COVID-19 Vaccine Uptake among Recipients in Saskatchewan: A Patient-Oriented Realist Evaluation

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Abstract

Background:

When the COVID-19 vaccination program started in Saskatchewan, Canada, there was a need to understand what worked or did not work during the vaccination pilot phase that took place in Regina, Saskatoon, and Prince Albert to plan for improved vaccine uptake. This evaluation study had three objectives: a) to document the vaccination implementation plan in the three pilot sites; b) to understand how, for whom, in which circumstances, and why the plan led to vaccine uptake from the perspectives of eligible vaccine recipients; and c) to establish program theories that could be adapted to multiple settings.

Methods:

We conducted a patient-oriented realist evaluation of the Saskatchewan's vaccination pilot phase that happened from December 2020 to March 2021. The study comprised of three iterative phases, including developing initial program theories (IPTs) by reviewing literature as well as Saskatchewan's COVID-19 vaccination delivery plan (phase one), testing the IPTs by conducting interviews with vaccine recipients (phase two), and developing final program theories (PTs) by refining the IPTs (phase three). Three patient and family partners were fully engaged at each phase. A retroductive approach was used to analyze qualitative data.

Results:

Virtual interviews were performed with six participants representing each group of eligible vaccine recipients (ICU/ED physicians, nurses, and healthcare workers; long-term care [LTC] managers and healthcare workers; and family members and care givers of LTC residents on behalf of LTC residents). In the three final PTs, 12 contextual factors and 14 casual mechanisms resulted in an intermediate outcome of vaccine willingness or hesitancy which then led to vaccine uptake as an outcome of interest. Communication (e.g., social media, internal and external sources of communication) and trust (e.g., in leadership and medical professionals), were the most prominent contextual factor and causal mechanism, respectively.

Conclusions:

Our final program theories displayed the complexity and interconnectedness of contexts and mechanisms. Some mechanisms were activated for some participants, and not for others, depending on their circumstances which consequently affected vaccine uptake. These findings suggest the need for more tailored strategies to address vaccine recipients' specific needs and conditions.

Plain English Summary

Our study evaluated the pilot phase of Saskatchewan's COVID-19 vaccination program, a time when there were uncertainties about the program's effectiveness. We aimed to understand how, for whom, in what context, and why the implementation of the COVID-19 vaccination program led to vaccine uptake for pilot phase vaccine recipients using a theory-driven approach realist evaluation. We partnered with three patient and family partners (PFPs) and engaged in three iterative phases: developing initial program theories (through literature search, review of Saskatchewan's COVID-19 vaccination documents, and communication with PFPs), testing the initial program theories (through interviews with pilot phase vaccine recipients), and formulating final program theories (through analysing the interview data). The first phase showed contextual factors and underlying causal mechanisms that resulted in the outcome of interest, in this case, vaccine uptake. Patient and family partners took part in the analysis and development of three final program theories for each group of vaccine recipients. Overall, communication (e.g., social media) and trust (e.g., in leadership) were the most prominent contextual factor and mechanism, respectively, affecting vaccine uptake among recipients. We saw complexity, dynamics, and interconnectedness of contexts and mechanisms. Depending on individual circumstances, some mechanisms were activated for some participants, and not for others, even when participants were from the same group. Our findings have practical implications for vaccination programs development. Determining contexts and mechanisms affecting vaccine uptake is a key element, especially when the population's needs vary.

Introduction

The COVID-19 pandemic pushed Canada, like other countries, into the largest vaccination campaign in human history (1, 2). Rapid vaccine development and the pressing demand for rapid immunization, left little time to ground COVID-19 vaccination programs in evidence-based practice. This led to many ethical and logistical challenges (3). Lessons learned from previous outbreaks, such as Ebola, have confirmed that poorly designed vaccination programs can result in major barriers such as vaccine hesitancy and refusal (4), public mistrust in prioritization plans and implementation (4), lack of community engagement and miscommunication (5, 6), exclusion of the most vulnerable populations (e.g., pregnant women) (7), burden on countries' economy and social fabric (8), and re-emergence of the disease (5).

During the implementation of COVID-19 vaccines, Saskatchewan was periodically reported as one of the provinces in Canada with a lower vaccination rate and higher rate of COVID-19 deaths (9–11). To better understand the efficacy of the pilot phase of the province's vaccination program (December 2020 – March 2021), we assembled a patient-oriented research team and conducted a realist evaluation. In this article, we report our findings obtained from pilot phase vaccine recipients which helped to formulate refined theories of how, why, for whom, and under what circumstances the COVID-19 vaccination program led to vaccine uptake. The aim of our study was to explore contextual factors and underlying mechanisms that led to vaccine uptake.

Methods

We have previously published the study's protocol in CMAJ Open (12). Below is the methods summary of the vaccine recipients' arm of the study. We used the Guidance for Reporting Involvement of Patients and the Public (GRIPP2) Short Form (SF) (Additional file 1) (13) as well as the Realist And Meta-narrative Evidence Syntheses: Evolving Standards II (RAMESES II) (Additional file 2) to report methods and data analysis (14).

Setting

Our interdisciplinary research team was based in Saskatchewan and consisted of three PFPs (C.S., B.A., G.F.), five realist evaluators (A.R.A., T.C., N.M., T.V., G.G.), two Saskatchewan Health Authority employees (A.R.A., J.V.), one Saskatchewan Health Authority (SHA) policymaker (C.H.) and one research assistant (M.Y.). The study was conducted virtually due to COVID-19 restrictions.

Our study focused on the cities in which the pilot phase of Saskatchewan's COVID-19 vaccination program occurred (i.e., Regina, Saskatoon, and Prince Albert) (15, 16). The Government of Saskatchewan and the SHA used pilot term to describe administering vaccine to high-risk and vulnerable population (17). The first COVID-19 vaccination was delivered in Regina (December 15, 2020), followed by Saskatoon (December 22, 2020) and Prince Albert (January 7, 2021). The pilot phase ended in March 2021 when COVID-19 vaccines were administered to high-risk populations of priority healthcare workers, elderly residents, and northern communities (17–19).

Study Design

We used realist evaluation, a theory-driven approach where researchers examine the question of "what works, for whom, in what circumstances, how and why?" through the development of a program theory (20–23). Typically, realist evaluation encompasses three phases: 1) eliciting the initial program theory(s), 2) testing the initial program theory(s) through data collection, and 3) formulating a refined final program theory(s) based on the findings of collected data in phase two (24–27). In developing, testing, and refining a program theory, realist evaluators assume that an outcome (vaccine uptake, in this study) is generated by mechanisms being triggered in specific contexts through an actor(s) (vaccine recipients, in this study) (27). These causal relations, referred to as CMO configurations (CMOCs), are the building blocks of program theory (28).

In phase one of this study (January – May 2021), the PFPs received training about realist evaluation by A.R.A and T.C (explained in more details under the Patient Engagement section). The initial program theories (IPTs) were co-developed with PFPs to identify the vaccine program's underlying assumptions, outcomes of interest, and proposed mechanisms of achieving the targeted outcome (12). We reviewed COVID-19 vaccination peer-reviewed and grey literature as well as COVID-19 vaccination program documents and communications (e.g., SHA implementation meeting notes) from the three sites (29). Three categories of IPTs were developed (Fig. 1, Fig. 2, and Fig. 3), one for each group of actors (ICU/ED

physicians and healthcare workers; LTC managers and healthcare workers; and LTC residents) in the pilot phase. The identified mechanisms for the recipients were overlapping (Fig. 4), hence, we grouped them into “mechanism chain” with two categories: reasoning and cognitive/emotional mechanisms (24). In phase two of the study (June – September 2021), we tested the IPTs through online interviews. In phase three (October – December 2021), we refined and validated the IPTs by retroductively analyzing the interview data and generated the final program theories for vaccine recipients.

Patient Engagement

We used the Saskatchewan Centre for Patient Oriented Research (SCPOR) Patient-Oriented Research Level of Engagement Tool (PORLET) (30) to facilitate and guide the level of engagement with the PFPs. We selected the three PFPs purposefully due to their prior experience and engagement in a variety of health research studies including patient-oriented realist research. Their background brought perspectives of social workers, health educators, cancer survivors, and family members and caregivers of LTC residents to the team. We held 16 meetings with PFPs: nine meetings to train the PFPs using the training materials for realist evaluation (31), as well as discuss and develop IPTs, a participants’ invitation letter and consent form, an interview guide, a plain language version of the IPTs, and recruitment strategies; three meetings to run mock-up interviews; three meetings to review preliminary analysis results; and one final research team meeting to finalize the final program theories.

A.R.A. and T.C. used Mural boards (online platform) to train PFPs on realist evaluation program theory development. The boards contained tables with context, mechanism, and outcome columns for each group of vaccine recipients. The tables were prepopulated with literature samples related to vaccination. During the training sessions, A.R.A. and T.C. demonstrated how to extract contexts, mechanisms, and outcomes from the samples. Subsequently, further sample resources were co-analyzed by the PFPs. This approach led to build the IPTs in collaboration with the PFPs.

Along with A.R.A., PFPs were each assigned to two interviews based on their previous research experience and background. PFPs are engaged in knowledge translation such as dissemination of findings at conferences or a manuscript format.

Participants

The study population was composed of all individuals in Saskatchewan who were eligible for a COVID-19 vaccine during the pilot phase, including healthcare workers in intensive care units / emergency departments / COVID-19 units, staff at testing and assessment centres, elderly residents in long term care (LTC), older adults over 80 years of age, and residents in remote northern communities. Caregivers of LTCresidents were also eligible for inclusion when residents were not physically or mentally able to participate in an in-depth interview. We recruited participants through PFPs and the Saskatchewan Care Network, using purposive sampling to ensure diverse inclusion of healthcare and non-healthcare workers.

Data Collection

To test the IPTs developed in phase one, a PFP and A.R.A. co-conducted one interview with each participant (30–45 minutes). The three PFPs and other members of the research team co-developed an interview guide based on a realist evaluation teacher-learner approach (Additional file 3) (32). The PFPs and researchers also co-created a plain language version of the IPTs (Additional file 4). After receiving consent from the participants, interviews were audio-recorded and later transcribed. Participants were offered an honorarium for their participation.

Data Analysis

Qualitative data collected from interviews was analyzed using a retroductive approach common in realist research (21–26). As such, we employed both inductive and deductive coding (21) and used the team's insights to understand what caused vaccine uptake (refer to the protocol paper for detailed information on data analysis) (12). Two researchers (A.R.A., T.C.) conducted the preliminary analysis to identify the CMOCs from each interview. They compared and contrasted the CMOCs with the IPTs and refined the IPTs accordingly. The findings of the preliminary analysis were then reviewed by each PFP who co-conducted the corresponding interview. All findings were discussed in a final meeting where all research team members were present.

Ethics Approval

The study was part of a larger project "Developing a patient-oriented realist evaluation for COVID-19 vaccine implementation in Saskatchewan" which received a letter of exemption from the University of Saskatchewan Behavioural Research Ethics Board and the Saskatchewan Health Authority Research Ethics Board because of its program evaluation status (33). The study's consent forms reflected this exemption status.

Results

We interviewed six participants: two physicians from Regina and Saskatoon, two LTC managers from Saskatoon and Prince Albert, and two family members and care givers of LTC residents from Saskatoon. Our findings led to three final program theories (PTs): ICU/ED physicians and healthcare workers (Fig. 5); LTC managers and healthcare workers (Fig. 6); and LTC residents (Fig. 7). The refined mechanism chain is presented in Fig. 8.

Confirmed Contexts and Mechanisms

Interviewees confirmed all initial contextual factors and underlying mechanisms (Table 1). Of the confirmed contextual factors, interviewees emphasized on communications (e.g., social media and its impact). Of the underlying mechanisms, trust, a sense of community versus individuality, and an understanding of disease transmission were underscored.

Table 1
Confirmed contextual factors and underlying mechanisms within the initial program theories for vaccine recipients

Confirmed Element	Context or Mechanism	Quote Examples
Communication	Context	“The media wasn't always helpful …” (Participant #2) “I think social media is insanely important, almost as important as worldview because you oftentimes form your worldview based on social media.” (Participant #3) “I think the pilot project was horribly advertised.“ (Participant #3) “Information about the vaccines from other media, I take the Globe and Mail, and I think that the coverage was really excellent …” (Participant #4) “I think we were communicated fairly well from the nursing home” (Participant #5) “… things came out very quickly for us.” (Participant #6)
Decision making capacity	Context	“She was not competent to make the decision for herself as to whether she should have the vaccination or not, and I'm assuming that I was asked about this.“ (Participant #4)
Demographics	Context	“Obviously, research would be interesting to see whether it did, but in my view, it really boils down to worldview, demographic, and social media.” (Participant #3) “She's a woman, may have different views. Caucasian may have different views…” (Participant #3)
Family presence and need for family support	Context	“… you know, family presence is really needed …” (Participant #4) “But it went on far too long and greatly to the detriment of our residents, as well as family members who were better able to, you know, adapt to the situation that I know.” (Participant #4)
Health literacy	Context	“I'm very much about immunizations.” (Participant #2)
Location	Context	“So, you know, people who were in in nursing homes people are in long term care facilities, etc., they're obviously more likely to take it because they knew that the price to not taking it.” (Participant #3)
Policy: Denied from visiting family members in LTC facilities	Context	“I think it's great for the policy where you have denied from visiting family members in long term care. That was the most frustrating part, so I think that's very important to have that there.” (Participant #5)
Religion / world view	Context	“… so I come from the Protestant Evangelical Christian background up and, if you look at a lot of the vaccine hesitancy, it seems to originate in that people group because of a lot of misconceptions about the vaccine …” (Participant #1) “I do think that the world view is certainly a major aspect in this.” (Participant #3)

Confirmed Element	Context or Mechanism	Quote Examples
Perception of personal vulnerability	Mechanism	"… I worked so closely with the COVID patients …" (Participant #1)
Perception of risk to side effects	Mechanism	"I was a little bit concerned about perhaps what were the side effects, …" (Participant #2)
Perception of transparency from source	Mechanism	"… it was a little bit confusing at the beginning conflicting views from different scientists …" (Participant #4) "…there were a number of sessions where we could go over lunch hour and actually listen to people talk about each of the vaccines and what the risks were with the side effects, what the benefits were …" (Participant #6)
Physical exhaustion / perception of competing priorities	Mechanism	"…. I'm not putting 4 hours at age of 23 into getting a vaccine that most likely blah blah blah." (Participant #3) "… I think staff you know were physically exhausted because they had to do more than that they did before because caregivers were not coming in." (Participant #5)
Sense of community versus individuality / responsibility	Mechanism	"… you are protecting yourself and others …" (Participant #1) "…well, we're all in this together. We need a high rate of vaccination to protect the community." (Participant #4)
Trust • Trust in vaccine efficacy and safety • Trust in healthcare institutions / medical professionals • Trust in leadership	Mechanism	"I was very confident. I'm always very confident that they have done the research, they've done the work and generally it's all been well prepared and thought out and that nobody would ever impose any harm if they knew." (Participant #2) "… I also believe in the systems that our country has, and our province has …" (Participant #3) "I think the trust that was important and that was there for us." (Participant #5)
Understanding of disease transmission and prevention	Mechanism	"I think I'm pretty well informed." (Participant #4) "… you know you did some research on your own and talked to other people and other professionals about their opinion on that …" (Participant #5)

New Contexts and Mechanisms

Three and four new contextual factors and underlying mechanisms were added to the IPTs, respectively (Table 2). The new contextual factors included availability of resources / ease of access, open non-judgmental relationships, and pre-existing medical conditions. The new underlying mechanisms reflected concerns that one's experience of side effects will deter others, desire for high or early uptake, eagerness to provide positive leadership / being a champion, and perceptions of being the first.

Table 2
New contextual factors and underlying mechanisms added to the initial program theories for vaccine recipients

New Element	Context or Mechanism	Quote Examples
Availability of resources; Ease of access	Context	"I didn't have to sign up for anything and then everything else just kind of fell together and it happened very quickly." (Participant #1) "… I also believe that having that right on site for us was a huge reason we were able to reach such high rates." (Participant #2)
Open non-judgmental relationships	Context	"And I think that if people are hesitant, we have to be open to having that conversation with them in a very trusting, nonjudgmental way to hear their fears, to hear what's making them hesitant so that we can then move past that by validating those feelings and emotions and helping them to understand that things are safe, that things are going to be okay, and that yes there may be side effects, but they're just a normal body reaction but they don't last forever" (Participant #6)
Pre-existing medical conditions	Context	"… they had mentioned that not everyone, like as far as a resident, would receive the vaccine because of immune comptonization." (Participant #5)
Concern that side-effects or one's experience will deter others	Mechanism	"… I was worried that I would be the one that would have a reaction and then people would be like look even this guy had that reaction …" (Participant #3)
Desire for high or early uptake	Mechanism	"… I was hoping that it was going to be efficient or also would be good uptake …" (Participant #1)
Eagerness to provide positive leadership / being a champion	Mechanism	"… I felt that If I was to take the vaccine, potentially, I may influence a lot of people to believe in the message I that I have …" (Participant #3)
Perception of being the first	Mechanism	"I felt very fortunate to be one of the first people in Saskatchewan to have received the vaccine." (Participant #2) "… I did feel quite also excited and really wanted to be the first …" (Participant #3)

Refined Contexts and Mechanisms

One contextual factor and two underlying mechanisms were refined (Table 3). The contextual factor of communication was refined to communication via person's preferred or trusted source. The underlying mechanism of anxiety (regarding the disease and vaccination) / fear of death was refined to two sub mechanisms: Anxiety (regarding the disease and vaccination): 1. fear of getting a needle and 2. fear of death. The underlying mechanism of sense of community versus individuality / responsibility was refined to sense of community versus individuality / perception of freedom / personal choice / responsibility".

Table 3
Refined contextual factor and underlying mechanisms within the initial program theories for vaccine recipients

Refined Element **(Refinement in bold)**	**Context or Mechanism**	**Quote Examples**
Communication to Communication via person's preferred or trusted source	Context	"… Like the side effects and all that kind of stuff that you got information about or some help from the general practitioner." (Participant #5)
Anxiety (regarding the disease and vaccination) / fear of death to two sub-mechanisms Anxiety (regarding the disease and vaccination) 1. fear of getting a needle 2. fear of death	Mechanism	"I think anxiety is something that is actually bigger than what we had anticipated that people actually have a fear of getting a needle." (Participant #6) "… they now have therapy dogs …" (Participant #6)
Sense of community versus individuality / responsibility to Sense of community versus individuality / Perception of freedom / personal choice/ responsibility	Mechanism	"… They don't believe in the government rules in dictating what they need to do …" (Participant #3) "… I'm also a member of a health authority committee … and advise the health authority about it [COVID]. " (Participant #4) "… we're all in this together …" (Participant #4)

Discussion

We used a novel combination of patient-oriented research strategy and a theory driven realist evaluation approach which resulted in the generation of three program theories to understand the outcome of vaccine uptake. Overall, communication and trust were the most prominent contextual factor and underlying mechanism, respectively, affecting willingness or hesitancy among recipients for receiving a

vaccine. Depending on participants' experiences and contexts, their responses were different to the same interview questions even when those participants were from the same category of actors (e.g., LTC managers). Interviewees' diverse experiences and contexts subsequently impacted mechanisms that were activated for them.

Our study suggests that in the context chain, communication activated a multitude of mechanisms, including trust, understanding of disease transmission and prevention, and a sense of community versus individuality, anxiety, and fear of death. We found that communication through internal sources of information (e.g., SHA's daily news updates and physician town halls), external sources of information (e.g., social media) as well as the approach to communication (e.g., frequency, language, and tone of messages) influenced an individual's relationship with valid sources and their willingness or hesitancy to receive a vaccine. Our findings align with earlier reports that media had a significant impact on COVID-19 vaccine acceptance or refusal (34). Exposure to negative and misleading information triggered fear of COVID-19 and fueled skepticism to accept vaccination (34).

Trust, as the core mechanism and by-product of communication, was built through multiple sources including leadership, healthcare institutions, and medical staff which consequently impacted individuals' perceptions towards vaccine safety and efficacy and the decision to receive a vaccine. Similar findings were highlighted in the literature regarding the importance of trust in individuals' hesitation toward receiving a COVID-19 vaccine (35–38). Distrust in the safety and efficacy of vaccines and in authorities has been identified as a strong and common cause of low uptake by the public (36). However, none of these studies have been able to make the causal theoretical statements that our evaluation has demonstrated.

More can be learned about the contexts and underlying mechanisms that influence the decision-making of different groups to receive a COVID-19 vaccine. Future research should investigate how and why COVID-19 vaccination uptake differs among communities, examining contextual variations of culture and geography (rural versus urban). Such research should involve meaningful collaboration with patient and family partners from those communities.

Limitations

Some limitations of our study include 1) lack of engagement with Indigenous communities; 2) no direct interviews with people who did not receive a vaccine or those residing in LTC settings, 3) transferability of findings to similar contexts but not generalizability to every context, and 4) timing of the study. Our study's findings do not contain components related to Indigenous communities because we did not have Indigenous PFPs in our research team or include meaningful engagement with these communities. Anti-vaccine individuals and LTC residents were not interviewed due to recruitment challenges (e.g., lack of interest, COVID-19 restrictions) and health competence, respectively. Additionally, we studied the pilot phase of the immunization campaign, therefore the identified contextual factors or underlying mechanisms may not be applicable to different timeframes (e.g., mass immunization phase).

Nevertheless, if there are similar contexts to the pilot phase, evaluators can utilize our findings to assess vaccination campaigns. Also, interviews happened 4–6 months after the pilot phase which may have impacted participants' recollection (recall bias).

Lessons Learned from Patient Engagement

Patient partners co-designed this study. They were full team members at every stage of the research. Throughout this collaboration, we learned that building trusting relationships and ongoing effective communication were paramount to the success of patient engagement. Regular meetings and detailed meeting notes were sent to team members after each meeting to create an opportunity for reflection. These approaches were helpful to maintain engagement, especially in the context of virtual collaboration. Assembling a team of PFPs with varied backgrounds and experiences ensured that diverse perspectives of vaccine recipients were reflected in the initial and final program theories. The PFP's strong backgrounds in research helped balance the power differentiation between them and other team members. The researchers ensured that PFPs were provided with different resources (e.g., realist evaluation materials, COVID-19 vaccine literature) and opportunities (e.g., one-on-one mock-up interviews) to give them experience to participate confidently in each research stage. The PFPs encouraged the other team members to clearly co-define the research objectives, clarify roles and expectations (e.g., if they were going to be engaged in knowledge dissemination), and timelines early in the project. This early discussion determined the scope of the project and team roles at the initial phase which smoothed our collaboration and avoided misunderstandings. All team members asked questions, shared opposite viewpoints, and challenged assumptions. When PFPs were asked to provide feedback, they expressed their satisfaction with the positive dynamics of the research team. Time commitment and need for adequate honoraria to compensate PFPs were crucial considerations during our research study planning.

Conclusions

We conducted a patient-oriented realist evaluation to obtain knowledge about how, why, for whom, and under what circumstances the pilot phase of the Saskatchewan COVID-19 vaccination program led to vaccine uptake among different groups of vaccine recipients. We generated three final program theories for the three groups of vaccine recipients. Our final theory confirmed that, while some contextual factors (e.g., communication and social media) and mechanisms (e.g., trust in vaccine efficacy and leadership) were common across different actors, some mechanisms became activated for some actors in some circumstances, and not for others, which impacted their decision to receive a vaccine. Our study can inform Saskatchewan's COVID-19 vaccination program, and other similar programs, to implement more tailored strategies by considering relevant contexts and mechanisms for specific vaccine recipients which may result in enhanced vaccine uptake.

Declarations

Ethics approval and consent to participate

The study was part of a larger project “Developing a patient-oriented realist evaluation for COVID-19 vaccine implementation in Saskatchewan” which received a letter of exemption from the University of Saskatchewan Behavioural Research Ethics Board and the Saskatchewan Health Authority Research Ethics Board because of its program evaluation status (33). The study’s consent forms reflected this exemption status.

Consent for publication

Not applicable

Availability of data and materials

Aggregate qualitative data associated with this study is available in response to a reasonable request sent to the corresponding author.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Gary Groot and Tracey Carr co-supervised the work. Amir Azizian, Candace Skrapek, Brenda Andreas, Gerald Farthing, Nazeem Muhajarine, Tanya Verrall, Collin Hartness, Jason Vanstone, Gary Groot, and Tracey Carr contributed to the study conception. Amir Azizian, Candace Skrapek, Brenda Andreas, Gerald Farthing, Maryam Yasinian, Gary Groot, and Tracey Carr contributed to the study design. Amir Azizian, Candace Skrapek, Brenda Andreas, Gerald Farthing, and Maryam Yasinian acquired the data. Amir Azizian, Candace Skrapek, Brenda Andreas, Gerald Farthing, and Tracey Carr contributed to the data analysis. Amir Azizian, Tracey Carr, and Maryam Yasinian drafted the manuscript. All authors revised the manuscript critically for important intellectual content, approved the final version to be published and agreed to be accountable for all aspects of the work.

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Figures

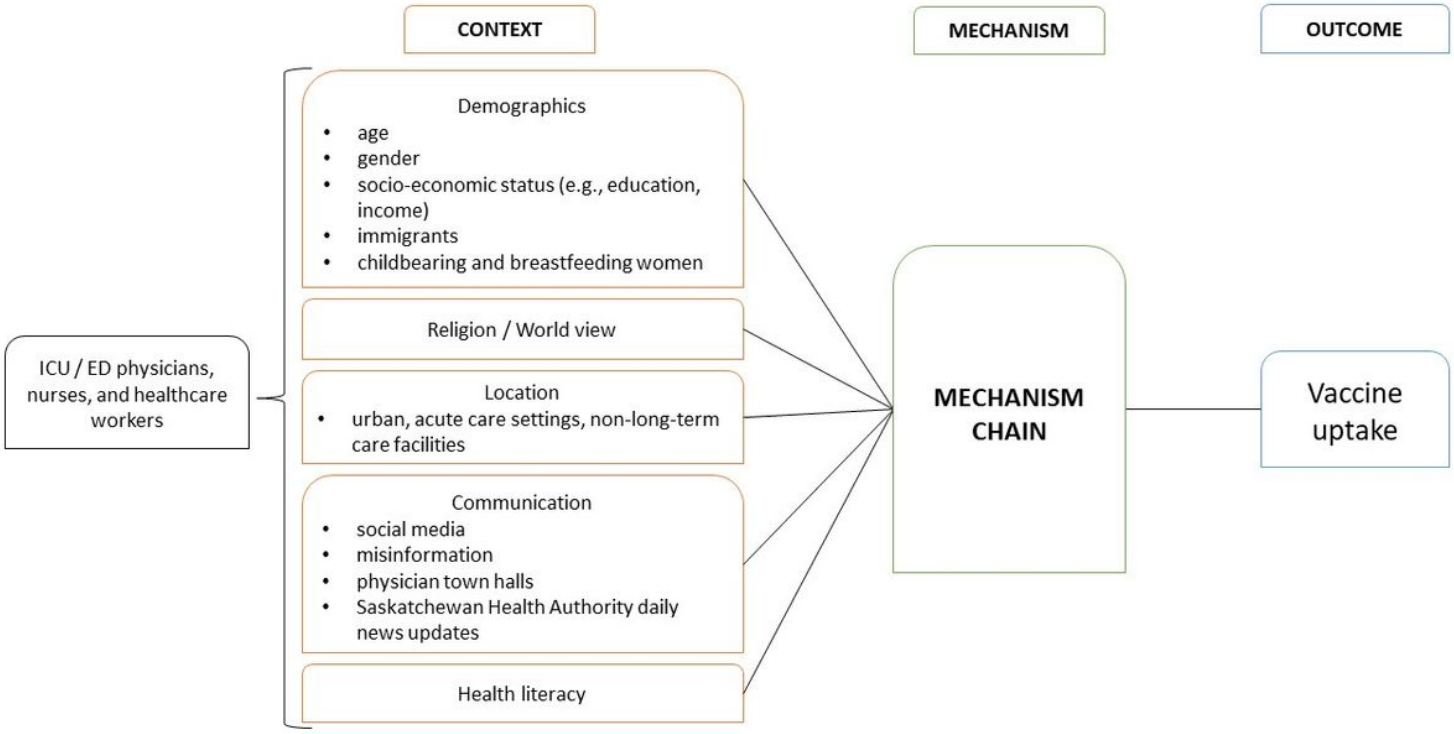

Figure 1

Initial program theory for ICU/ED physicians, nurses, and healthcare workers

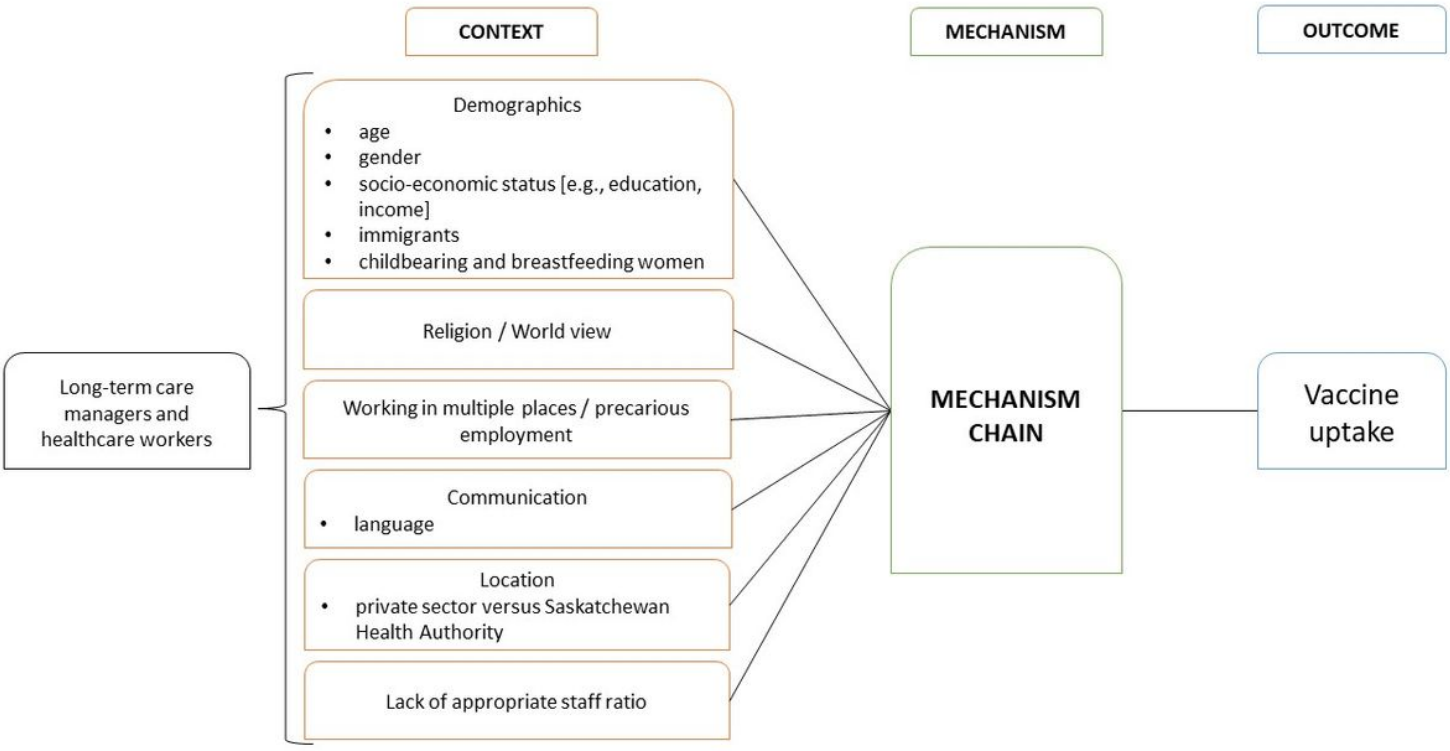

Figure 2

Initial program theory for long-term care managers and healthcare workers

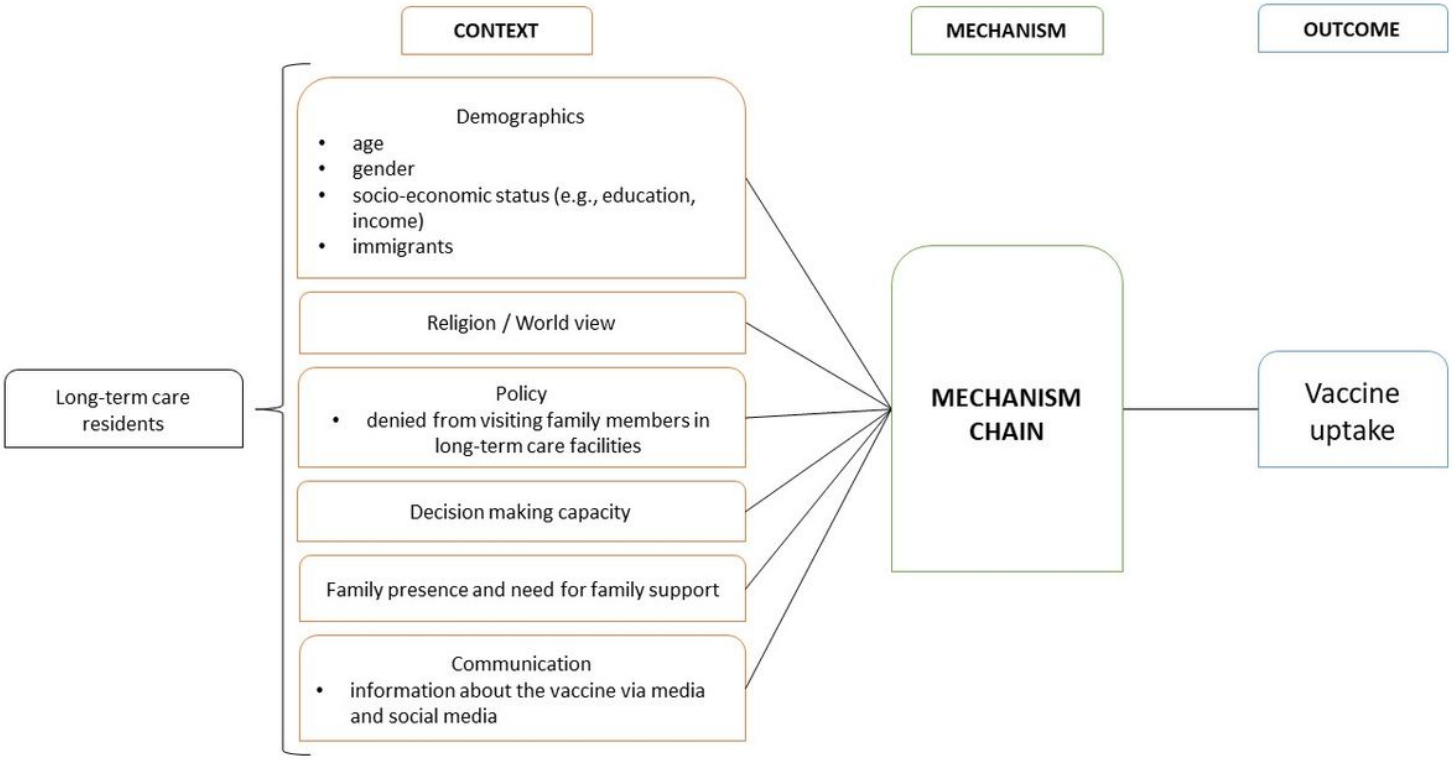

Figure 3

Initial program theory for long-term care residents

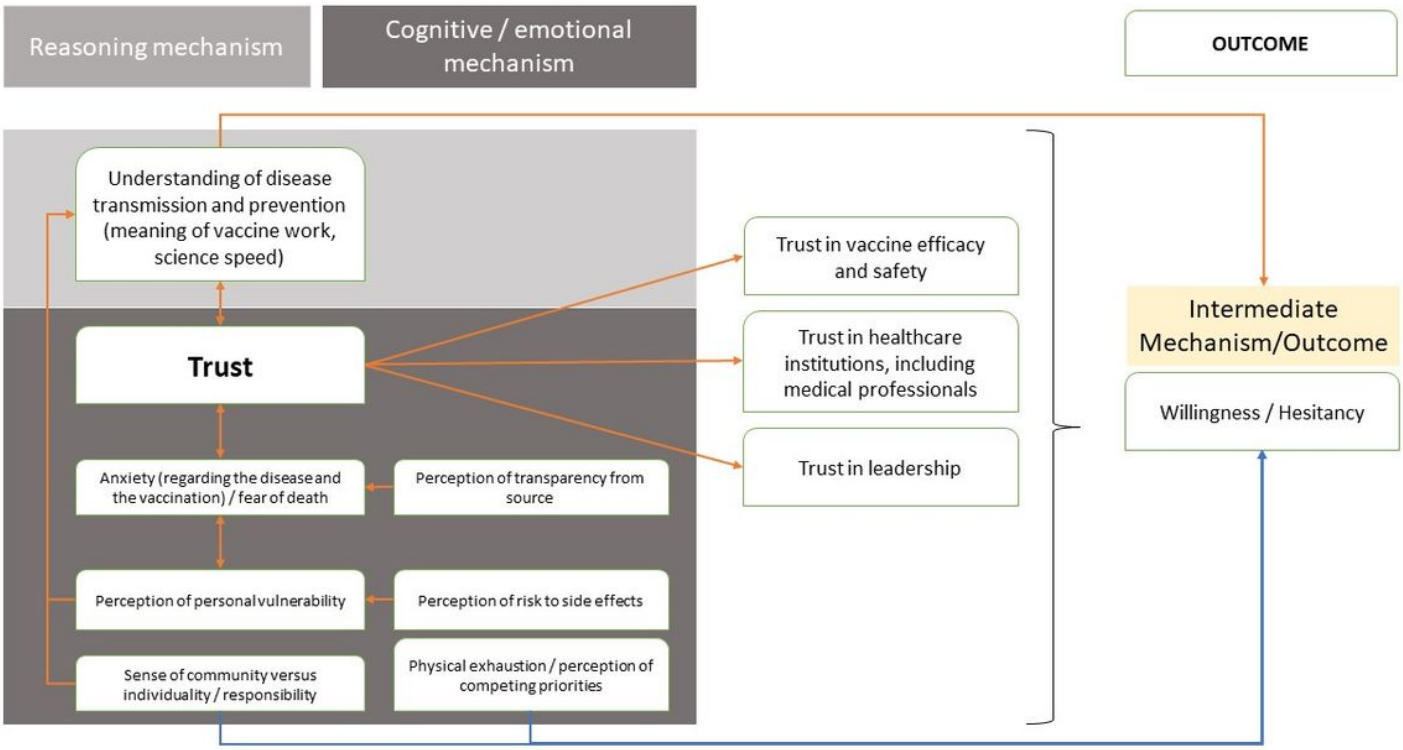

Figure 4

Initial program theories mechanism chain for vaccine recipients

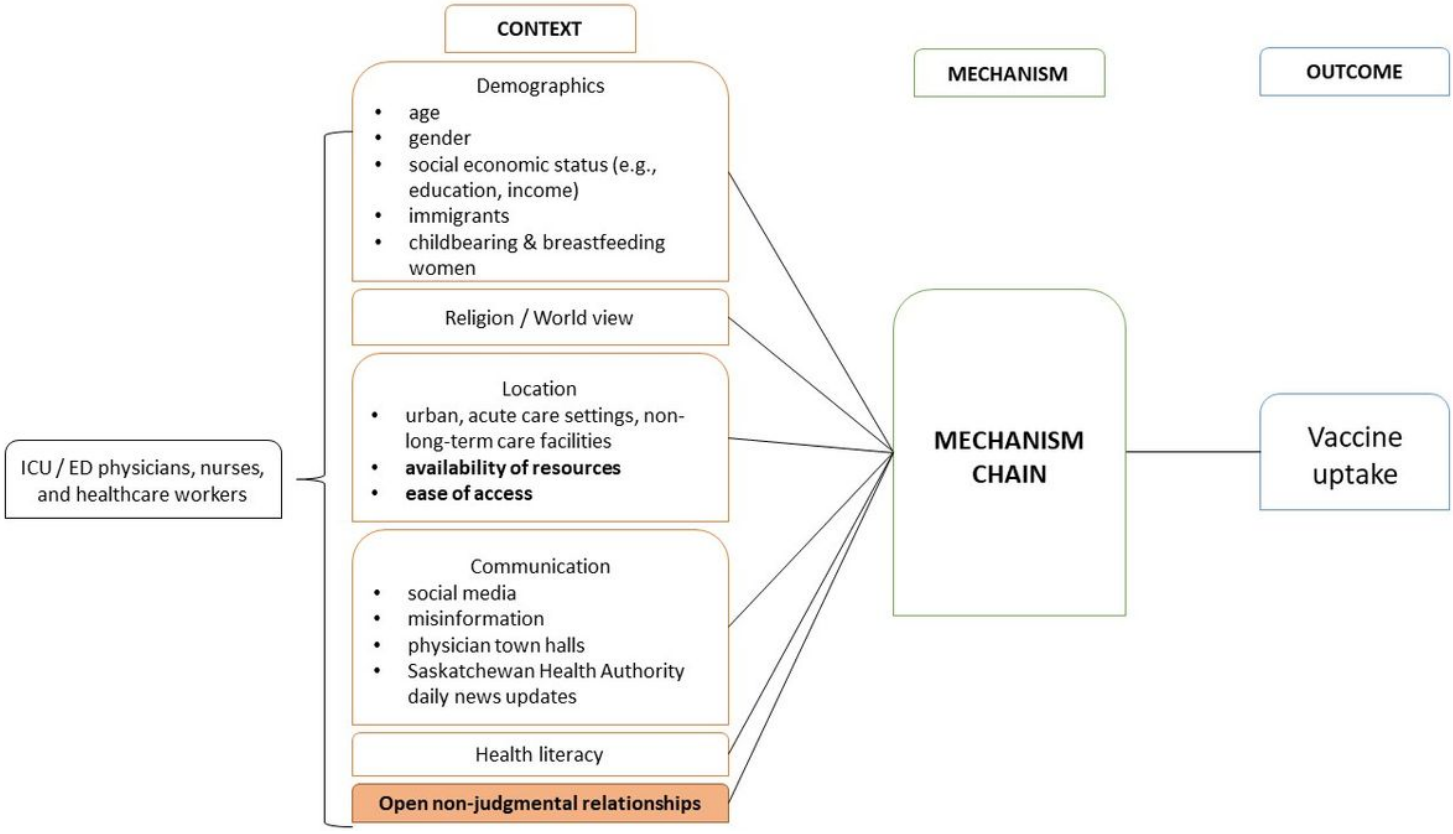

Figure 5

Final program theory for ICU / ED physicians, nurses, and healthcare workers

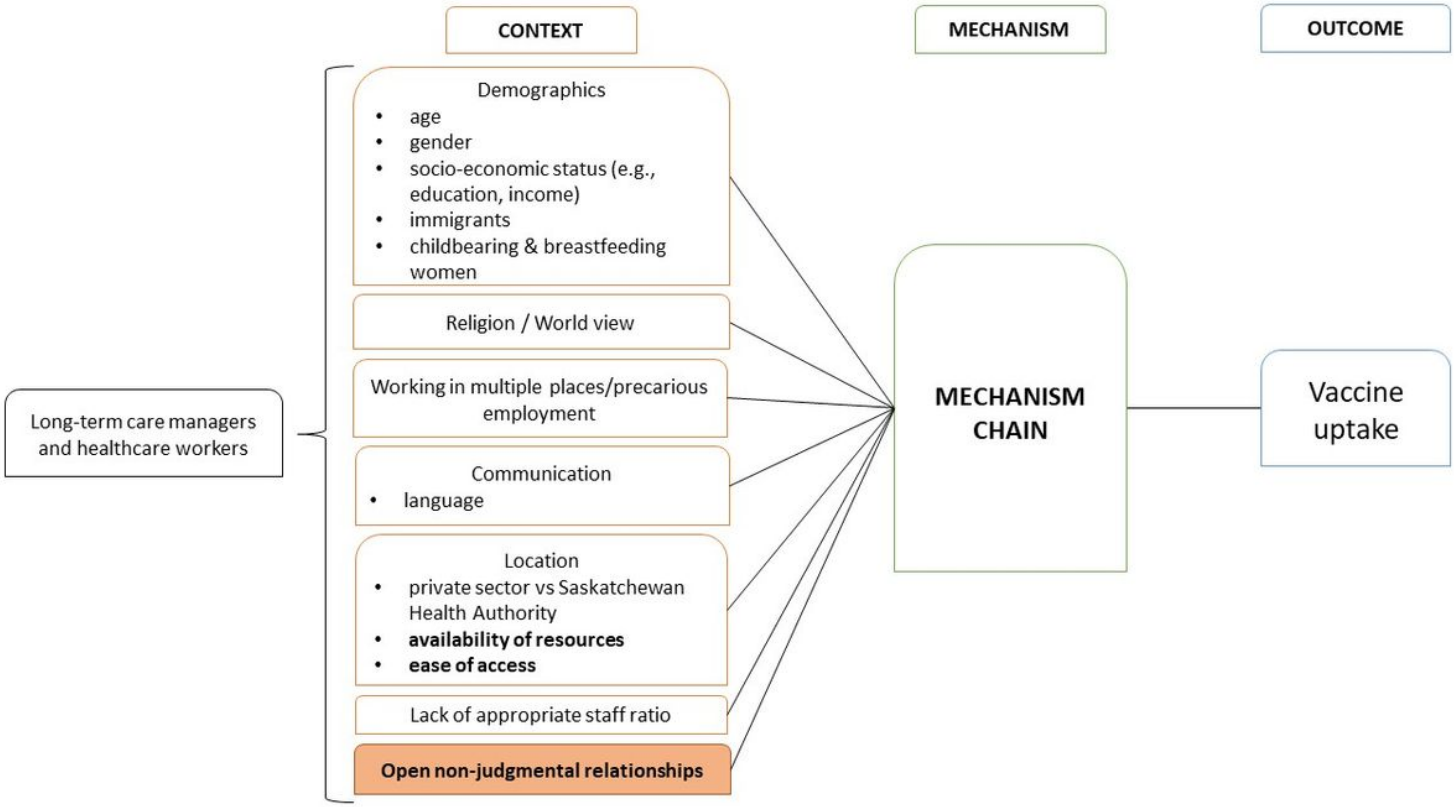

Figure 6

Final program theory for long-term care managers and healthcare workers

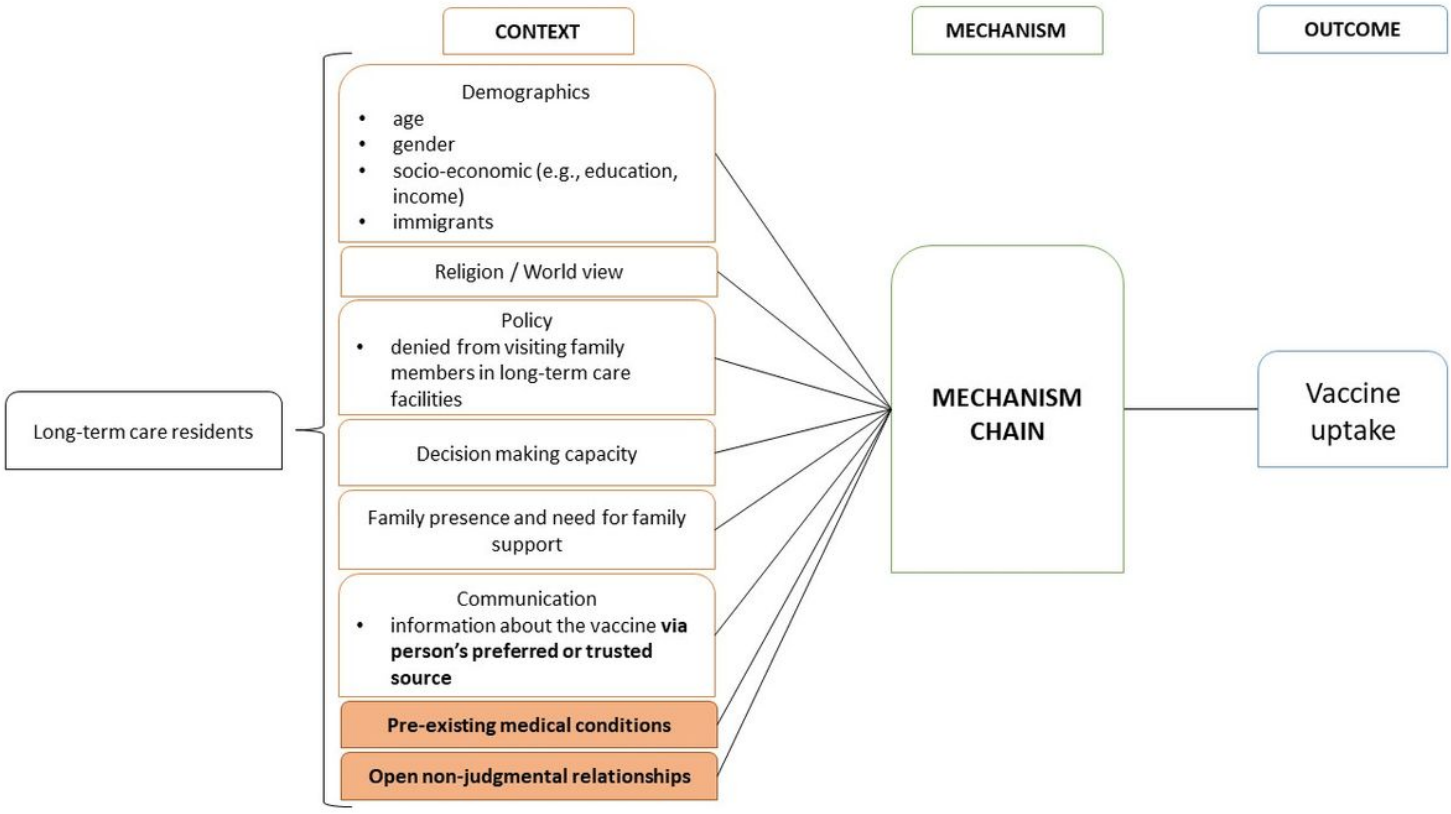

Figure 7

Final program theory for long-term care residents

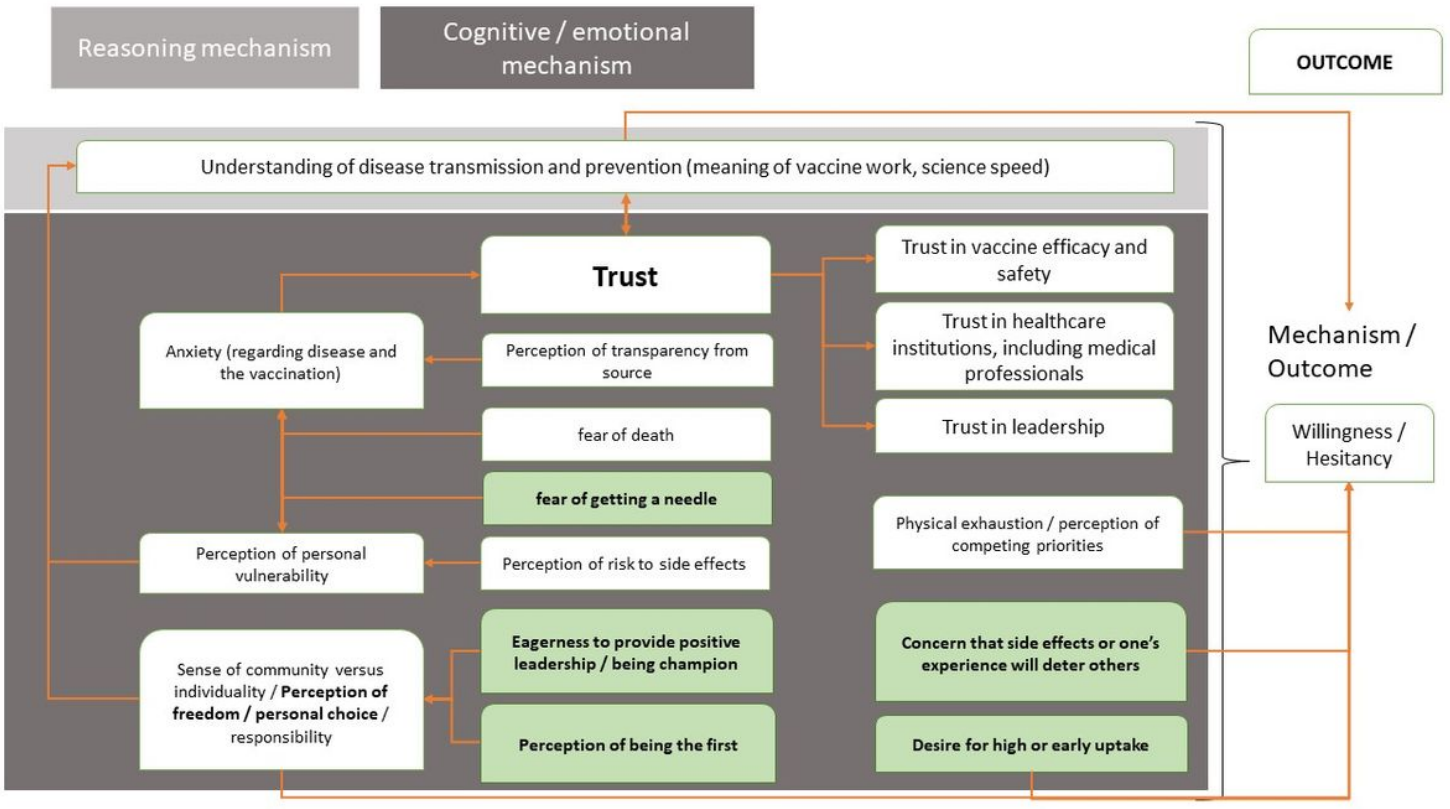

Figure 8

Final program theories mechanism chain for vaccine recipients

Supplementary Files

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- Additionalfile1GRIPP2SF.docx
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- Additionalfile3InterviewGuide.docx
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