. 4. Overview of the final co-created three-component intervention

system automatically responded with a text message containing a link to the appointment booking website. Subsequently, the audience received an educational post detailing step-by-step instructions for navigating the website. This seamless integration of reminders, educational content, and interactive features aimed to facilitate informed decision-making and encourage uptake of influenza vaccination among the audience.

These articles were scheduled to be sent every Monday, Wednesday, and Friday at 17:30. Each time, one main article contained one piece of information, accompanied by a reminder article with highlighted countdown days for optimal jab in the feature image and title. The order was selected randomly, as participants suggested that following a session-by-session order might diminish students' interest. The reminder article contained information on why the vaccine is needed and where and how to receive it. All articles followed

Category 1: Factual information

- Why you need influenza vaccine using evidence-based information supported by charts and figures from credible sources
- Cartoon #1: Distinguish between influenza and normal cold
- Cartoon #2: How vaccine works in the body
- Cartoon #3: Why vaccine is safe – vaccine history

Category 2: Sharing experiences

- How to manage influenza in the UK: Provides easy-to-understand information about the UK health system
- Personal story of a student receiving the vaccine: Narrates a student's experience before and after receiving the influenza vaccine
- Q&A #1: common questions and answers asked by participants
- Q&A #2: common questions and answers asked by participants

Category 3: Guidance

- Step-by-step guidelines for booking influenza vaccines online: Detailed instructions with screenshots on navigating pharmacy websites for vaccine booking, using Boots as an example.
- Comparison of pharmacies based on criteria such as price, opening hours, and booking procedures
- Recommendations for over-the-counter medicines
- Instructions for checking university vaccine coupons

Fig. 5. Categories of educational posts (Component 1 details)

a standard layout, starting with the main content and ending with links to the previous article, auto-reply guidelines, and references.

5) Satisfaction with the Co-created Intervention

To evaluate participant satisfaction with the co-created intervention, we administered a four-item survey to each participant. In terms of satisfaction with the intervention, all respondents consistently provided scores within the high range of 8-10. Notably, 10 students expressed their intent to use and share the intervention with friends. The appropriateness of the intervention received favourable ratings, with 9 participants assigning scores within the 8-10 range, while 2 respondents rated it at 6. Additionally, the cultural relevance of the intervention received positive feedback, as indicated by scores falling in the 9-10 range from the respondents.

IV. DISCUSSION

This paper presented the intervention design process of a co-created WeChat intervention aimed at increasing the influenza vaccine uptake among Chinese University Students in the UK. Engaging students in the design process of our study empowered participants to drive the intervention's design, shifting the initiative from researchers to the individuals directly involved. Despite the small sample size, there was considerable consistency in the continuous focus groups for collecting responses.

Understanding and addressing the factors impacting influenza vaccination behavior is a complex challenge, particularly among university students who often perceive themselves as a "low-risk" group. Our study, in line with prior research, identifies barriers such as limited vaccine accessibility, the perception of not needing vaccination, and a lack of motivation to receive vaccination [7,8,9,10,11]. Notably, our findings highlight convenience as a crucial factor influencing vaccine uptake, emphasizing the need to address convenience-related issues. Education emerges as a key behavioral technique for promoting vaccination, aligning with previous research demonstrating the impact of individual knowledge on influenza vaccines [38]. Research conducted at a large public university indicated that unvaccinated students, upon gaining knowledge about how influenza vaccination protects young and healthy individuals, showed an enhanced willingness to receive the vaccine [39]. While previous research has shown that enhancing knowledge about protecting close social contacts can boost vaccination plans [36], our study did not reflect this, possibly because Chinese students, living independently without their families, may experience reduced motivation for pro-social vaccine behavior.

Previous interventions predominantly focused on identifying effective strategies to motivate university students to receive the influenza vaccine, with an emphasis on the type of intervention [40, 41]. Notably, conventional incentives like T-shirts, food, or coupons were found to have limited impact [40]. Recommendations from these interventions highlight the preference for information channels such as emails, campus-based events, and online resources [40]. However, there is a notable gap in the literature concerning the design of intervention content and functions. Furthermore, existing interventions primarily employ a top-down approach, drawing from extensive evidence and behavior change theories presumed to be universally applicable [7]. Yet, these

interventions lack end-user involvement in their development. In contrast, employing end-users in the co-creation of public health interventions is believed to enhance adherence and effectiveness by empowering end-users to tailor outcomes to their specific circumstances [26]. This study explores the feasibility of co-creation as a method to inform the design process.

The utilization of a co-created decision support app for university students reflects a novel strategy, leveraging the advantages of uniting individuals with shared commonalities toward a collective goal [20]. However, the current literature lacks in-depth coverage of the development, implementation, and effectiveness of co-created interventions [21], presenting a knowledge gap that our study aims to address through this novel co-creation approach. Further, it is noteworthy that Chinese students studying in the UK are considered an ethnic minority group, suggesting that the application of the co-creation technique in health education could be highly beneficial for this demographic [42]. Systematic review studies emphasize the inadequate reporting of ethnic minority group involvement in co-creation studies and highlighted the necessity for more comprehensive exploration and documentation in this field [27,43]. Our study contributes to this discourse by illustrating that the presence of facilitators and interventionists sharing a similar ethnic background and utilizing their native language can create a more comfortable environment, encouraging participants to disclose information.

The design and development process in this study brought to light certain disparities in priorities between researchers and participants. While previous studies highlight the importance of providing end-users with available, evidence-based, and trustworthy information through eHealth technology, participants expressed conflicting views. Although they acknowledged the necessity of trustworthy information, their emphasis during workshops and usability testing indicated a preference for engaging and appealing content over an abundance of theoretical and factual details about the influenza vaccine and its impact on the human body. This preference could be attributed to the participants' non-medical backgrounds, suggesting that they had previously encountered similar information and were more inclined towards innovative and captivating approaches to convey health-related information.

The co-creation method, while offering significant benefits, also presents challenges. One notable advantage and challenge lies in shared governance over the process, where any interference can potentially lead to misguided results [21,26]. Our study highlights the importance of trust-building over time, aligning with the community-based participatory principle, as demonstrated in the sample of students from the conception of the co-created idea to its implementation. Flexibility is crucial to promote participation, a finding consistent with previous studies [22,24]. However, we encountered difficulties scheduling meetings due to the busy timetable at the university, and the voluntary nature of participation made maintaining a consistent participation rate challenging. Our experience underscores the value of forming a community with a sense of belonging, particularly for freshmen new to the university.

This study provided an example of working with Chinese students in the UK to enhance influenza vaccine uptake, offering valuable insights into engaging ethnic minority

groups to influenza vaccine uptake. However, to comprehensively assess the applicability and efficacy of co-created interventions, additional research is needed. Future studies should expand their focus to diverse demographic samples to test its scalability or adaptability and extend the evaluation over a more extended time frame to understand sustained engagement and long-term effectiveness statistically. The subsequent phases of our project will involve assessing its real-world effectiveness, providing a crucial step in determining its practical impact.

This study has several limitations that warrant consideration. Firstly, the limited number of participants may impact the generalizability of the new framework. The predominance of postgraduate students in the sample could be seen as a convenience sample, although it aligns with the broader demographic composition of Chinese students in the UK, where a majority pursue master's degrees [13]. The potential unfamiliarity among some participants may have inhibited the open sharing of opinions and perspectives. Additionally, the prior participation of some students in an initial survey study raises the possibility that a fresh perspective from individuals unfamiliar with the emerging intervention might have yielded different insights. However, participatory design principles emphasize mutual learning and shared understanding among stakeholders for inclusive decision-making. Furthermore, the intervention development and formative evaluation have their limitations. Not every content, such as news-related information, could be tested in focus groups, and this will be added in the evaluation stage when relevant. However, the consistency of the material in concepts, foundations, authorship, and language across the team led by the same researcher was prioritized over testing every written word. Our primary goal was to gather user feedback on functionality, design, and layout rather than scrutinizing individual content elements.

V. CONCLUSION

This study provides valuable insights into adopting a user-centred co-creation approach for designing a multi-component decision support intervention, to enhance influenza vaccine uptake among Chinese students in the UK. While developing evidence-based interventions with stakeholder involvement can be challenging and resource-intensive, it remains a more effective alternative than pursuing non-evidence-based, non-user-centred interventions. This study serves as a practical example of harmonizing evidence-based content with user-centred requirements, emphasizing mutual learning and shared understanding. Future studies could assess the scalability, adaptability, usability, acceptability, and effectiveness of the intervention in a real-world setting using an experimental design.

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