A randomized controlled trial evaluating an online intervention based on the Trans-theoretical Model in increasing seasonal influenza vaccination among community dwelling people aged ≥65 years

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Acknowledgements

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Outline

- Background
- Objectives
- Methods
- Key results
- Conclusion

Background

Seasonal influenza vaccination (SIV)

--- an important health initiative for older adults

- **Effective in preventing influenza and all-cause mortality among individuals aged ≥65 years**

- **Strongly recommended by the WHO and the Hong Kong Centre for Health Protection (CHP)**
  - All individuals aged ≥65 years should receive SIV once every year
  - All Hong Kong residents aged ≥50 years can receive:
    - Free SIV at public hospitals/clinics
    - Subsidized SIV at private clinics

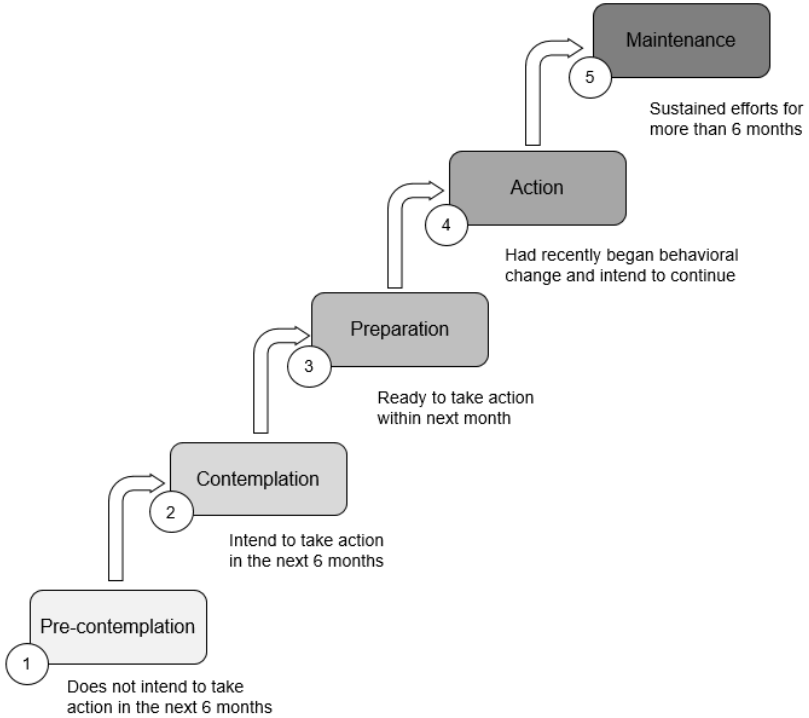
- **Inadequate coverage of SIV among older adults in Hong Kong**
  - **44.7%** in 2020-2021 flu season (CHP, 2023)
  - **40.4%** in 2021-2022 flu season (CHP, 2023)

Constraints of existing interventions promoting SIV for older adults

- Mailing simple and standard reminders --- **small effective size**
- Telephone or face-to-face educational session --- larger effective size but **resource demanding and less sustainable**
- Interventions tailored to one's needs and characteristics are most effective in addressing vaccine fatigue --- **lack of tailored interventions**
- Traditional tailored interventions --- resource demanding (need to assess needs before administrating interventions, prepare different interventions to cater the needs) and difficult to implement at large scale

Stage of changes (SOC)

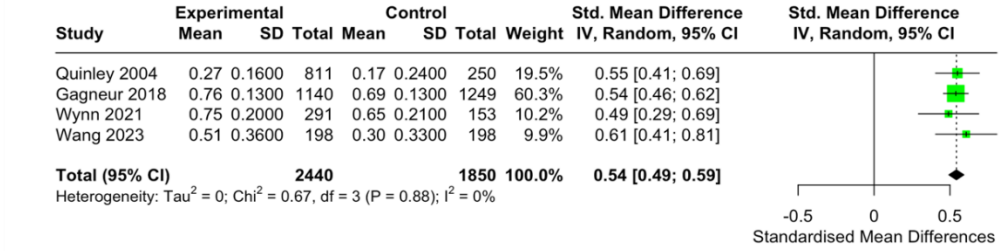
--- The framework to guide our Chatbot

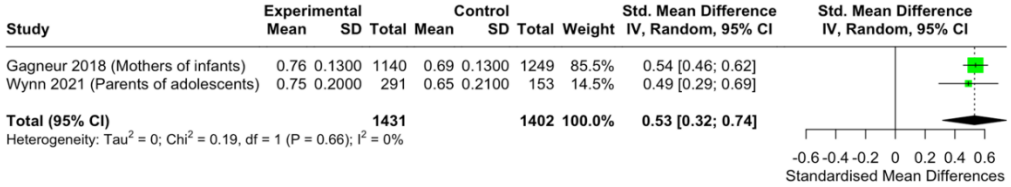


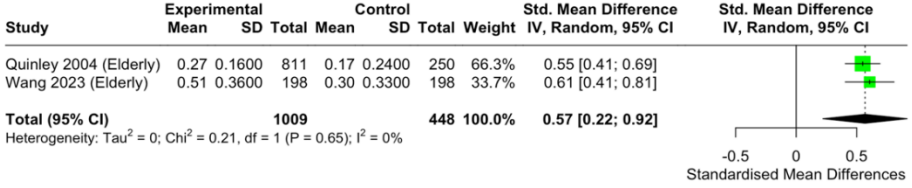
Stage of changes (SOC)

- A core concept of the Trans-theoretical Model
- Different health promotion strategies should be applied for people at different SOC
- Interventions tailored to one's SOC are more effective than non-SOC-tailored interventions, especially among less motivated individuals
  (Noar et al, 2007; Lach et al 2004)

Effectiveness of SOC-tailored interventions in increasing uptake of any type of vaccination



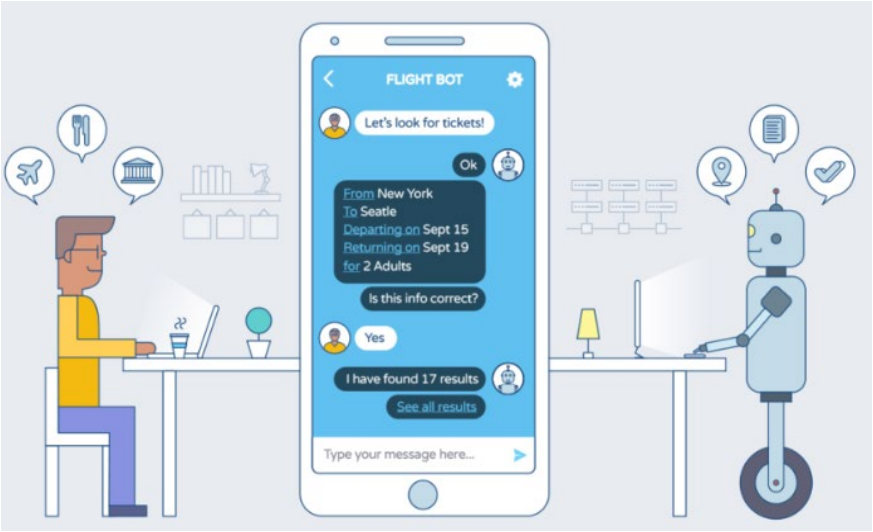




Findings of our meta-analysis

- 3 randomized controlled trials + 1 quasi-experimental study
- SOC-tailored interventions are more effective than non-SOC-tailored interventions or no intervention
- Similar effects applied to the subgroup of older adults

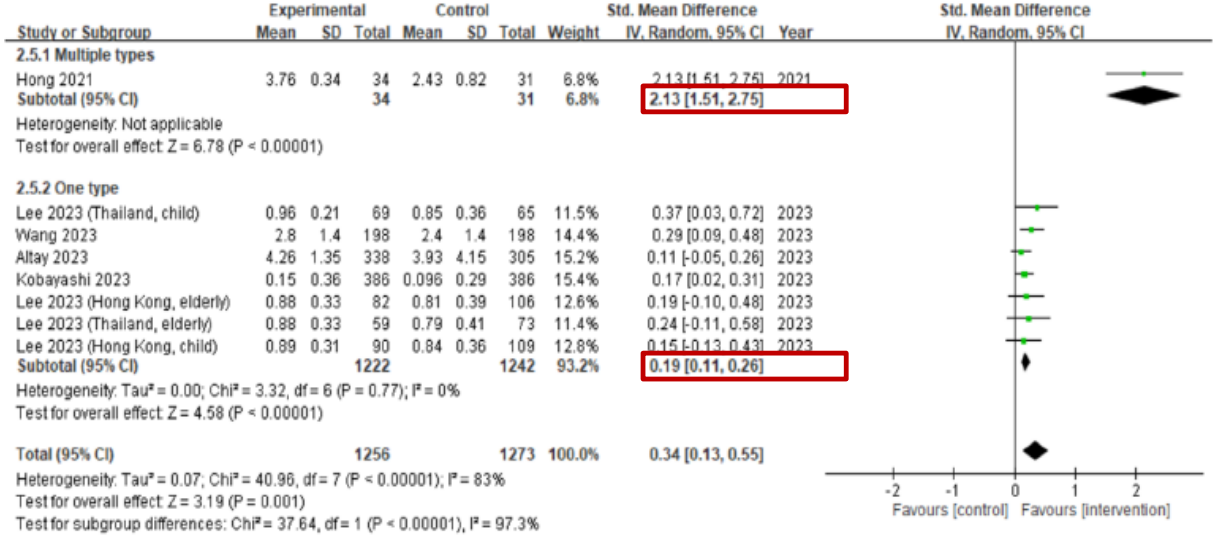
A Chatbot is suitable to deliver SOC-tailored interventions

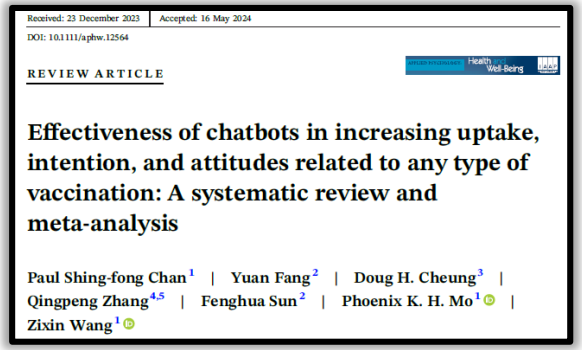


Advantages of Chatbot

- A computerized program that acts to replicate human interaction through text, speech, and visual forms of communication (Singh 2023)
- Proactively interacts with users to improve compliance
- Automatically measure users' SOC
- Automatically select pathway of interventions based on users' SOC
- Suitable to deliver SOC-tailored interventions promoting SIV

Effectiveness of Chatbots in improving attitudes supporting vaccination uptake

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REVIEW ARTICLE

Effectiveness of chatbots in increasing uptake, intention, and attitudes related to any type of vaccination: A systematic review and meta-analysis

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Chatbot-delivered interventions could significantly improve attitudes favoring different types of vaccination

Objectives and hypothesis

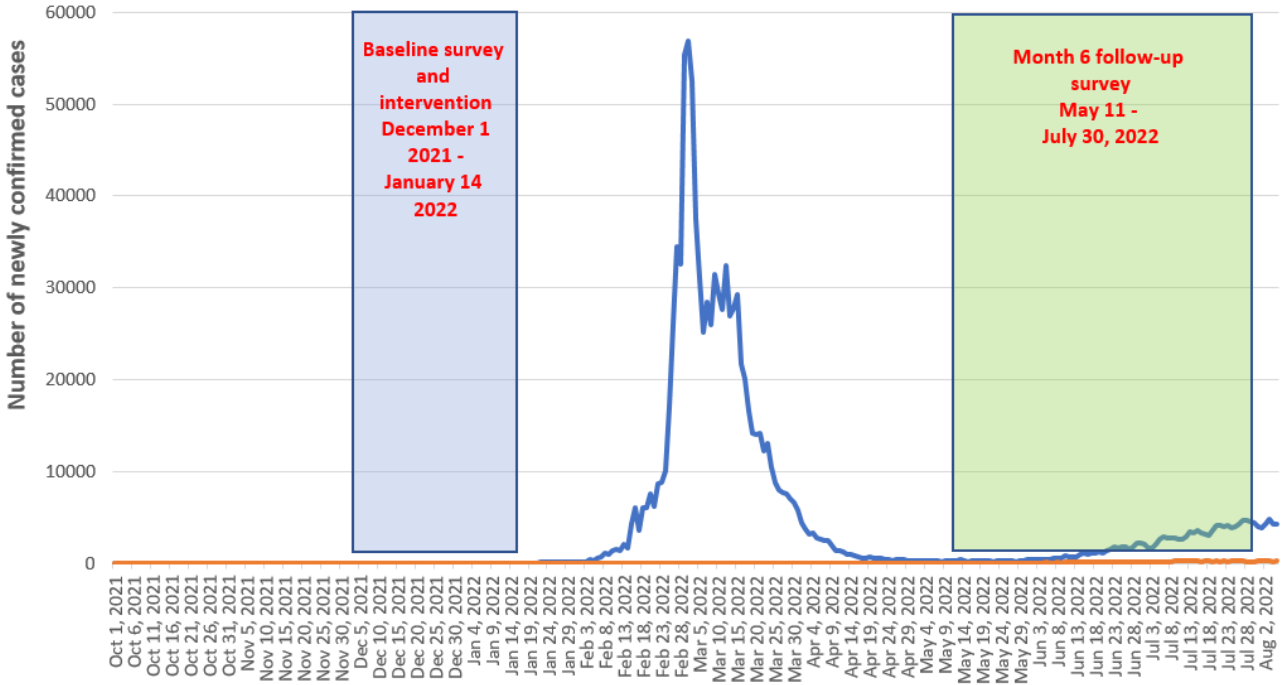
- **Primary objective**
  - To evaluate the relative efficacy of a Chatbot-delivered **SOC-tailored online intervention (the intervention group)** compared with a Chatbot-delivered **standard, non-SOC-tailored online intervention (the control group)** in increasing SIV uptake among Hong Kong residents 65 years or older.
  - The online intervention in both groups were delivered by a rule-based Chatbot.

- **Hypothesis**
  - The intervention group would have higher SIV uptake during the study period compared with the control group

Methods

Study design

- A partially-blinded parallel-group randomized controlled trial



COVID-19 situation during the study period in Hong Kong

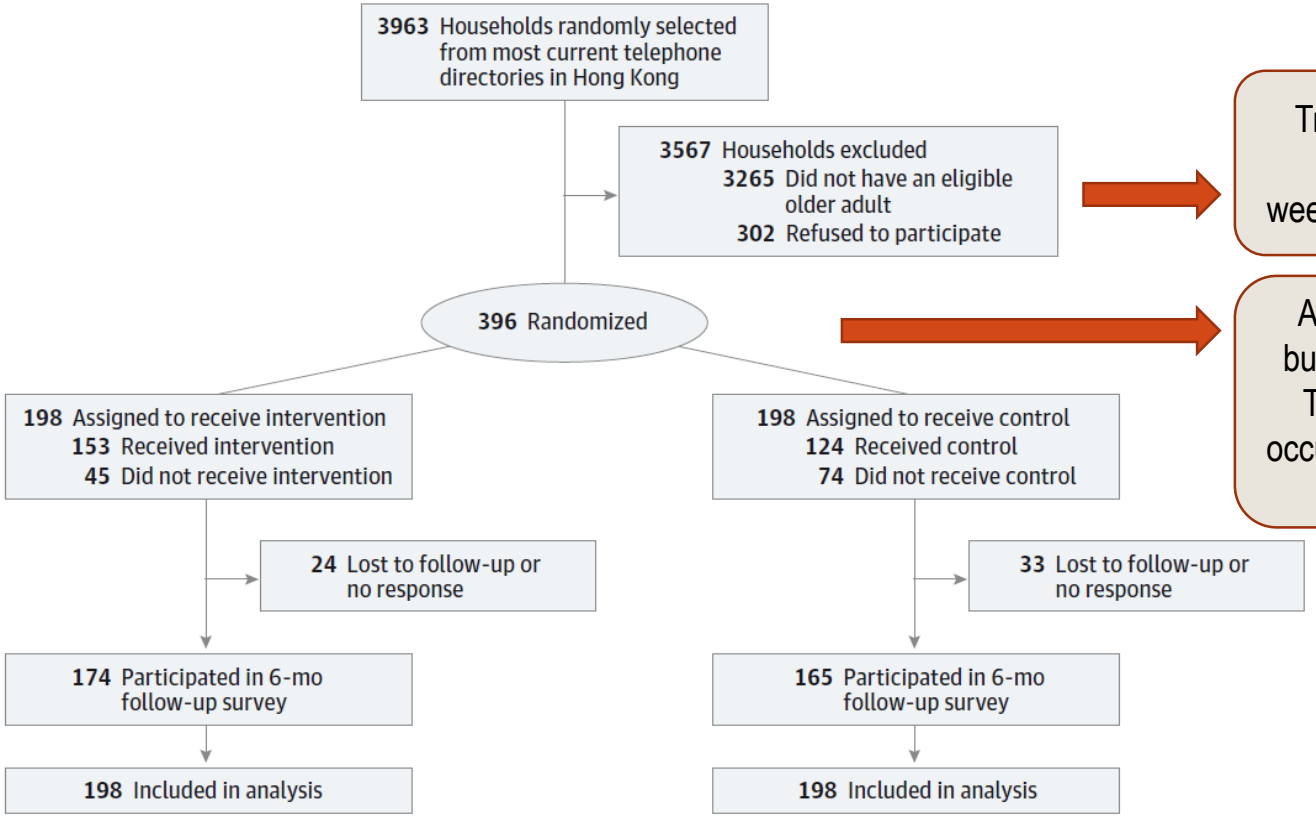
Trial registration:

ClinicalTrial.gov (NCT05155241)

Participants

- **Inclusion criteria**
  - Aged 65 years or older
  - Possession of a Hong Kong identity card
  - Ability to speak Cantonese and/or Mandarin
  - Willingness to participate in follow-up by telephone
  - Access to a smartphone
  - No SIV uptake for the 2021/2022 flu season
- **Exclusion criteria**
  - Cognitive impairment, blindness, or deafness
  - Inability to communicate effectively
  - With known contradictions to SIV as indicated by Hong Kong CHP
- **Sample size**: 198 per group (396 in total)

Study flow diagram



Trained interviewers conducted telephone calls 6-10pm on weekdays and 2-9pm on Saturdays

A randomization algorithm was built into the intervention system. The automated randomization occurred online and was concealed from the research team

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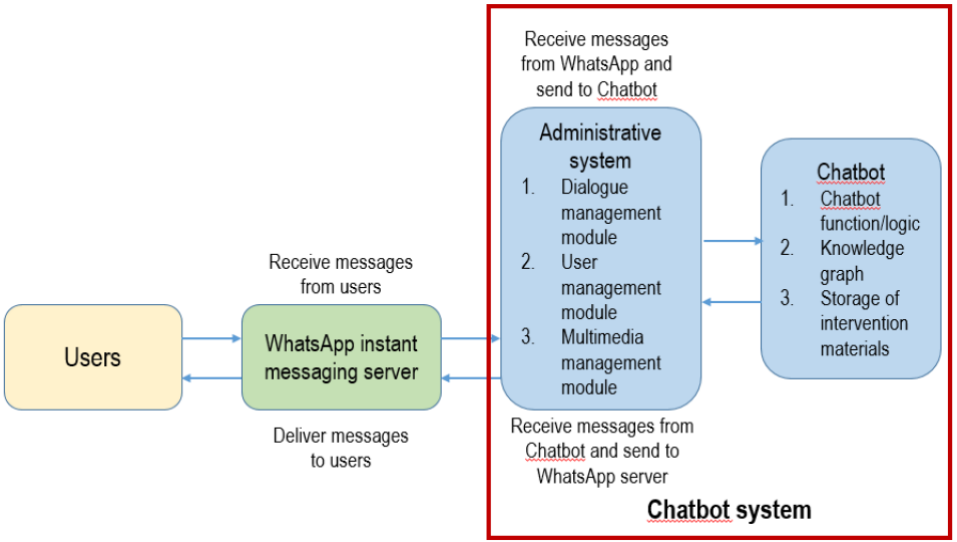
Co-creation of the Chatbot and health promotion with older adults



Architecture of the Chatbot

A mature rule-based Chatbot for smoking cessation (Wang et al, 2018)

Adaption --- informed by in-depth interviews of five Hong Kong residents aged ≥65 years

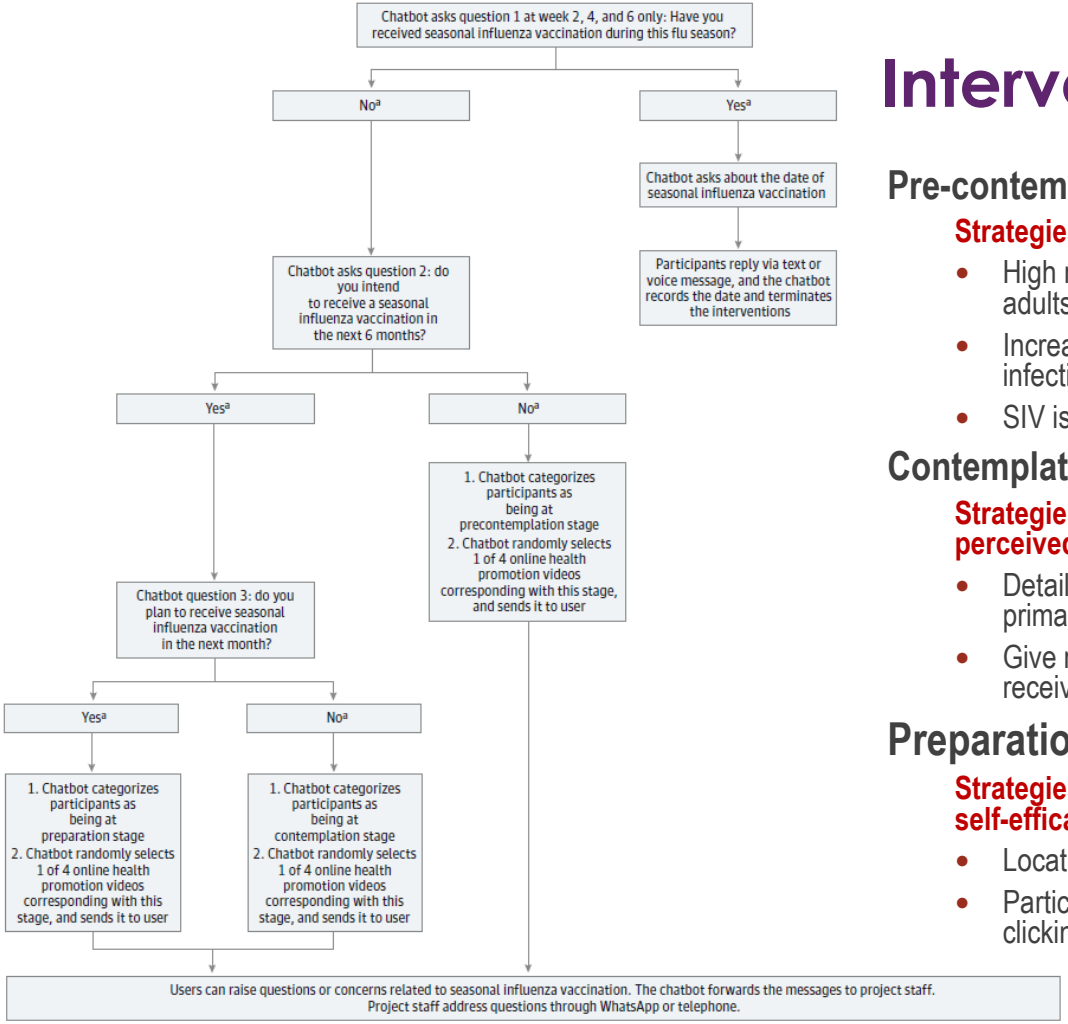
Key suggestions given by the informants:

1) Human-machine interaction should be simple
2) Using videos instead of chats to deliver complicated health promotion messages
3) Avoiding typing on the smartphone.

Using WhatsApp platform to implement Chatbot

Pilot testing and refining

- 10 older adults were invited to use the Chatbot. Their conversation with the Chatbot was retrieved and reviewed



Intervention group

Pre-contemplation stage

Strategies: increase awareness of the importance of SIV

- High risk of influenza infection and severe consequences among older adults
- Increased risk of death associated with influenza and COVID-19 co-infection
- SIV is effective, and free SIV is available

Contemplation stage

Strategies: increase perceived pros and self-efficacy, and reduce perceived cons of SIV

- Detailed information about efficacies and safety of SIV (discussed by a primary care physician + testimonial of vaccinated older adults)
- Give recommendation and encourage participants to make plans to receive SIV (by a primary care physician)

Preparation stage

Strategies: assist with developing concrete action plan and increase self-efficacy to receive SIV

- Location and contact information of facilities providing free SIV
- Participants indicate when and where they plan to receive SIV (by clicking a box)

Control group

A standard online video (lasting 2 minutes)

- Sent by the Chatbot automatically at week 0, 2, 4, and 6
- Covering basic information about who could, when to, and where to receive SIV --- identical to information disseminated by the government through mass media channels

Outcomes

Primary outcome --- self-reported SIV uptake at Month 6

- Validated by requesting participants to upload an image of SIV receipt

Secondary outcome --- SOC at baseline and Month 6

- Same set of questions used by the Chatbot

Statistical analysis

Both complete case analysis and Intention-to-treat analysis were performed

- A Markov Chain Monte Carlo method was used to impute missing values of SOC at Month 6 separately by randomized group (Sullivan et al, 2018)

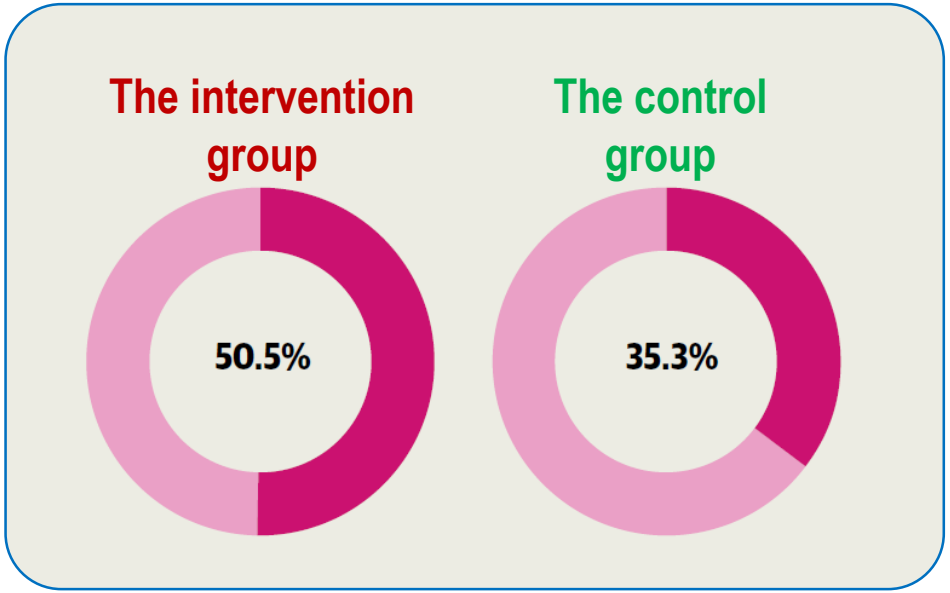
Key Results

Key findings: Baseline characteristics

- **Socio-demographic characteristics**
  - Age, mean (SD): 70.2 (4.3)
  - Females: 62.9%, Males: 37.1%
  - Monthly household income < HK$20,000 (US$2,580): 74.2%
- **Health conditions**
  - Presence of chronic conditions: 60.4% (hypertension: 47.7%; diabetes: 18.9%)
- **No. of SIV doses in the past 3 years**
  - 0 dose: 45.5%, 1 dose: 8.3%, 2 doses: 12.1%, 3 doses: 34.1%
- **SOC**
  - Pre-contemplation stage: 37.4%
  - Contemplation stage: 22.0%
  - Preparation stage: 40.6%

No between-group differences in baseline characteristics was found

Primary outcome
- SIV uptake in the past 6 months



All participants self-reported SIV uptake were able to provide receipt for verification

Intention-to-treat analysis

- 50.5% vs. 35.3%
- **RR: 1.43, 95%CI: 1.13, 1.80, P=.002**

Complete case analysis

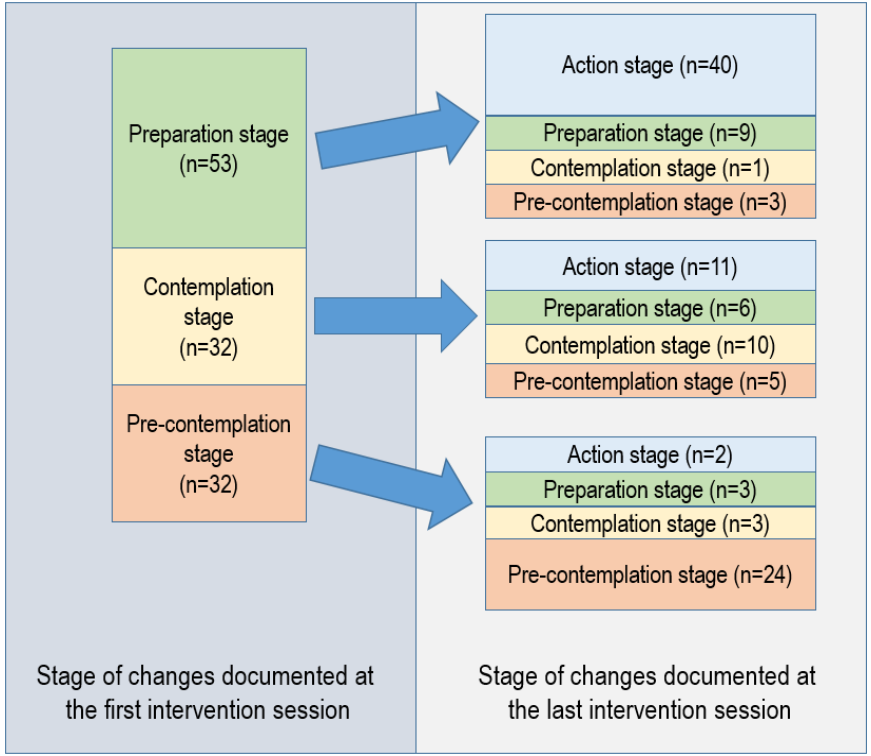
- 57.5% vs. 42.4%
- **RR: 1.35, 95%CI: 1.09, 1.69, P=.006**

Secondary outcome - SOC

Intention-to-treat analysis	Intervention group (n=198), n (%)	Control group (n=198), n (%)	P value
SOC at Month 6			
Pre-contemplation stage	68 (34.3)	88 (44.4)	
Contemplation stage	18 (9.1)	21 (10.6)	
Preparation stage	0 (0)	9 (4.5)	
Action stage	112 (56.6)	80 (40.4)	.001
SOC score [a], mean (SD)	2.8 (1.4)	2.4 (1.4)	.02
Changes in SOC score from baseline to Month 6, mean (SD)	0.7 (1.0)	0.5 (1.0)	.04

a: 1=pre-contemplation, 2=contemplation, 3=preparation, 4=action

Changes in SOC documented by the Chatbot in the intervention group



Among 117 participants in the intervention group who had completed at least two intervention sessions

- 55.6% progressed to higher SOC
- 36.8% stayed in the same SOC
- Only 7.7% went back to lower SOC

SOC-tailored interventions were useful to facilitate progression to higher SOC

Compliance and process evaluation

- **More participants in the intervention group completed at least one episode of intervention than that of the control group (77.3% vs. 62.6%, P<.001)**

- **Process evaluation of the Chatbot was positive (among 124 participants in the intervention group)**
  - Easy to interact with the Chatbot: 78.2%
  - Satisfied with the Chatbot-delivered interventions: 78.2%
  - Chatbot-delivered interventions were helpful to increase their understanding about SIV: 77.4%
  - Chatbot-delivered interventions were helpful to reduce barriers to receive SIV: 82.3%

Conclusion

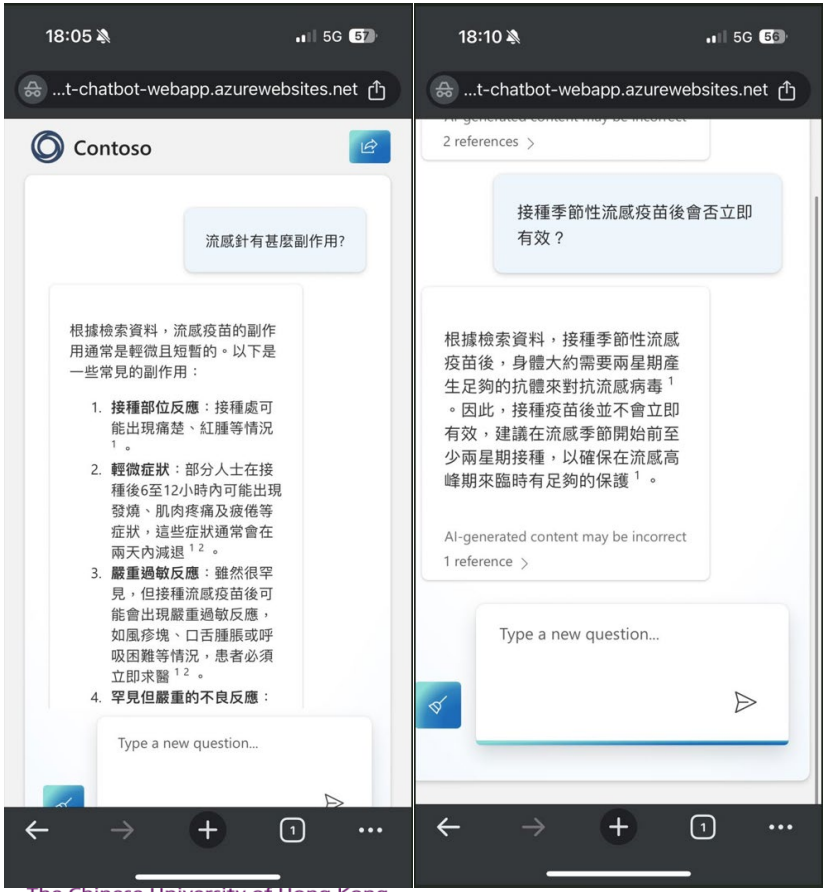
Conclusion
- Theoretical and practical implications

- SOC-tailored intervention was more effective than non-SOC-tailored intervention to increase SIV uptake
- SIV uptake rate in the intervention group was higher than the overall SIV coverage among all Hong Kong residents aged 65 or above in the same flu season (50.5% vs 40.4%)
- WhatsApp + Chatbot were viable in providing health promotion that was tailored to the needs of older adults at different SOC
- Fully automatic --- requires fewer resources to implement

Conclusion
- Constraints and the way forward

- Constraints of rule-based conversation
  - Constraints on the input data
  - A finite set of conversation are task oriented and straightforward
  - Lack of user-initiated conversation
  - Challenges in maintaining user engagement
- As compared to rule-based conversation, free-flow conversation will enhance user experience and engagement
- Free-flow conversation powered by ChatGPT may overcome the constraints

Our SIV-ChatGPT



- The research team trained a ChatGPT based on GPT4.0
- Available as a Web App and is accessible through smartphone
- Two independent experts in vaccination behaviours evaluated the ChatGPT-generated responses to 20 randomly selected questions related to SIV
- The overall contents were **correct, clear and concise** to a very high degree
- An ongoing trial is evaluating the feasibility and effectiveness of the SIV-ChatGPT among older adults (ClinicalTrial.gov: NCT06679647)

JAMA Network Open

RCT: Chatbot-Delivered Online Intervention to Promote Seasonal Influenza Vaccination During the COVID-19 Pandemic

POPULATION

147 Men, 249 Women

Chinese-speaking adults aged ≥65 y who have not received seasonal influenza vaccination

Mean age, 70.2 y

SETTINGS / LOCATIONS

Communities in Hong Kong

INTERVENTION

396 Individuals randomized

198 Stage-tailored online interventions
A rule-based chatbot provided interventions tailored to stage of changes at weeks 0, 2, 4 and 6

198 Non-stage-tailored online interventions
A rule-based chatbot provided standard interventions at weeks 0, 2, 4 and 6

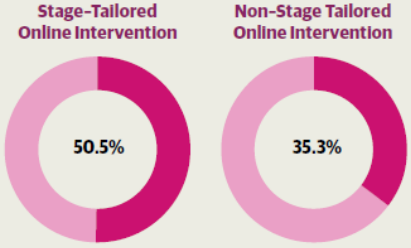
PRIMARY OUTCOME

Self-reported seasonal influenza vaccination measured at month 6

FINDINGS

Seasonal influenza vaccination uptake in the intervention group was significantly higher than the control group at month 6

Self-Reported Seasonal Influenza Vaccination:



Intent-to-treat analysis:
Relative risk,1.43; 95% CI, 1.13-180; *P* = .002

Wang Z, Chan PS, Fang Y, et al. A chatbot-delivered online intervention to promote seasonal influenza vaccination uptake among older adults during the COVID-19 pandemic: a randomized clinical trial. *JAMA Netw Open*. 2023;6(9):e2332568. doi:10.1001/jamanetworkopen.2023.32568

For more information, please access our paper in *JAMA Network Open* 2023, 6(9), e2332568.

THANK YOU

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