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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Abstract :

Objective : This paper presents the results of a realist evaluation of knowledge translation (KT) strategies implemented in the field of cancer prevention at the local level in France.

Design : Realist evaluation study**.**

Setting : The target population comprised decision makers and field professionals working in prevention and public health services operating in regions of France (i.e., ARS, IREPS, and their partners).

Participants : This evaluation collected data from 2 seminars, 82 interviews, 18 observations, and 4 focus groups over 18 months.

Intervention : the TC-REG project combined various activities: Supporting access to and adaptation of usable evidence, Strengthening professionals' skills in analyzing, adopting, and using the policy briefs, Facilitating the use of evidence in organizations and processes. TC-REG project aimed to evaluate the impact of a support KT process for the use of evidence in cancer prevention concerning the modification of decisions and preventive practices, depending on the authorities in four regions of France.

Results : Collected data allowed to define the configurational recurrences sought at the respondent level, at the regional level, and at the inter-region level. From these raw results eight final refined middle-range theories were defined. Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate it and under what conditions. These analyses provided a basis for the production of seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Conclusion : The results obtained from the analyses led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion.

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Ethics and dissemination:T his study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

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Strengths and limitations of this study'

- The large amount of qualitative data allowed us to create a knowledge translation taxonomy and to develop eight middle-range theories illustrating how to activate mechanisms and under what conditions.
- This study provided a basis for the production of seven operational and contextualized recommendations to develop knowledge translation (KT) to inform regional policy-making regarding health promotion and disease prevention.
- The results obtained from the analyses described here led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion

KEYWORDS : Knowledge transfer; Realist evaluation; France; Prevention; Public health, Cancer

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Competing interests

The authors declare that they have no competing interests.

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Introduction

Evidence-based decision-making and practice are major issues in public health. For researchers, this means looking ahead to the dissemination of findings and integrating different types of knowledge and decision-making challenges [1]. It also implies a need for greater collaboration between the research community and decision-makers [2]. Even if decision-makers, stakeholders, and researchers mostly agree that it is necessary to move forward with evidence-informed practices and policy-making, some barriers persist related to people, organizations, contexts, and evidence's attributes [3–5]. Gervais et al. [3,6] suggested that KT research concerning decision-making processes offers multiple explanatory factors, which can be classified in three categories. The first category relates to the specific properties of the evidence itself: nature, availability, accessibility, quality and credibility, intelligibility, ability to meet needs, adaptability, and transferability [6]. The second category relates to the characteristics of decision-makers: beliefs or personal values, political leanings, sociodemographic characteristics, level of education, previous experiences, motivation, and ability to interpret data. These characteristics may influence how new knowledge is addressed during the decision-making process [7]. The third category relates to the characteristics of the organizations and local contexts in which knowledge producers and users perform their work [3]: openness to change; material, human, and financial resources available for KT; social and political context in the external environment; style of management; leadership; staffing; and stakeholder coalitions. Multiple barriers to the adoption of evidence in the field of public health underline the nonlinear process between knowledge production and knowledge use. These barriers prevent optimal production and use of evidence. To address this, it is necessary to assess how

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knowledge is produced and used; to enhance the understanding of decision-making processes and mechanisms; and to examine the abilities of public health services to integrate research findings into their decisions and operations. This assessment requires a systematic approach that includes the adaptation of scientific knowledge; the abilities of users to capture, understand, and apply available evidence; and the presence of an organizational and supportive culture for use of this evidence. These are the major challenges of knowledge translation (KT)[8], defined as "the group of activities and interaction mechanisms that foster the dissemination, adoption and appropriation of the most up-to-date knowledge possible for use in professional practice and in healthcare management" [9].

Over the past several decades, a growing body of literature has been published regarding KT [8,10,11]. Facilitators and barriers related to KT have been studied in several contexts [12–14]; several KT frameworks that provide a mapping of KT processes have been described [15]. Although these frameworks are helpful for understanding the key elements involved in KT, they lack consistency regarding implementation of KT schemes in local contexts because they provide broad concepts without concrete examples of KT activities to implement. The literature highlights the insufficient dissemination of scientific knowledge [16–20]; it also emphasizes that, to be effective, KT modalities must be contextualized to the environment in which knowledge dissemination is required. Thus, the effectiveness of KT strategies depends on the context in which they are implemented [8,21–24]. The contextualization of KT strategies is therefore necessary to remove barriers to knowledge use.

This paper presents the results of a realist evaluation study of KT strategies implemented in the field of health promotion and prevention disease at the local level in France. The aim of the TC-

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REG (i.e. “Transfert de Connaissances en REGion”) study was to evaluate the impact of a support process for the use of evidence in cancer prevention to influence the decisions and preventive practices in four regions of France. This study documented the mechanisms, processes, the configurations (i.e., Contexts/Mechanisms/Outcomes [CMOs]) [25] and the conditions of effectiveness established as a result of this support to ensure KT.

RAMESES II reporting standards for realist evaluations were used [26].

Methods/design

Theoretical framework

The realist approach [25] is increasingly used for appraising the interactions among an intervention, its mechanisms, and its contexts. The overall aim is to achieve a better understanding of an intervention’s success factors and how these may be replicated in other contexts. In realist evaluation, developed by Pawson and Tilley [25], the effectiveness of the intervention depends on the underlying mechanisms that contribute within a given context. Realist evaluation involves identification of CMO configurations. The aim comprises understanding how and why an intervention works. A middle-range theory (i.e., a theory aimed toward describing interactions among outcomes, mechanisms, and contexts and therefore CMO configurations) is established to highlight the mutual influences of intervention and context [27,28]. This approach is linked to the black box paradigm [29] and differs from the experimental paradigm, which evaluates effectiveness without analysis of the mechanism by which an intervention is successful, as well as without the influence of context. Realist evaluation determines whether an intervention worked in a manner consistent with its

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underpinning theory. The generative causality works via three assumptions [30]: i) an intervention is not successful in isolate, and is not the source of a given outcome; ii) all interventions trigger a mechanism or a set of mechanisms that produce an outcome; and iii) all interventions are delivered within specific contexts.

Hence, realist evaluation involves identification of middle-range theories. Hypothesized and validated by empirical investigations, these CMO configurations help to understand how an intervention causes change, considering both context and target group [27,28]. The recurrence of CMOs is observed in successive case studies [28]. To consider context, realist evaluators observe successive cases, which Lawson (quoted by Pawson in 2006 [30]) has described as "demi-regularities of CMOs" (i.e., regular, not necessarily permanent occurrences of an outcome when an intervention triggers one or more mechanisms in a given context) [28]. Analysis of these recurrences in different contexts allows the isolation of key elements that can be replicated in a family of contexts. This yields middle-range theories that become increasingly robust with progression among cases. "These middle-range theories, in certain conditions, predict possible intervention outcomes in contexts different from the one in which the intervention was tested" [28,31].

Applied to our case

As the realist principle is suitable for studying non-linear interactions in complex systems, we adopted this approach [32]. In our study, each region involved in the TC-REG project, with its own context, constituted a case. For each case, the intervention was studied to identify contributory mechanisms in a given context, along with the variation in outcomes. CMO configurations were identified through analyses of successive cases. A cross-case analysis was

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performed to highlight recurrent CMO configurations and thus identify key features for possible replication.

Drawing on the literature and experience of professionals locally involved in the TC-REG project, initial middle-range theories were established [25,30], then tested in each case (i.e., region) through collection of qualitative data [28].

Mechanisms were identified qualitatively, in accordance with the definition of Ridde et al.: "a mechanism is an element of reasoning and reaction of an agent with regard to an intervention productive of an outcome in a given context" [33,34], and in accordance with the definition of Cambon et al.: "What characterizes and punctuates the process of change and hence, the production of outcomes"[35].

In a realist approach, interventional elements contribute to the context. Contextual elements have been included among all elements collected qualitatively that satisfy the following definition: elements located in time and space that may affect the intervention and the outcomes produced. Therefore, this study distinguished between Ci (for contextual factors linked to the intervention) and Ce (for external contextual factors that are not linked to the intervention).

Population

This study was conducted in four regions of France[1] and within different types of organizations and their partners: regional health agencies (ARS[2]), which are responsible for policy-making

[1] Paca, Brittany, Martinique, Normandy
[2] Agence Régionale de Santé : regional health agency

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and prevention policies; and non-profit organizations (IREPS[3]). IREPS develop health promotion and prevention programs; they also provide methodological supports to field professionals for the implementation of prevention interventions in different settings (e.g., workplaces, schools, care settings, recreation and community centers, and rural or urban areas). ARS and IREPS work collaboratively to implement prevention and health policies in local contexts.

This study focused on stakeholders who agreed to implement TC-REG in the 4 regions. The sample of this study is composed of :

- ARS public health professionals: five agents per region (deputy directors in charge of prevention, heads of strategy departments, and project managers);
- IREPS professionals: 10 people per region (directors, project managers, and communication managers);
- Members of specialized prevention commissions within the Regional Conferences on Health and Autonomy and members of the Public Policy Coordination Commission, both dedicated to prevention in various regions of France (five people) and partners of IREPS and ARS.

These 65 persons will be named TC-REG project manager in this article.

Patient and Public Involvement

The TC-REG study does not include any patient or public involvement in terms of setting research priorities, defining research questions or outcomes, providing input into the study design, or disseminating the results. The research participants answered interviews.

[3] Instance Régionale d'Education et de Promotion de la Santé pour tous : Regional organization for health promotion and education

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Intervention

The intervention is a knowledge translation plan implemented differently in each region. It was elaborated through a collaborative process combining : i) literature analyses, especially the recent literature like the report entitled "The science of using science: researching the use of research evidence in decision-making" [2]; and ii) workshops gathering stakeholders from the IREPS and ARS (20 people). Its aim was to collectively become acquainted with and master the concept of KT, identify effective strategies highlighted in the literature and their conditions of transferability, and define the middle-range theory supporting the study and the intervention theories of each region to implement the KT. This seminar also enabled a consensus definition of the initial middle-range theory (C/M/O)

Box 1: The TC-REG Initial middle-range theory).

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Box 1: The TC-REG Initial middle-range theory

Initial middle-range theory

"The modalities of an effective knowledge transfer scheme combine levers that:

- promote access to information and an adaptation of it (Ci)*,
- promote the development of capacities to understand and use them (Ci)*,
- allow the modification of organizational processes (Ci)* in order to facilitate their production and their appropriation in practice settings.

These modalities of KT produce an increasing use of scientific knowledge (O)*** by reinforcing:

- the perception of their usefulness (M)**,
- the motivation to use them (M)**,
- the ability to adapt them to the issues present in practical settings (M)**".

*Ci=contextual factors linked to the intervention
**M= Mechanism
**O= Outcome

At this point, no contextual factors were identified, because there was no consensus on this topic among participants. This process was described in the published study protocol [36]. These KT plans were implemented in the 4 regions over a 12-month period. Each KT plan aims

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to improve the use of Evidence-based prevention intervention synthesis (SIPREV) realized by the research team in partnership with the International Union for Health Promotion and Education. The SIPREV consist of six summaries of systematic reviews concerning: nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life, and psychosocial skills. These summaries present effective prevention practices. These documents were distributed in the four regions in September 2018.

In each of the 4 regions the following categories of activities were combined : i) Supporting access to and adaptation of scientific and usable evidence, especially policy briefs, ii) Strengthening professionals' skills in analyzing, adopting, and using the policy briefs in the course of their practices and decision-making processes (e.g., training, journal club, and tutoring); iii) Facilitating the use of evidence in organizations and processes (e.g., collaborative workshops, normative processes, and incentives). The detailed activities implemented in regions and corresponding to these operational objectives have been transcribed into a standardized taxonomy published by Affret et al. [37].

Data collection

This study alternated between theoretical and empirical stages. Data collection consisted of qualitative investigations through interviews and observations. The results were discussed and enriched during a seminar on 18 October 2019 with the TC-REG project manager of the four regions involved. More details regarding this study are available in the published study protocol [36].

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Based on the middle-range theory (developed during the seminar in May 2017) and to collect CMOs related to the realist analysis, three series of interviews and one series of observations were conducted.

The first round of non-directive interviews aimed to specify, with reference to the initial middle-range theory, the potential mechanisms to be activated and the external contextual elements (so-called Ce) missing in our initial intervention theory. Thirty-six face to face interviews were conducted in October/November 2017, which led to the identification of several contexts and mechanisms (see Table 1:Objective, data, and qualitative investigation methods for details).

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Table 1:Objective, data, and qualitative investigation methods

Round	Objective	Methods	Sample	Data collected	Timeframe
1st round of interviews	Specify, with reference to initial middle-range theory, mechanisms to be potentially activated, as well as contextual elements (missing in initial theory)	Nondirective interviews: Q1: What do you think about the use of data from science and what do you put in this category? Q2: Has this idea evolved? Q3: How has it evolved?	36 interviews with TC-REG project managers in these regions : - Brittany: 8 - Martinique: 12 - Normandy: 9 - PACA: 7	**M:** Mechanisms Three mechanisms identified in initial middle-range theory: - Perception of usefulness (instrumental utility, conceptual utility, strategic utility) - Perception of abilities to use middle-range theory: knowledge, experience, capability (psychosocial skills) - Perception of motivation **Ce: Contextual elements related to:** People: -Initial training: school career, level of	October/November 2017

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		Q4: How do you explain these developments?		- Work experience - Age and years of experience in office - Continuing education on data/research	
Observations	Identify local contextual elements and mechanisms activated by use of evidence-based data (SIPREV or other)	Nonparticipating observations	18 observations: - Brittany (n = 1) - Martinique (n = 2) - Normandy (n = 12) - PACA (n = 3)	- Awareness - Leadership Organization - Instituted modalities of the use of scientific data - Material resources: databases, magazine package, newsletter, mailing lists - Human resources: staff who can help to find, interpret, and use the results of the research (e.g., training) - Prior partnership with researchers/universities - Dedicated spaces/moments for communication with partners (e.g., meetings, seminars)	Throughout TC-REG project

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				- External factors (e.g., PRC, PRS, Ministry) - Political impulse	
2nd round of interviews	Identify KT activities currently carried out among regions to determine taxonomy enabling comparison	Semi-directive interviews and regional focus groups	10 interviews with TC-REG project managers in these regions: - Brittany *n* = 2 - Martinique *n* = 2 - Normandy *n* = 3 - PACA *n* = 3 4 focus groups (1/region)	**Ci**: Determine KT activities carried out among regions according to transfer plan defined in August 2017. Activities were then labeled to determine Cis	February/August 2018
3rd round of interviews	Identify **Ci-Ce-M-O** configurations in IG	Semi-directive interviews	36 interviews with TC-REG project managers in these regions: - Brittany: 7 - Martinique: 10 - Normandy: 10	**Ci-Ce-M-O configurations:** i.e., answer to this question: through which mechanism(s) does the increased use of evidence take place and what activities and contextual circumstances can influence it? A reminder was made for	April/June 2019

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			PACA: 9	each mechanism identified after the first round (leaving the possibility of mentioning others).	

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In the second round, the interviews were semi-directive and aimed to identify KT activities (so-called Ci) actually carried out in the regions, thereby determining a taxonomy that would enable them to be compared among regions. Ten semi-directive face to face interviews with the TC-REG project managers in the regions and four focus groups were conducted between February 2018 and August 2018. This round of data collection allowed precise determination of KT activities carried out in the regions, in accordance with the KT plan defined in August 2017, as well as collection of Cis. More details have been described in Affret et al [37].

The third round of interviews aimed to identify CeCiMO configurations. In total, thirty-six semi-directive telephone interviews were conducted between April and June 2019.

For all interviews, professionals were selected according to the following criteria: i) Participation in TC-REG study ; ii) Agreement to participate in the interviews; iii) Agreement with this use of the data extracted from the interviews ; iv) Diversity among institutes and professions (i.e., managerial and non-executive positions).

The observations aimed to identify local contextual elements (Ce) and mechanisms (M) activated by the use of evidence-based data (evidence-based prevention intervention synthesis or other). Eighteen observations were conducted during the TC-REG project (Table 1:Objective, data, and qualitative investigation methods).

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Data analysis

Collected data were coded and analyzed with NVivo® software. Because the three series of interviews and the single set of observations comprised different types of information, they helped to iteratively establish information regarding CMO configurations at stake. The data were analyzed by two researchers (LC et OA), then compared and reanalyzed to reach a consensus between the two. Data were coded to identify different levels of information. A first level of coding and analysis was used to identify and separate: i) favorable/unfavorable contexts element to use scientific data, especially the data in SIPREV (Ce), ii) arguments evocated by the panel pro or cons the use of scientific data (foreshadowing the mechanisms to be activated, M). Then, a second, more detailed level of coding allowed specification of the Ce and M to be activated in the use of scientific knowledge.

The second round of interviews allowed the research team to identify a list of KT activities carried out in the four regions. This list was presented at the 2nd steering committee meeting on 13 February 2019 to establish consensus regarding the wording of the activities. Thus, 18 distinct KT actions were identified; these were grouped into 11 strategic categories, thus constituting a taxonomy. The elaboration of a standardize taxonomy helped us to use the same definition of the same activity in the third analysis described next. This specific work is published elsewhere [37].

The third round of reviews allowed the researchers to identify the CeCiMO. For each mechanism (those identified following the second round of interviews or newly cited) cited by each professional as having evolved, the content analysis focused on the activities and

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contextual elements that had enabled its evolution. The analysis was therefore based on 3 nodes of analysis: 1) which mechanisms activated by the KT plan, 2) for each mechanism, which activity of the KT plan influenced (based on the KT taxonomy evocated before) it, 3) for each activity, which element of the context influenced it (in the list elaborated after the 1st round of interviews or newly evocated). This analyze allowed to determine a list of different CeCIMOs, by region (the four) or by types of respondent (policymakers or field professionals). We then carried out a transversal analysis of the different CeCiMOs in order to define the configurational recurrences or semi-regularities (i.e. the repetitive CeCiM0) according this rule: activities [Ci] in which association frequency with mechanisms [M] was higher than the average of the associations; contexts [Ce] in which association frequency with mechanisms [M] AND with activities [Ci] was higher than the average of the associations. This allows us to produce a shared list of interregional (most generalizable) CeCIMOs.

The results of the analysis of the series 2 and series 3 interviews were discussed during a seminar on 18 October 2019, which brought together two people per ARS and IREPS from each of the four regions. This discussion allowed validation of the final CeCiMO configurations (middle-range theories) defined by the analysis. **Error! Reference source not found.Error! Reference source not found.**illustrates the timeline of the TC-REG project.

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Results

Raw results

Qualitative evidence allowed identification of links among components of the middle-range theories. The following three mechanisms were most strongly involved in the use of scientific knowledge among professionals:

- Perception of strategic utility (i.e., to legitimize practice):

"That's it, we really need scientific data, proven data to support what they are saying to be taken seriously."

Albert, Ireps

- Perception of instrumental utility (i.e., to change or improve practice):

"It gives us reliable elements to be able to adapt, to build our actions, well… I see it in that sense"

Véronique, Organization

- Ability to master these data (i.e., ability to use data easily and independently):

"The data transmitted by TC-REG (the SIPREVs) will be able to evolve as a support for work and validation of scientific data in the ground and to apply them concretely"

Fannie, ARS

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For each of these three mechanisms, the most important activities were: i)Communication regarding scientific data, ii) Adaptation to realities encountered in the field by the professionals, iii) Support activities for the use of these data.

Contexts that had the greatest influence on activities were : i) political and organizational contexts, as well as ii) previous experience regarding use of scientific evidence in practice.

Final middle-range theories

From these raw results eight final refined middle-range theories were defined (see Figure 2: Final MRTs). Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate these mechanisms and under what conditions they will be activated.

1. Use of scientific knowledge (O) is facilitated if professionals **feel able to understand it (M)**. This perception is facilitated by activities that help to change practices (e.g., training, support, and seminars) (Ci), particularly if the organizational context facilitates these practices (Ce) (e.g. creating trained team dedicated to these activities) and, if there is a political will to encourage it (Ce), and if the professionals gain experience from it (Ce).
2. Use of scientific knowledge (O) is facilitated if professionals **feel able to autonomously become acquainted with or master (M)** it in their practice. This perception is facilitated by activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data (Ci), particularly when the organization facilitates this use (Ce), when there is an institutional policy promoting the transfer of knowledge (Ce), and when professionals gain experience from it (Ce). This perception is also increased by communication/dissemination activities based on scientific data (Ci), when they are adapted to the reality and needs of professionals (Ci). These activities are more effective if professionals are familiar with the dissemination channels (Ce).

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3. Use of scientific knowledge (O) is facilitated if professionals **feel able to locate and identify** such knowledge (M). This perception is facilitated by communication activities regarding these data (Ci), especially if the professionals know where to find these activities (Ce). It is also facilitated by support activities that can lead to changes in behavior (e.g., training, support, and seminars) (Ci), especially if the organization facilitates their use (Ce), if the institution encourages it (Ce), and if the professionals have some experience in the specific topic (Ce).
4. Use of scientific knowledge (O) is facilitated if professionals **are motivated to use it (M)**. This motivation can be induced by communication activities (Ci) and support for changing practices (Ci), especially if the professionals know the dissemination channels (Ce) and have already attempted to integrate these data into their practice (Ce).
5. Use of scientific knowledge (O) is facilitated if professionals perceive them as **useful to improve their practice (M)**. This perception is activated by communication activities (Ci), adaptation of evidence-based data to their reality and needs (Ci), and activities supporting changes in practices (e.g., training, support, and seminars) (Ci), particularly if the organization facilitates the use of these data (Ce), the institution encourages it, and if the professionals have acquired experience in this practice.
6. Use of scientific knowledge (O) is facilitated if professionals **perceive it useful to create new frameworks for analyzing their practices (M)**. This perception is activated by communication activities regarding these data (Ci) and by an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This consideration is more effective if professionals have experience in the use of scientific knowledge (Ce), especially if they have been trained (Ce), and if the organization and institutional political policy are favorable toward KT (Ce).
7. Use of scientific data (O) is facilitated if professionals perceive them as **useful to legitimize or advocate their professional activity (M)**. This perception is facilitated by communication activities regarding these data (Ci), particularly when there is a political will in favor of KT (Ce) and when professionals are aware of the dissemination channels (Ce). This perception is also promoted by activities supporting changes in

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practices (e.g., training, support, and seminars) (Ci) that are supported by political will and professionals' experience (Ce); these are added favorable organizational conditions (Ce).

8. Use of scientific data (O) is facilitated if professionals perceive them as **useful in creating new partnerships (M)**, particularly within the research community. This perception is made possible by activities that support changes in practices (e.g., training, support, and seminars) (Ci), as well as by structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This perception is more effective when professionals can financially justify the use of scientific data (Ce), when the institutional political will is favorable toward KT (Ce), when organizations facilitate this transfer (Ce), and when the professionals have experience in the use of scientific knowledge (Ce).

Taking up in this way each activity present in these refined middle-range theories it is possible to draw up practical recommendations for the field professionals for the development of KT. We have thus elaborated seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Recommendation 1 - Favorable professional environment for KT

Use of scientific evidence is facilitated if the institution in which professionals work shows a clear political will in this area and if the environment makes it easier to understand and to use making it more practical and more rewarding.

Recommendation 2 - Learning experience

While the use of scientific evidence in practice requires a significant initial investment (e.g., cognitive and temporal), the study shows that more use of scientific data by professionals leads to more routine implementation. This constitutes a learning experience.

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Recommendation 3 - Short-term utility and independent appropriation

The mechanisms most strongly involved in anchoring KT use are linked to the possibility of direct use of scientific evidence in the activities of professionals. Indeed, professionals are more inclined to use scientific data when they perceive these data as useful to legitimize, advocate, or concretely modify their practices, as well as when they feel able to mobilize these data independently. This perception is accentuated if these data are accessible, in accordance with their needs (adapted), and if they have been trained in the use of these data.

Recommendation 4 –Promoting the perception of scientific data usefulness

Communication/dissemination of scientific data promotes perception of its usefulness, ability, and motivation to use scientific data, if the environmental working conditions allow for their use. Evidence-based dissemination activities are particularly crucial in:

- Motivation to use scientific evidence, as well as ability to identify and master it.
- Perception of the instrumental utility of scientific evidence in daily practice.
- Perception that use of scientific evidence will bring a new way of presenting their activity (conceptual utility).
- Perception that use of scientific evidence will legitimize their activities, supported by confidence in its added value (strategic utility).

Recommendation 5 – An adapted knowledge

Data transformation and adaptation activities have an impact on the capability to utilize the data and the perception that they allow for concrete changes, if the professional environment is favorable to such changes. Data transformation and adaptation activities for stakeholders, such as inclusion of evidence-based data (via typical communication tools: adaptation and

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dissemination of evidence through video vignettes, explicit and oriented guides, scientific documents, creation of bibliographical selections [evidence-based actions], and multidisciplinary and multi-professional co-construction of KT tools and processes), most notably influence:

- Ability to utilize scientific data in practice.
- Perception that use of scientific data will enable professionals to change their practices (instrumental utility).

Recommendation 6 – Structural activities as facilitator

These activities facilitate the use of scientific data influence, the perceived usefulness of scientific data, particularly in framing practices and mobilizing new partnerships with research or other organizations. Structural activities to facilitate KT (e.g., institutional communication regarding a KT program or plan; use of the KT program to develop specific partnerships ; identification of a style guide for KT activities; development of a support service for KT development; evaluation of promising practices, modification, reinforcement, or activity orientation of an existing KT plan; establishment of internal coordination meetings [how to use evidence] or systematic reminders of the importance [interest and added value] of using scientific data in team and/or project meetings or in professional or financial documents) influence:

- Perception that use of scientific data brings a new way of presenting activities (conceptual usefulness).
- Perception that use of scientific data will allow the development of new partnerships (process utility) with the research community.

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Recommendation 7 – Activities to support KT influence the understanding and perceptions of the usefulness of these data

When the organizational and political environment within the institution is favorable, activities supporting KT will influence the capacity to understand and use scientific data and the perception of the usefulness of these data at multiple levels (i.e., entering into new partnerships, as well as legitimizing and/or renewing one's practices).

Activities to support KT (e.g., specific communication meetings on evidence-based science, awareness on the use of evidence-based data [meetings or seminars], and training to analyze and use scientific knowledge; analysis and exchange workshops; methodological support; existence of a proactive advocate for the deployment of KT [encouragement, mobilization, reminders, and support regarding the development of KT]; methodological support for deployment of KT; creation and dissemination of methodological tools based on scientific data [grids and repositories] to support autonomous use; development of a methodological guide to assist in the implementation of KT, and to facilitate the use of tools developed based on evidence [whether from SIPREV]) influence:

- Capacity of professionals to understand, become acquainted with, and identify evidence from science.
- Their motivation to use evidence from science.
- Their perception that use of scientific evidence will enable changes in practices (instrumental utility), legitimize activities, and convince others of its added value (strategic utility).
- Their perception that use of scientific evidence will enable development of partnerships with the research community if this interaction activity is supported and rewarded financially.

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These recommendations and facilitators are made possible and catalyzed by professionals' experiences of evidence-informed practices and by the official (i.e., political, organizational, or institutional) position, which should be explicitly favorable toward and encourage use of such practices.

Discussion

The aim of this study was to experiment and characterize the factors associated with the success of a KT plan in health promotion and disease prevention settings in the local context in France. Success was defined as the plan's ability to i) enable public health stakeholders to address the challenges of KT and ii) bring about changes in public health policy and practices (i.e., integration of evidence-informed public health and collaborative practices). We sought to explain the parameters and conditions of these strategies to determine their transferability into other contexts by expansion of the results obtained in the first seminar into eight more precise final theories.

Notably, by specifying the middle-range theories in the French context, the results were consistent with numerous studies regarding KT [19,24,38]. Indeed, they confirmed the need to (i) combine KT strategies [24,38–40], (ii) make actions sustainable [41], (iii) transform institutions beyond simply raising the awareness of professionals [42], (iv) adapt the evidence to ensure it could be transferred to each type of audience [39,43–45], and (v) support change [6]. More specifically, our study underlines the particular weight of three major types of

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activities: i) those which help to change practices and promote scientific data use (e.g., training, support, and seminars), ii) those which adapt scientific data (adapted emails, policy-briefs, advocacy, etc.), iii) and those providing support for changing practices by an institutional daily promotion of institutional structure (e.g. existence of a proactive referent for KT roll-out, development of a methodological guide to help KT implementation, development of methodological guides to assist in the use of tools developed using evidence, introducing specific exchange on evidence in current meetings, etc.). Moreover, they confirm four of most influencing contextual parameters to support KT : i) the political will in institution [46], ii) the professionals' experience in evidence use [47] ; iii) the organizational facilitators promoting evidence use (linked to person (adopter), specific practices or supports) help) [42,48], and iv) an immediate benefit in the use of evidence [2].

In addition, this study highlighted the key mechanisms to be activated to enable changes in practice in the KT strategies. They can be grouped into three dimensions: i) capacities: finding, understanding, and appropriating evidence; ii) attitudes: motivation and feeling that evidence is useful; and iii) the perception of a direct interest in the use of evidence: changing practices, legitimizing the activity, advocacy, and formation of new partnerships. With reference to the interventional system concept [35], which emphasizes that mechanisms are the key functions of interventions, the results of these interventions must be transferable into other contexts. Our results confirm that the success of knowledge transfer results from "combinations of knowledge, relationship, and organizational characteristics contribute to knowledge transfer success" which are "dependent on the type of ecosystem partnership involved"[47].

Strengths and limitations:

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Our study highlighted some crucial information from the analyses. The large amount of qualitative data allowed us to create a taxonomy [37] and to develop eight refined middle-range theories and seven recommendations that will be valuable for knowledge and decision-making challenges.

Due to the specificity of our study we made several adjustments to the initial protocol. Two rounds of interviews were initially planned. During the first seminar on May 2017, we were only able to develop a very generalist initial middle-range theory. Indeed, neither the exploratory survey nor the experience of the professionals mobilized in the seminar allowed us to define a more detailed level of KT activity, mechanisms, or contextual elements of influence, which could be used to develop several theories. Furthermore, we did not find any taxonomy in the literature sufficiently operative to structure regional action plans. Because of these observations, we reviewed our investigation strategy in three rounds of interviews, rather than two. We developed a taxonomy of KT activities that allowed comparison of identical activities among regions [37]. These developments strongly mobilized the research team, thus mobilizing the project's resources. Thus, the last seminar could not be carried out.

The limit of this work remains its potential for generalization. The work has been carried out in a particular field and country, the prevention field in France. It would be interesting to check whether these middle range theories are verified in other fields and other countries where the KT development might be more advanced. These investigations could lead us to refine our middle range theories or open to other configurations. Indeed, we can hypothesize that other difficulties would have to be overcome and therefore other mechanisms to be activated.

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Moreover, the follow-up was carried out over 18 months. No doubt that some activities will eventually prove to be not very effective and others will surprise by their effectiveness because they have a longer latency. In fact, both professional practices and their impact take a long time to modify. Moreover this impact could be difficult to observe due to the complexity of what is at stake. There is therefore a real interest in verifying the stability of these middle range theories over time.

Finally, we have not analyzed the potential synergy between Ci and Ce either, even if the observations show some leads. For example, we can observe that some external contextual elements (Ce) such as "pre-trained professionals" echo activities (Ci) "training of professionals in CT".

Notwithstanding these limits, the work carried out nevertheless offers concrete paths for the development of KT by having allowed the groups of activities to specify the conditions for their success and opens the way for further development in terms of research.

Conclusion and perspectives

This study used a realist methodology to reveal the factors associated with the success of a KT plan, and elucidated the mechanisms by which such strategy can bring change in public health policy and practices. We sought to explain the parameters and conditions of these strategies to determine their potential transferability into other contexts through three types of mechanisms to be activated : i) the capacities (finding, understanding, and appropriating evidence) of field professionals; ii) the attitudes, (motivation and feeling that evidence is useful); and iii) the perception of a direct interest in the use of evidence (changing practices, legitimizing the

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activity, advocacy, and formation of new partnerships). We suggest they are the key functions of KT in prevention, which can be activated if a combination of activities and organizational characteristics are gathered.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, it follows the relevant French legislation of the research category on interventional research protocol involving the human person. An informed consent was obtained from all individual participants included in the study.

This study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

The English in this document has been checked by at least two professional editors, both native speakers of English

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Data statement

Not applicable

Authors' contribution

LC supervised the study. JMF, OA and LC drafted this article and all authors revised the manuscript. The project design was developed by LC and OA. OP, OA collected the data. OA and LC analyzed the data under the supervision of LC. JMF contributed to part of this analysis. All authors read and approved the final manuscript.

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List of abbreviations

ANSP: National Public Health Agency

ARS: regional health agency

Ce : Contextual factor not linked to the intervention

Ci : Contextual factor linked to the intervention

CMO: Context – Mechanism – Outcomes

INCa: National Cancer Institute

IREPS : Regional Authority for Education and Health Promotion

TC-REG: Knowledge transfer in regions

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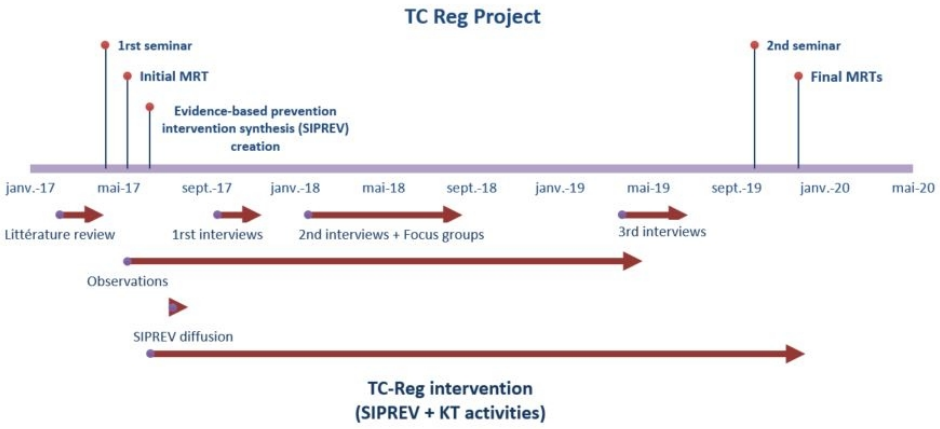

Figure 1: TC-REG Project Timeline

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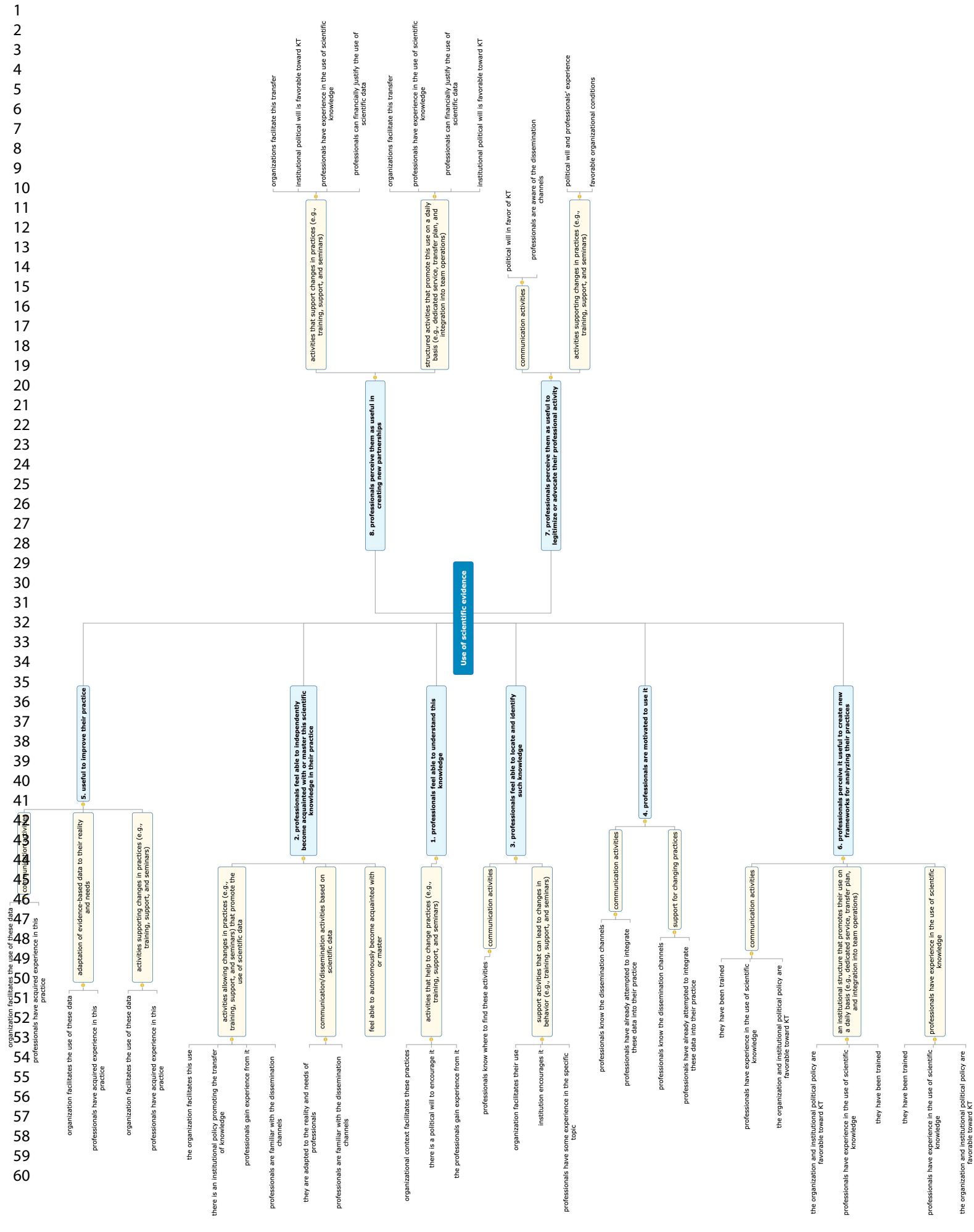
Use of scientific evidence
8. professionals perceive them as useful in creating new partnerships
activities that support changes in practices (e.g., training, support, and seminars)
organizations facilitate this transfer
institutional political will is favorable toward KT
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
organizations facilitate this transfer
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
institutional political will is favorable toward KT
7. professionals perceive them as useful to legitimize or advocate their professional activity
communication activities
political will in favor of KT
professionals are aware of the dissemination channels
activities supporting changes in practices (e.g., training, support, and seminars)
political will and professionals' experience
favorable organizational conditions
5. useful to improve their practice
adaptation of evidence-based data to their reality and needs
organization facilitates the use of these data
professionals have acquired experience in this practice
activities supporting changes in practices (e.g., training, support, and seminars)
organization facilitates the use of these data
professionals have acquired experience in this practice
2. professionals feel able to independently become acquainted with or master this scientific knowledge in their practice
activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data
the organization facilitates this use
there is an institutional policy promoting the transfer of knowledge
professionals gain experience from it
professionals are familiar with the dissemination channels
communication/dissemination activities based on scientific data
they are adapted to the reality and needs of professionals
professionals are familiar with the dissemination channels
feel able to autonomously become acquainted with or master
1. professionals feel able to understand this knowledge
activities that help to change practices (e.g., training, support, and seminars)
organizational context facilitates these practices
there is a political will to encourage it
the professionals gain experience from it
3. professionals feel able to locate and identify such knowledge
communication activities
professionals know where to find these activities
support activities that can lead to changes in behavior (e.g., training, support, and seminars)
organization facilitates their use
institution encourages it
professionals have some experience in the specific topic
4. professionals are motivated to use it
communication activities
professionals know the dissemination channels
professionals have already attempted to integrate these data into their practice
support for changing practices
professionals know the dissemination channels
professionals have already attempted to integrate these data into their practice
6. professionals perceive it useful to create new frameworks for analyzing their practices
communication activities
they have been trained
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT
an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
the organization and institutional political policy are favorable toward KT
professionals have experience in the use of scientific knowledge
they have been trained
professionals have experience in the use of scientific knowledge
they have been trained
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT

		TITLE	Reported in document Y/N/Unclear	Page(s) in document
1		In the title, identify the document as a realist evaluation	Y	1
SUMMARY OR ABSTRACT				
2		Journal articles will usually require an abstract, while reports and other forms of publication will usually benefit from a short summary. The abstract or summary should include brief details on: the policy, programme or initiative under evaluation; programme setting; purpose of the evaluation; evaluation question(s) and/or objective(s); evaluation strategy; data collection, documentation and analysis methods; key findings and conclusions Where journals require it and the nature of the study is appropriate, brief details of respondents to the evaluation and recruitment and sampling processes may also be included Sufficient detail should be provided to identify that a realist approach was used and that realist programme theory was developed and/or refined	Y	2
INTRODUCTION				
3	Rationale for evaluation	Explain the purpose of the evaluation and the implications for its focus and design	Y	4
4	Programme theory	Describe the initial programme theory (or theories) that underpin the programme, policy or initiative	Y	4&9
5	Evaluation questions, objectives and focus	State the evaluation question(s) and specify the objectives for the evaluation. Describe whether and how the programme theory was used to define the scope and focus of the evaluation	Y	5
6	Ethical approval	State whether the realist evaluation required and has gained ethical approval from the relevant authorities, providing details as appropriate. If ethical approval was deemed unnecessary, explain why	Y	2 and 28
METHODS				
7	Rationale for using realist evaluation	Explain why a realist evaluation approach was chosen and (if relevant) adapted	Y	8
8	Environment surrounding the evaluation	Describe the environment in which the evaluation took place	Y	6
9	Describe the programme policy, initiative or product evaluated	Provide relevant details on the programme, policy or initiative evaluated	Y	9
10	Describe and justify the evaluation design	A description and justification of the evaluation design (i.e. the account of what was planned, done and why) should be included, at least in summary form or as an appendix, in the document which presents the main findings. If this is not done, the omission should be justified and a reference or link to the evaluation design given. It may also be useful to publish or make freely available (e.g. online on a website) any original evaluation design document or protocol, where they exist	Y	7 & 12
11	Data collection methods	Describe and justify the data collection methods – which ones were used, why and how they fed into developing, supporting, refuting or refining programme theory Provide details of the steps taken to enhance the trustworthiness of data collection and documentation	Y	11&12
12	Recruitment process and sampling strategy	Describe how respondents to the evaluation were recruited or engaged and how the sample contributed to the development, support, refutation or refinement of programme theory	Y	8
13	Data analysis	Describe in detail how data were analysed. This section should include information on the constructs that were identified, the process of analysis, how the programme theory was further developed, supported, refuted and refined, and (where relevant) how analysis changed as the evaluation unfolded	Y	19&20
RESULTS				
14	Details of participants	Report (if applicable) who took part in the evaluation, the details of the data they provided and how the data was used to develop, support, refute or refine programme theory	Y	9&12-18
15	Main findings	Present the key findings, linking them to contexts, mechanisms and outcome configurations. Show how they were used to further develop, test or refine the programme theory	y	21-24
DISCUSSION				
16	Summary of findings	Summarise the main findings with attention to the evaluation questions, purpose of the evaluation, programme theory and intended audience	y	28
17	Strengths, limitations and future directions	Discuss both the strengths of the evaluation and its limitations. These should include (but need not be limited to): (1) consideration of all the steps in the evaluation processes; and (2) comment on the adequacy, trustworthiness and value of the explanatory insights which emerged In many evaluations, there will be an expectation to provide guidance on future directions for the programme, policy or initiative, its implementation and/or design. The particular implications arising from the realist nature of the findings should be reflected in these discussions	y	30
18	Comparison with existing literature	Where appropriate, compare and contrast the evaluation's findings with the existing literature on similar programmes, policies or initiatives	y	23-25
19	Conclusion and recommendations	List the main conclusions that are justified by the analyses of the data. If appropriate, offer recommendations consistent with a realist approach	Y	24-27&31
20	Funding and conflict of interest	State the funding source (if any) for the evaluation, the role played by the funder (if any) and any conflicts of interests of the evaluators	Y	3

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Implementation Science

STUDY PROTOCOL

Open Access

Evaluation of a knowledge transfer scheme to improve policy making and practices in health promotion and disease prevention setting in French regions: a realist study protocol

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Abstract

Background: Evidence-based decision-making and practice are pivotal in public health. However, barriers do persist and they relate to evidence properties, organisations and contexts. To address these major knowledge transfer (KT) issues, we need to rethink how knowledge is produced and used, to enhance our understanding of decision-making processes, logics and mechanisms and to examine the ability of public health services to integrate research findings into their decisions and operations. This article presents a realist evaluation protocol to assess a KT scheme in prevention policy and practice at local level in France.

Methods/design: This study is a comparative multiple case study, using a realist approach, to assess a KT scheme in regional health agencies (ARS) and regional non-profit organisations for health education and promotion (IREPS), by analysing the configurations contexts/mechanisms/outcomes of it. The KT scheme assessed is designed for the use of six reviews of systematic reviews concerning the following themes: nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life and psychosocial skills. It combines the following activities: supporting the access to and the adaptation of scientific and usable evidences; strengthening professionals' skills to analyse, adopt and use the evidences in the course of their practices and their decision-making process; facilitating the use of evidence in the organisations and processes. RAMESE II reporting standards for realist evaluations was used.

Discussion: The aims of this study are to experiment and characterise the factors related to the scheme's ability to enable public health stakeholders to address the challenges of KT and to integrate scientific knowledge into policy and practice. We will use the realist approach in order to document the parameters of successful KT strategies in the specific contexts of preventive health services in France, while seeking to determine the transferability of such strategies.

Keywords: Knowledge transfer, Realist evaluation, Complex intervention, Prevention, Public health

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Background

Evidence-based decision-making and practice are major issues in public health. For researchers, this means looking ahead to the dissemination of findings and integrating different types of knowledge and decision-making challenges [1]. It also implies greater collaboration between the research community and decision-makers [2]. Public health research issues have to be approached alongside societal and health issues too. It follows that evidence-based policy-making and planning in public health offer a way to improve the efficiency, credibility, and sustainability of health systems [1]. Furthermore, this can lead to a better social acceptance of the chosen decisions and interventions [3].

Despite the general agreement about the interest of evidence informed practices and policy-making (EIDM), barriers do persist in both the production and use of evidence. These barriers relate to people, organisations, contexts and properties of evidences [4]. To address this, it is necessary to rethink how knowledge is produced and used, to enhance our understanding of decision-making processes, logics and mechanisms and to examine the ability of public health services to integrate research findings into their decisions and operations. This requires a systemic approach, which includes the adaptation of scientific knowledge, the ability of users to capture, understand and apply the available evidence, as well as an accurate organisation and a supportive culture for using evidence. These are the major challenges of KT, defined by the National Public Health Institute of Quebec (INSPQ) as "the group of activities and interaction mechanisms that foster the dissemination, adoption and appropriation of the most up-to-date knowledge possible for use in professional practice and in healthcare management" [5].

What stands in the way of the use of scientific evidence in public health?

In France, there is no formal and structural KT scheme. There are a few initiatives led by the National Public Health Agency (ANSP) and the National Cancer Institute (INCA), which for instance produce literature reviews. But policy-makers and prevention professionals do not use them. It confirms that a passive diffusion of knowledge is not effective, and the effectiveness of KT strategies depends on the context in which they are implemented [6–10]. The contextualization of the KT strategies is necessary to remove barriers to knowledge use. According to Gervais et al. [3, 11], KT research on decision-making processes offers a number of explanatory factors which may be classified in three categories. The first relates to the specific properties of the evidence itself: nature, availability, accessibility, quality and credibility (data and sources), intelligibility, ability to meet needs, adaptability and transferability [3]. The second category relates to the personal characteristics of decision-makers: beliefs or personal values, political leanings, socio-demographics, level of education, previous experiences, motivation and ability to interpret data, etc. All of them may influence how new knowledge is addressed in the decision-making process.[12]. The third category refers to the characteristics of the organisations and local contexts in which knowledge producers and users work [4]: openness to change, material, human and financial resources available for KT, social and political context in the external environment, style of management, leadership, staffing, stakeholder coalitions, etc. Consequently, the multiple barriers to the adoption of evidence in the field of public health underline the non-linear process between knowledge production and knowledge use. If these barriers are to be overcome, we need to address all the parameters that affect the decision-making process. This is a focal point for KT research.

The mechanisms of an effective knowledge transfer

Various strategies are available to overcome barriers to the use of KT. A recent work conducted by Langer et al. identified six mechanisms involved in effective KT:

- "Awareness" (M1) is defined as building awareness for, and positive attitudes toward, evidence-informed decision-making (EIDM). This mechanism emphasises the importance of decision-makers' valuing the concept of EIDM.
- "Agree" (M2) is defined as the building mutual understanding and agreement on policy-relevant questions and the kind of evidence needed to answer them. This mechanism emphasises the importance of building mutual understanding and agreement on policy questions and what constitutes fit-for-purpose evidence.
- "Communication and access" is (M3) defined as providing communication of, and access to, evidence. This mechanism emphasises the importance of decision-makers receiving effective communication of evidence and convenient access to it.
- "Interact" (M4) is defined as the interaction between decision-makers and researchers. This mechanism emphasises the importance of decision-makers interacting with researchers in order to build trusted relationships based on mutual trust, collaborate, and gain exposure to a different type of social influence.
- "Skills" (M5) is defined as supporting decision-makers to develop skills in finding and making sense of evidence. This mechanism emphasises the importance of decision-makers' having the necessary skills to identify, appraise, synthesise evidence, and integrate it with other information and political needs.

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- "Structure and process" (M6) is defined as influencing decision-making structures and processes. This mechanism emphasises the importance of decision-makers' psychological, social and environmental structures and processes (e.g. personal models, professional norms, habits, organisational and institutional rules) in providing means and barriers to action.

The authors underline that these strategies are effective if combined and contextualized in their implementation setting, confirming previous work of Ridde et al. [13] and Barwick [14]. Consequently, we hypothesize that in France, as elsewhere, simple diffusion and "one size fits all" strategies are not effective.

In this paper, we present the protocol of a realist evaluation study of knowledge transfer strategies implemented in the field of health prevention at a local level in France. We have used RAMESE II reporting standards for realist evaluations [15].

Study objectives and location

The objective of the study is to identify the configurations contexts/mechanisms/outcomes of an effective KT scheme in local prevention sector. This study will be conducted in four French regions and within two types of organisation and their partners: regional health agencies (ARS), which are responsible for policy-making and prevention policies; and non-profit organisations (IREPS). IREPS develop health promotion and prevention programs and provide methodological supports to field professionals for the implementation of prevention interventions in different settings (work places, schools, care settings, recreation and community centres, rural or urban areas, etc.). ARS and IREPS work together to implement prevention and health policies in local contexts.

Methods/design

We have reported this manuscript in line with the RAMESES II reporting standards for realist evaluation.

Study design and conceptual framework

This study is a comparative multiple case study of a KT scheme in the field of health prevention using a realist approach [16, 17]. It concerns French public health services: ARS and IREPS. The case study design is the more suitable research strategy to investigate a phenomenon within its context and analyse this phenomenon's interactions with several other elements relevant for our area of study [18].

The realist approach [17] is increasingly used for appraising the interactions between an intervention, its mechanisms and its contexts. The overall aim is to achieve a better understanding of an intervention's success factors and how these may be replicated in other contexts. This type of evaluation examines what works, under what conditions and for whom, based on a middle-range theory (or configurational theory) which describes the interactions between outcomes, mechanisms and contexts [17, 19]. Thus, realist evaluation integrates the paradigm of black box evaluation [20]. While the experimental paradigm evaluates effectiveness without appraising an intervention's mechanisms of impact, realist evaluation answers the following question: did the intervention work according to the theory underpinning it? This type of evaluation seeks to understand the intervention by focusing on its mechanisms and the influence of context. The mechanism is defined in this case as the "part of a participant's response to an intervention, generally hidden and sensitive to variations in context, and which produces effects" [21]. In realist evaluation, causality is generative, meaning that what generates the effect relates specifically to the interactions between context and cause (here, the intervention methods) [19]. However, as we will study the patterns between these interactions in different contexts, we hypothesise that it is possible to isolate key elements that may apply across a set of contexts. These findings will thus generate intermediate theories that will be sharpened little by little as each case will be investigated.

To conduct a realist evaluation, we alternate theoretical and empirical stages (Cf. Fig. 1: The realist sequences). According to Langer's work [2] and many authors [7, 10, 13, 14, 22], we hypothesize that an effective KT scheme has to combine an access to and an adaption of knowledge, the development of professionals' skills to analyse, adopt and transfer knowledge into their contexts, the improvement of organisations and processes in order to facilitate the integration of knowledge. We also conducted an exploratory qualitative study in the four regions to collect data on the pre-existing scheme and activities related to KT and the potential local barriers. The questions were the following: what kind of KT activities are possible (types, timeline, duration, management)? Who may be involved? What structural/organisational mechanisms would be affected? What contextual factors, outside the control of those involved, would need to be addressed? Data will be collected by means of semi-structured interviews with IREPS directors and ARS public health directors (8 people). Based on the behaviour change wheel theory [23] and an exploration of the behavioural theories used in KT strategies [24], we hypothesize that the change of which will occur in knowledge use may be notably due to the motivation to use knowledge, the perception of its usefulness and practicality and the ability to adapt it in to fit different settings.

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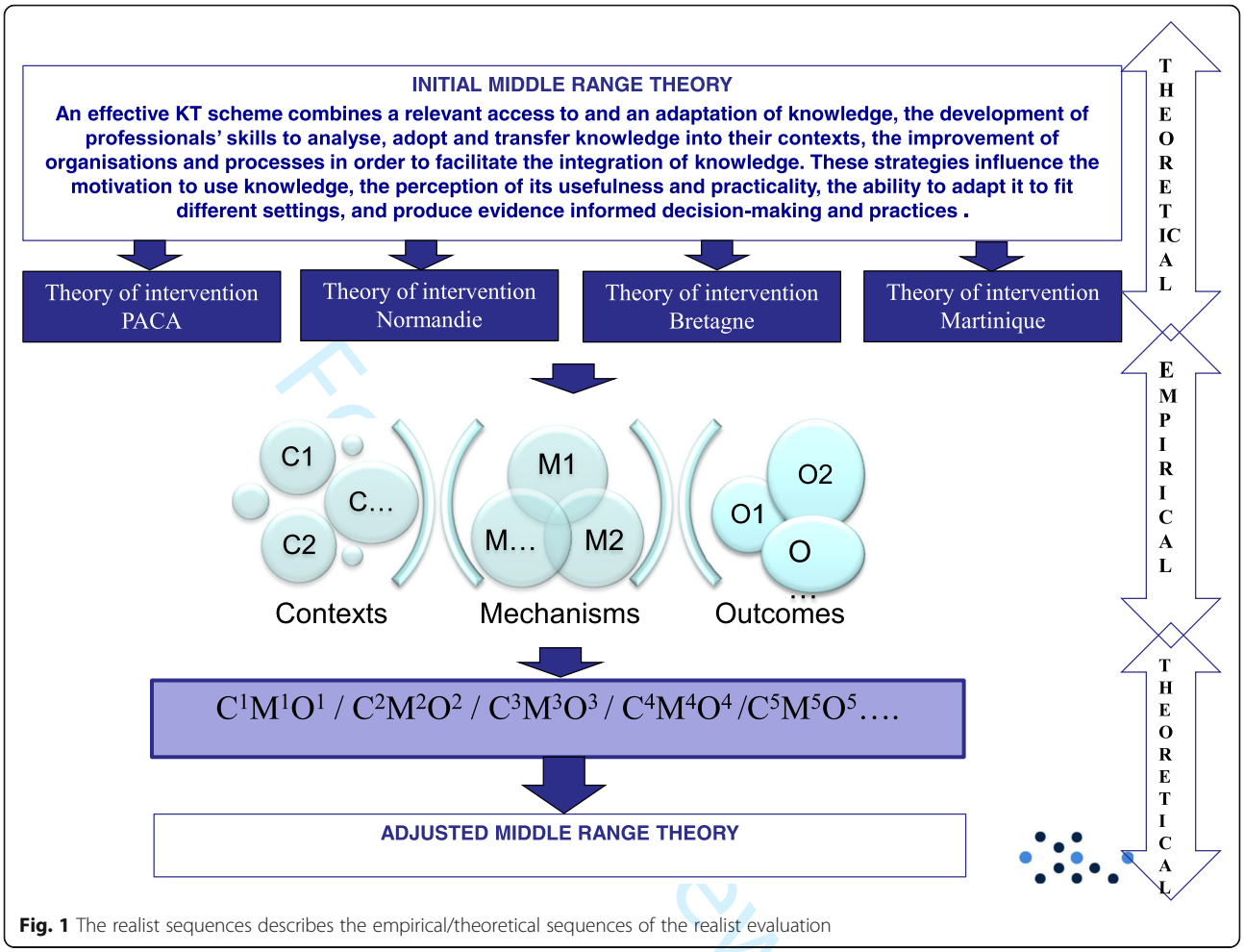

Fig. 1 The realist sequences describes the empirical/theoretical sequences of the realist evaluation

According to all the above scientific literature, and to support our realist evaluation, we built an initial middle range theory, defined as following: "An effective KT scheme combines a relevant access to and an adaptation of knowledge, the development of professionals' skills to analyse, adopt and transfer knowledge into their contexts, the improvement of organisations and processes in order to facilitate the integration of knowledge. These strategies influence the motivation to use knowledge, the perception of its usefulness and practicality, the ability to adapt it to fit different settings, and produce evidence informed decision-making and practices".

This initial middle range theory leads to the design of four theories of intervention one for each region describing the interventions, the expected outcomes, the contexts' parameters and the expected mechanisms. This work will be conducted in a preliminary 2-day workshop, gathering ARS and IREPS professionals. These theories will be applied in the 4 regions, for 12 months, and data will be collected in order to characterize the contexts, mechanisms and outcomes and to determine the effective CMO configurations.

Finally, a cross-sectional analysis of the case studies will be conducted allowing us to identify potential regular CMO patterns, which would constitute an adjusted middle-range theory. The different stages are presented in Fig. 1 (Cf Fig. 1: The realist sequences).

Intervention strategies

The intervention is a KT scheme designed for the use of policy briefs (PBs), which will be written on the basis of six reviews of systematic reviews (completed by international guidelines); an international scientific committee have carried out these reviews. They concern the following themes: nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life and psychosocial skills. These themes are primary in France. They present effective prevention practices.

Based on the report entitled "The science of using science: researching the use of research evidence in decision-making" [25], the scheme combines the following activities:

- Supporting the access to and the adaptation of scientific and usable evidences especially the policy briefs.
- Strengthening professionals' skills to analyse, adopt and use the policy briefs in the course of their practices and their decision-making process (training, journal club, tutoring, etc.).
- Facilitating the use of evidence in the organisations and processes (collaborative workshops, normative processes, incentives, nudge, etc.).

According to the initial middle range theory and the 4 theories of change, professionals will make an action plan to apply them in their local settings. Theses KT activities will be set up over a 12-month period.

Population

The targeted population is composed of prevention and public health services operating in French regions, namely, the ARS and IREPS and their partners. The study will focus on three groups of stakeholders:

- ARS public health professionals: five agents per region (deputy directors in charge of prevention, heads of strategy departments and project managers);
- IREPS professionals: ten people per region (directors, project managers and communication managers).
- Members of specialised prevention commissions within the Regional Conferences on Health and Autonomy (CRSA) and members of the Public Policy Coordination Commission (CCPP) both devoted to prevention in French regions (five people) and partners of IREPS and ARS.

We already have the agreement for the data collection given by the four ARS involved in the project since it began.

Data collection

Data will be collected to document the support scheme's mechanisms and contexts parameters involved in effectiveness. They will be collected before the implementation of the KT scheme at the end and throughout the implementation. They will be collected on the 3 categories of people described before; 20 people per each region (80 at all).

Collected data will characterise the context, the mechanisms relating to the organisation and to the individuals involved, the PBs and the set-up for KT.

A description of data collected and how and they will be collected are presented in Tables 1 and 2, but these variables will be adjusted according to the four theories of intervention and the action plans (Cf. Table 1 : Expected outcomes and Table 2 : Contexts and mechanisms expected).

Data will be collected by means of:

- Semi-structured interviews conducted with the above-mentioned population (20 people per region)
- The observation of health promotion meetings and collective events resulting from the scheme's implementation: project selection committees, selection processes, trainings, seminars, presentations etc. The aim of these observations is to study the types of interactions between the professionals who deal with KT strategies (for instance, leadership, uptake, bottom up or top down approaches).
- A documentary analysis (calls for project, action plans, projects applications, reports of meeting, etc.)

The observation and documentary analysis grids and the interview guideline will be designed based on the four intervention theories and tested on a sample of five stakeholders not involved in the process, but belonging to the IREPS network.

The collection will last 12 months.

Data analysis

Data will be processed through a content analysis [26] defined as "A set of systematic and objective procedures for analysing communication processes in order to obtain indicators (quantitative or not) inferring knowledge related to the conditions (inferred variables) under which meaningful information is both sent and received". This analysis will code, classify and grade content in order to identify patterns, trends and specific features. We will use a software program called *Nvivo* to assist us in conducting and integrating a thematic analysis of the interviews and an analysis of the observation reports. The qualitative analysis will lead to:

- Document the uptake of evidence and the practice changes triggered by the intervention. This will be carried out on a case-per-case basis in monographic format, in order to identify the mechanisms at play, the degree of intervention, the contextual contingencies and the changes arising in the three types of knowledge use (instrumental, conceptual, persuasive).
- Identify the most regular CMO configurations by a cross-analysis of the different cases and a combination of the different data collected according to their linkage with the "context" meanings, "mechanism" meanings and "outcomes" meanings (cf Tables 1 and 2).

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Table 1 Expected outcomes

Stakeholders	Outcomes	Indicators	Data collection
ARS	Agents use policy briefs (PBs) in discussions at committee level	Number of verbatims per meetings Type of PBs or extracts from PBs Ways of using PBs	Semi-structured interview Observation
	Agents use evidences from PBs as criteria of project assessment	Existing in assessment grids	Documentary analysis Semi-structured interview
	Agents use evidences from PBs as part of conventional tools agreed between the ARS and its implementers (e.g. integration into specialised library and reference services)	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
	Agents advocate evidences from PBs in their productions (communications, reports, action plans, etc.)	Number of communications, reports, action plans mentioning PBS or extracts from PBs	Semi-structured interview Observation Documentary analysis
IREPS	Professionals use evidences from PBs to design their projects	Number of projects mentioning PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs to evaluate their projects	Number of evaluation based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs to make reports to their sponsors	Number of reporting based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs in the methodological supports for field professionals	Number of methodological supports based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Observation
	Professionals advocate evidences from PBs in their productions (communications, reports, action plans, etc.)	Number of communications, reports, action plans mentioning PBS or extracts from PBs	Semi-structured interview Observation Documentary analysis
	Professionals use evidences from PBs as part of conventional tools agreed with their sponsors, included ARS and partners.	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
Field professionals	Field professionals use evidences from PBs to design their projects	Number of projects mentioning PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Field professionals use evidences from PBs to design their conventional tools with partners and sponsors	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
CRSA	CRSA committee use evidences from PBs to make statements	Number of verbatim per meetings Type of PBs or extracts from PBs Ways of using PBs	Observation Documentary analysis Semi-structured interview
CCPP	CCPP committee use evidences from PBs to design their partnership aim, their common projects	Number of verbatim per meetings Type of PBs or extracts from PBs Ways of using PBs	Observation Documentary analysis Semi-structured interview

Based on the observed elements, we will classify the outcomes in three categories of use as recorded in the literature [27, 28].

- Instrumental use: knowledge users draw on the IBs to make decisions or to change their practice;
- Conceptual use which implies changes in understanding and thinking inspired by the IBs;
- Persuasive use (also called strategic or symbolic use) which refers to a use of knowledge as a means to justify decisions or actions.

We will process these data to characterise the mechanisms identified in the intervention theory and induced by the intervention. This will enable us to answer the following questions about several mechanisms related to knowledge, people and organisations: (1) were they present in the contexts studied? (2) Did they positively or negatively influence the outcomes from a user's perspective? (3) Which mechanism(s) was (were) actually active (which parameter influenced which other parameter and/or which outcome)? (4)Which outcome(s) was (were) produced?

Then, a secondary middle range theory will then be developed, leading to future guidelines.

Development of an adjusted middle range theory

Based on this analysis, we will compare the CMO configurations, which will be identify with the initial middle range theory, and we will figure out an adjusted middle range theory. This work will be conducted during a

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Table 2 Contexts and mechanisms expected

Types of variable	CMO	Types	Variables	Questions	Data collection
Context in each region (C)		Relating to regional policy-making and policy action on prevention	Leadership	Type of management Type of management structuring	Observation Documentary analysis Semi-structured interview
			How public health is organised	Funders Types of funding ways (competitive call for project, conventional agreement, etc.) Assessment of actions Main partnership between stakeholders.	Observation Documentary analysis Semi-structured interview
			Support mechanisms for stakeholders/ practitioners	Types of supporting process Who support the practitioners Who are supported Who fund the supporting activities	Observation Documentary analysis Semi-structured interview
			Opportunities	Opportunities to work with researchers, to use evidences from researchers in practices	Observation Documentary analysis Semi-structured interview
			Collaborative	Experiences of collaborating work with researchers Assessment of them	Observation Documentary analysis Semi-structured interview
			Specific decision-making and operational process	Description of decision-making process Description of designing, setting and assessment of interventions	Observation Documentary analysis Semi-structured interview
Parameters influencing the use of the PBs	Mechanisms (M)	Relating to the PBs	Acceptability of PBs Closeness between practices and PBs recommendations Convenience of PBs with context and practices Credibility perceived of PBs Other mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Relating to stakeholders/ professionals	Ability to integrate new practices in the context, in the habits (capabilities) Interest from PBS using Culture of change existing (previous experiences, awareness, agreement) Motivation of using PBs Levels of interaction between researchers and practitioners to discuss about evidence-informed practices Other mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Relating to organisations	Changes in ability to evolve (opportunities in functioning, hierarchical agreement, etc.) Temporality (opportunity to take time to introduce new knowledge coming from PBs) Other blocking or driving mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Others	Other mechanisms not envisaged initially		Observation Documentary analysis

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Table 2 Contexts and mechanisms expected *(Continued)*

			Semi-structured interview
Conduct of the KT	Intervention (I) set up locally	Type of KT activity set up locally Duration of these activities (action plans) Types of activity carried out Stage of completion of the expected activities Contributors involved in KT strategies Partnerships involved in KT strategies Financial resources in KT strategies Material resources in KT strategies	Observation Documentary analysis Semi-structured interview

second interdisciplinary workshop, based on a discussion about analysis from data collected, gathering all ARS staff responsible for prevention and public health, IREPS directors and project officers, plus agents from ANSP and INCA.

KT development guidelines in France will emerge from this meeting.

Communication and dissemination of results

Different types of actors will be involved throughout the study: prevention professionals, policy-makers and researchers. Thus, multiple methods will be used to communicate research results:

- Developing short and practical policy briefs about knowledge transfer to national policy-makers and practitioners
- Delivering presentations at local, national meetings in France and relevant international meetings for professionals and researchers
- Regular project review meetings and continuous engagement with key decision-makers and practitioners, in particular as part of the Public Health Initiative for the Interaction between Research, Intervention and Decision-*Initiative en Santé Publique pour l'Interaction entre la Recherche, l'Intervention et la Décision* (InSPIRe-ID), a knowledge transfer consortium, led by the French Ministry of Health.
- Delivering presentations at national and international conferences and publishing articles in peer-reviewed academic journals with emphasis on open access
- Developing a project research report for the funder, with a publishable executive summary

Discussion

This article describes a protocol using a realist design to understand how a KT scheme works, for whom and in what circumstances. In research, realist evaluation is valuable for evaluating interventions in their contexts; it addresses contextual factors in relation to the mechanisms and outcomes of these interventions. Thus, partial patterns can be revealed to explain how interventions may foster enhanced KT.

However, even if there is weak support in France to develop KT at a local level, KT is highly recommended by health national authorities. Consequently, we need to address a potential social desirability bias, resulting both from the subject and the fact that the data are not self-reported [28]. This bias results from the tendency of survey respondents to answer questions in a manner that will be viewed favorably by others. Moreover, we will design the interventional scheme with the different stakeholders. Researchers are thus involved in the assessed process. This contextual parameter must be taken into account in the evaluation.

The aim of this study is to experiment and characterise the success factors of a KT scheme in health promotion and disease prevention settings. By success, we mean the scheme's ability to (1) enable public health stakeholders to address the challenges of KT and (2) bring about changes in public health policy and practice: integration of evidence-informed public health, collaborative practices etc. We will seek to explain the parameters and conditions of these strategies in order to determine their transferability into other contexts. This will provide a basis for the production of operational and contextualised guidelines in order to develop KT to inform regional policy-making on health promotion and disease prevention. Ultimately, this research aims at enhancing overall policy-making and quality of implementation in the sector. With this in mind, this project will be of great interest for public policy-makers who are currently moving towards evidence-informed health promotion and disease prevention in France.

Abbreviations

ANSP: Agence Nationale de Santé Publique (National Agency for Public Health); ARS: Agence Régionale de Santé (Regional Health Agency); CCPP: Commission de Coordination des Politiques Publiques (Public Policy Coordination Committee); CRSA: Conférence Régionale de la Santé et de l'Autonomie (Regional Conference on Health and Autonomy); FNES: Fédération Nationale d'Education et de promotion de la Santé (National Federation for Health Education and Promotion); I: Intervention; IB: Intervention brief; INCa: Institut National du Cancer (National Cancer

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Institute); InSPIRe-ID: Initiative en Santé Publique Pour l'Interaction entre la Recherche, l'Intervention et la Décision (a public health initiative dealing with the interaction between research, intervention and decision-making); INSPQ: Institut National de santé publique du Québec (Quebec Public Health Expertise and Reference Centre); IREPS: Instance Régionale d'Education et de Promotion de la Santé (a non-profit organisation promoting health at a regional level); KT: Knowledge translation; PACA: Provence-Alpes-Côte-d'Azur (region in the south of France)

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Availability of data and materials
Not applicable

Authors' contributions
LC and AP drafted this article and all authors revised the manuscript. The project design was developed by LC and AP. LM, FA, JP, MP and CF were involved in implementing the project and in developing the evaluation design. VR and CD were involved in the design of the middle range theory. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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Not applicable

Ethics approval and consent to participate
The project will be carried out with full respect of current relevant legislation (e.g. the Charter of Fundamental Rights of the EU) and international conventions (e.g. Helsinki Declaration). The methods development, data collection and analysis will take account of the following issues:

- Anonymity of study respondents will be preserved and ensured at all times as respondent(s) request. Unnecessary collection of personal data will be avoided, and respondents will have the right to review outputs and withdraw consent. All personal data will be coded, removed from the data for analysis and stored separately. Only designated research staff will have access to the keys linking the data with the personal information.
- Informed consent will be obtained from all study participants, and in the case of refusal, alternative means of data collection will be explored (e.g. alternative respondents).

In addition, this study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Abstract:

Objective: This paper presents the results of a realist evaluation of a knowledge translation (KT) intervention implemented in the field of health promotion and disease prevention at the local level in France.

Design: Realist evaluation study**.**

Setting: The target population comprised decision makers and field professionals working in prevention and public health services operating in regions of France (i.e., ARS, IREPS, and their partners).

Participants: This evaluation was based on data collected from 2 seminars, 82 interviews, 18 observations, and 4 focus groups over 18 months.

Intervention: the TC-REG intervention combined various activities: Supporting access to and adaptation of usable evidence, Strengthening professionals' skills in analyzing, adopting, and using the policy briefs, Facilitating the use of evidence in organizations and processes. The TC-REG intervention aimed to increase the use of evidence in cancer prevention, health promotion and disease prevention in four regions of France.

Results: The collected data was used to define favorable/unfavorable contexts for the use of scientific data and mechanisms to be activated to encourage the use of scientific knowledge. From these raw results eight final refined middle-range theories were defined. Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate knowledge and under what conditions. These analyses provided a basis for the production of seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Conclusion: The results obtained from the analyses led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion.

Ethics and dissemination: This study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

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Strengths and limitations of this study'

- The large amount of qualitative data allowed us to create a knowledge translation taxonomy and to develop eight middle-range theories illustrating how to activate mechanisms and under what conditions.
- This study provided a basis for the production of seven operational and contextualized recommendations to develop knowledge translation (KT) to inform regional policy-making regarding health promotion and disease prevention.
- The results obtained from the analyses described here led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion
- A limitation of this work remains its potential for generalization, as this work has been carried out in a particular field and country, the prevention field in France.

KEYWORDS: Knowledge transfer; Realist evaluation; France; Prevention; Public health, Cancer

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Competing interests

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Introduction

Evidence-based decision-making and practice are major issues in public health. For researchers, this means looking ahead to the dissemination of findings and integrating different types of knowledge and decision-making challenges [1]. It also implies a need for greater collaboration between the research community and decision-makers [2]. Even if decision-makers, stakeholders, and researchers mostly agree that it is necessary to move forward with evidence-informed practices and policy-making, some barriers persist related to people, organizations, contexts, and evidence's attributes [3–5]. Gervais et al. [3,6] suggested that KT research concerning decision-making processes offers multiple explanatory factors, which can be classified in three categories. The first category relates to the specific properties of the evidence itself: nature, availability, accessibility, quality and credibility, intelligibility, ability to meet needs, adaptability, and transferability [6]. The second category relates to the characteristics of decision-makers: beliefs or personal values, political leanings, sociodemographic characteristics, level of education, previous experiences, motivation, and ability to interpret data. These characteristics may influence how new knowledge is addressed during the decision-making process [7]. The third category relates to the characteristics of the organizations and local contexts in which knowledge producers and users perform their work [3]: openness to change; material, human, and financial resources available for KT; social and political context in the external environment; style of management; leadership; staffing; and stakeholder coalitions. Multiple barriers to the adoption of evidence in the field of public health underline the nonlinear process between knowledge production and knowledge use. These barriers prevent optimal production and use of evidence. To address this, it is necessary to assess how knowledge is produced and used; to enhance the understanding of decision-making processes and mechanisms; and to examine the abilities of public health services to integrate research findings into their decisions and operations. This assessment requires a systematic approach

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that includes the adaptation of scientific knowledge; the abilities of users to capture, understand, and apply available evidence; and the presence of an organizational and supportive culture for use of this evidence. These are the major challenges of knowledge translation (KT)[8], defined as "the group of activities and interaction mechanisms that foster the dissemination, adoption and appropriation of the most up-to-date knowledge possible for use in professional practice and in healthcare management" [9].

Over the past several decades, a growing body of literature has been published regarding KT [8,10,11]. Facilitators and barriers related to KT have been studied in several contexts [12–14]; several KT frameworks that provide a mapping of KT processes have been described [15]. Although these frameworks are helpful for understanding the key elements involved in KT, they lack consistency regarding implementation of KT schemes in local contexts because they provide broad concepts without concrete examples of KT activities to implement. The literature highlights the insufficient dissemination of scientific knowledge [16–20]; it also emphasizes that, to be effective, KT modalities must be contextualized to the environment in which knowledge dissemination is required. Thus, the effectiveness of KT strategies depends on the context in which they are implemented [8,21–24]. The contextualization of KT strategies is therefore necessary to remove barriers to knowledge use.

This paper presents the results of a realist evaluation study of KT strategies implemented in the field of health promotion and disease prevention at the local level in France. By disease prevention we mean specific, population-based and individual-based interventions for primary and secondary prevention, aiming to minimize the burden of diseases and associated risk factors [25].

The TC-REG ("Transfert de Connaissances en REGion") intervention (referred to in this paper as the intervention) is a knowledge translation plan implemented differently in 4 French regions consisting of an accompanying support process for the use of evidence in cancer prevention.

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The aim of the TC-REG study was to evaluate the impact of this support process to influence the decisions and preventive practices in four regions of France. This study documented the mechanisms, processes, the configurations (i.e., Contexts/Mechanisms/Outcomes [CMOs]) [26] and the conditions of effectiveness established as a result of this support to ensure KT.

RAMESES II reporting standards for realist evaluations were used [27].

Methods/design

Theoretical framework

The realist approach [26] is increasingly used for appraising the interactions among an intervention, its mechanisms, and its contexts. The overall aim is to achieve a better understanding of an intervention's success factors and how these may be replicated in other contexts. In realist evaluation, developed by Pawson and Tilley [26], the effectiveness of the intervention depends on the underlying mechanisms that contribute within a given context. Realist evaluation involves identification of CMOs configurations. The aim comprises understanding how and why an intervention works. A middle-range theory (i.e., a theory aimed toward describing interactions among outcomes, mechanisms, and contexts and therefore CMOs configurations) is established to highlight the mutual influences of intervention and context [28,29]. This approach is linked to the black box paradigm [30] and differs from the experimental paradigm, which evaluates effectiveness without analysis of the mechanism by which an intervention is successful, as well as without the influence of context. Realist evaluation determines whether an intervention worked in a manner consistent with its underpinning theory. The generative causality works via three assumptions [31]: i) an intervention is not successful in isolate, and is not the source of a given outcome; ii) all interventions trigger a mechanism or a set of mechanisms that produce an outcome; and iii) all interventions are delivered within specific contexts.

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Hence, realist evaluation involves identification of middle-range theories. Hypothesized and validated by empirical investigations, these CMOs configurations help to understand how an intervention causes change, considering both context and target group [28,29]. The recurrence of CMOs is observed in successive case studies [29]. To consider context, realist evaluators observe successive cases, which Lawson (quoted by Pawson in 2006 [31]) has described as "demi-regularities of CMOs" (i.e., regular, not necessarily permanent occurrences of an outcome when an intervention triggers one or more mechanisms in a given context) [29]. Analysis of these recurrences in different contexts allows the isolation of key elements that can be replicated in a family of contexts. This yields middle-range theories that become increasingly robust with progression among cases. "These middle-range theories, in certain conditions, predict possible intervention outcomes in contexts different from the one in which the intervention was tested" [29,32].

Applied to our case

As the realist principle is suitable for studying non-linear interactions in complex systems, we adopted this approach [33]. In our study, each region involved in the TC-REG intervention, with its own context, constituted a case. For each case, the intervention was studied to identify contributory mechanisms in a given context, along with the variation in outcomes. CMOs configurations were identified through analyses of successive cases. A cross-case analysis was performed to highlight recurrent CMOs configurations and thus identify key features for possible replication.

Mechanisms were identified qualitatively, in accordance with the definition of Ridde et al.: "a mechanism is an element of reasoning and reaction of an agent with regard to an intervention productive of an outcome in a given context" [34,35], and in accordance with the definition of

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Cambon et al.: "What characterizes and punctuates the process of change and hence, the production of outcomes"[36].

In a realist approach, interventional elements contribute to the context. Contextual elements have been included among all elements collected qualitatively that satisfy the following definition: elements located in time and space that may affect the intervention and the outcomes produced. Therefore, this study distinguished between Ci (for contextual factors linked to the intervention) and Ce (for external contextual factors that are not linked to the intervention).

The TC-REG intervention

The intervention is a knowledge translation plan implemented differently in four region aiming to improve the use of scientific knowledge. It was elaborated through a collaborative process aiming to collectively become acquainted with and master the concept of KT, and to identify effective strategies highlighted in the literature and their conditions of transferability. As presented in Figure 1, two kinds of literature review were carried out simultaneously: a review of the existing literature with the aim of extracting knowledge on successful KT activities and effective mechanisms in KT, and the drafting of Policy briefs (PBs) consisting of six summaries of systematic reviews presenting effective prevention practices concerning nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life, and psychosocial skills. We also conducted an exploratory qualitative study (14 non-directive interviews) in the four regions to collect data on the pre-existing scheme as well as activities related to KT and the potential local barriers. Next, a seminar allowed us to consensually define the initial middle-range theory (CMO) based on the existing literature, the results from the exploratory study, the presentation of the PBs and the project team insights. Four KT plans were designed during this seminar and implemented in each of the 4 regions over a 12-month period. Each KT plan aims to improve the use of scientific knowledge.

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Figure 1: TC-REG Project Phase 1

In each of the 4 regions the following categories of activities were combined: i) Supporting access to and adaptation of scientific and usable evidence, especially policy briefs, ii) Strengthening professionals' skills in analyzing, adopting, and using the policy briefs in the course of their practices and decision-making processes (e.g., training, journal club, and tutoring); iii) Facilitating the use of evidence in organizations and processes (e.g., collaborative workshops, normative processes, and incentives). An illustration of the KT plan for one region is detailed in annex 1. The detailed activities implemented in regions and corresponding to these operational objectives have been transcribed into a standardized taxonomy published by Affret et al. [37].

Initial middle-range theory

Drawing on the literature and experience of professionals locally involved in the intervention, the initial middle-range theory was established [26,31], then tested in each case (i.e., region) through collection of qualitative data [29].

Box 1: The TC-REG Initial middle-range theory

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Initial middle-range theory

"The modalities of an effective knowledge transfer scheme combine levers that:

- promote access to information and an adaptation of it (Ci)*,
- promote the development of capacities to understand and use them (Ci)*,
- allow the modification of organizational processes (Ci)* in order to facilitate their production and their appropriation in practice settings.

These modalities of KT produce an increasing use of scientific knowledge (O)*** by reinforcing:

- the perception of their usefulness (M)**,
- the motivation to use them (M)**,
- the ability to adapt them to the issues present in practical settings (M)**".

*Ci=contextual factors linked to the intervention
**M= Mechanism
***O= Outcome

At this point, no external contextual factors (i.e. Ce for external contextual factors that are not linked to the intervention) were identified, because there was no consensus on this topic among participants. This process was described in the published study protocol [38].

Population

This study was conducted in four regions of France[1] and within different types of organizations and their partners: regional health agencies (ARS[2]), which are responsible for policy-making and prevention policies; and non-profit organizations (IREPS[3]). IREPS develop health promotion and prevention programs; they also provide methodological supports to field professionals for the implementation of prevention interventions in different settings (e.g., workplaces, schools, care settings, recreation and community centers, and rural or urban areas). ARS and IREPS work collaboratively to implement prevention and health policies in local contexts.

[1] Paca, Brittany, Martinique, Normandy
[2] Agence Régionale de Santé: regional health agency
[3] Instance Régionale d'Education et de Promotion de la Santé pour tous: Regional organization for health promotion and education

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This study focused on stakeholders who agreed to implement the intervention in the 4 regions. The sample of this study is composed of :

- ARS public health professionals: five agents per region (deputy directors in charge of prevention, heads of strategy departments, and project managers);
- IREPS professionals: 10 people per region (directors, project managers, and communication managers);
- Members of specialized prevention commissions within the Regional Conferences on Health and Autonomy and members of the Public Policy Coordination Commission, both dedicated to prevention in various regions of France (five people) and partners of IREPS and ARS.

These 65 persons will be named TC-REG project manager in this article.

For all interviews, professionals were selected according to the following criteria: i) Participation in TC-REG study ; ii) Agreement to participate in the interviews; iii) Agreement with this use of the data extracted from the interviews ; iv) Diversity among institutes and professions (i.e., managerial and non-executive positions).

Data collection

This study alternated between theoretical and empirical stages. Data collection consisted of qualitative investigations through interviews and observations. The results were discussed and enriched during a seminar on 18 October 2019 with the TC-REG project manager of the four regions involved. More details regarding this study are available in the published study protocol [38].

Based on the initial middle-range theory (developed during the seminar in May 2017) and to collect CMOs related to the realist analysis, three series of interviews and one series of observations were conducted.

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The first round of non-directive interviews aimed to collect and specify, with reference to the initial middle-range theory, the potential mechanisms to be activated and the external contextual elements (so-called Ce) missing in our initial middle-range theory. Thirty-six face to face interviews were conducted in October/November 2017. We asked the following question: "What do you think about the use of data from science and what would you place in this category?" and "Has your thinking evolved? How? How do you explain these evolutions?", which led to the identification of several mechanisms such as the perception of usefulness of the use of scientific knowledge, the perception of the ability to use them and the motivation to use them; and several contexts elements related to personal characteristics, organization.

In the second round, the interviews were semi-directive and aimed to identify a list of KT activities (so-called Ci) actually carried out in the regions, thereby determining a taxonomy that would enable them to be compared among regions. Ten semi-directive face to face interviews with the TC-REG project managers in the regions and four focus groups were conducted between February 2018 and August 2018. This round of data collection allowed precise determination of KT activities carried out in the regions, in accordance with the KT plans defined in August 2017, as well as collection of Cis.

The third round of interviews aimed to test our initial middle-range theory and to confirm Ce-Ci-M-O configurations, but also to identify new emerging configurations. These configurations were elaborated from the previous interviews and observations. During this round of interviews, we asked participants, "Since the beginning of the TC-REG intervention, do you use data from science? How? How do you explain that?" Then we asked more precise questions aiming to evaluate the impact of the KT plans in terms of using scientific knowledge (the Outcome="O"). Initially, we planned to classify the outcomes into three categories of use (instrumental use; conceptual use; persuasive use [38]), but since it appeared that these categories were in fact

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mechanisms leading to the use of scientific knowledge, our sole outcome is the use of scientific knowledge.

This third round of interviews aimed to test our initial middle-range theory and identify CMO configurations, i.e., to answer this question: through which mechanism(s) does the increased use of evidence take place and what activities and contextual circumstances can influence it?

In total, thirty-six semi-directive telephone interviews were conducted between April and June 2019.

The observations aimed to identify local contextual elements (Ce) and mechanisms (M) activated by the use of evidence-based data (PBs or other). Eighteen observations were conducted during the TC-REG project (Table 1: Objective, data, and qualitative investigation methods).

Table 1: Objective, data, and qualitative investigation methods

Round	Objective	Sample	Data collected
1st round of interviews October/November 2017	Specify: mechanisms and contextual elements	36 interviews with TC-REG project managers in these regions: - Brittany: 8 - Martinique: 12 - Normandy: 9 - PACA: 7	**O:** The current use of scientific data **M:** 13 Mechanisms **Ce:** 7 Contextual elements related to**:** People/ Organization
Observations Throughout TC-REG project	Identify local contextual elements and mechanisms	18 Non participating observations: - Brittany (n = 1) - Martinique (n = 2) - Normandy (n = 12) - PACA (n = 3)	
2nd round of interviews February/August 2018	determine taxonomy of KT activities currently carried out among regions	10 Semi-directive interviews with TC-REG project managers in these regions: - Brittany n = 2 - Martinique n = 2 - Normandy n = 3 - PACA n = 3 4 focus groups (1/region)	**Ci**: Determine KT activities carried out among regions according to transfer plan defined in August 2017.

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3rd round of interviews April/June 2019	Identify the evolution in the use of scientific data and **Ci-Ce-M-O** configurations	36 Semi-directive interviews with TC-REG project managers in these regions: - Brittany: 7 - Martinique: 10 - Normandy: 10 PACA: 9	**O:** The use of scientific data and its evolution (Pbs or other) Ci-Ce-M-O configurations

Data analysis

The data collected were coded and analyzed with the NVivo® software. Because the three series of interviews and the single set of observations comprised different types of information, they helped to iteratively establish information regarding the CMO configurations at stake. Data were analyzed step by step, allowing an inductive-deductive approach. The data were analyzed by two researchers (LC and OA), then compared and reanalyzed to reach a consensus between the two.

Data were coded to identify different levels of information. A first level of coding and analysis was used to identify and separate:

i) favorable/unfavorable contexts element to use scientific data, especially the data in PBs (Ce), ii) arguments evocated by the panel pro or cons the use of scientific data (foreshadowing the mechanisms to be activated, M).

Then, a second, more detailed level of coding allowed specification of the Ce and M to be activated in the use of scientific knowledge.

More precisely, the first round of interviews led to the identification of 7 external contextual elements (Ce): The existence of training prior to the use of scientific data; The financial valuation of KT; A favorable organizational context ; A favorable political context; A technical and logistical context that makes access to the data easier; Previous experiences with the use of evidence from science; Work time freed up for the use of scientific data in the professional

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activity. 13 mechanisms were also identified: 3 linked to personal abilities, 2 regarding personal motivations and 8 types of perceived usefulness.

The content analysis of the second wave of interviews identified a list of activities carried out in the 4 regions. This list was presented at the 2nd steering committee meeting on 13 February 2019 to establish a consensus regarding the wording of the activities. In this way, 18 distinct KT actions were identified; these were grouped into 11 strategic categories, thus constituting a taxonomy. The elaboration of a standardized taxonomy helped us to use the same definition of the activities. More details have been described in Affret et al [37].

Before the analysis of the 3rd round of interviews, the mechanisms and activities identified were grouped by type or theme (mechanisms were regrouped into 8 categories and KT activities in 4 groups).

The third round of reviews allowed the researchers to identify the Ce-Ci-MO configurations. For each mechanism (those identified following the second round of interviews or newly cited) mentioned by professionals as having evolved, the content analysis focused on the activities and contextual elements that had enabled its evolution. This round of interviews also served to identify the evolution of scientific knowledge use in these four regions (O).

The analysis was based on 3 nodes of analysis: 1) which mechanisms are activated by the KT plan, 2) for each mechanism, which activity in the KT plan was influenced (based on the KT taxonomy evocated before) it, 3) by each activity, which element of the context influenced it (in the list drawn up after the 1st round of interviews or newly cited).

This analysis allowed us to determine a list of different Ce-Ci-M-O, by region (the four) or by type of respondent (policymakers or field professionals). We then carried out a transversal analysis of the different Ce-Ci-M-O in order to define the configurational recurrences or demi-regularities (i.e., not perfect regularities but the repetitive Ce-Ci-M-O observed generating a

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perceptible uniformity [39]) according this rule: activities [Ci] in which the association's frequency with mechanisms [M] was higher than the average of the associations; contexts [Ce] in which the association's frequency with mechanisms [M] AND with activities [Ci] was higher than the average of the associations. This allowed us to produce a shared list of interregional (most generalizable) Ce-Ci-MOs.

The results of the analysis of the series 2 and series 3 interviews were discussed during a seminar on 18 October 2019, which brought together two people per ARS and IREPS from each of the four regions. This discussion allowed validation of the final CeCiMO configurations (middle-range theories) defined by the analysis. Figure 2 illustrates the timeline of the TC-REG project.

Figure 2: TC-REG project timeline

Patient and Public Involvement

The TC-REG study does not include any patient or public involvement in terms of setting research priorities, defining research questions or outcomes, providing input into the study design, or disseminating the results. The research participants answered interviews.

Results

As outlined previously, the analysis followed a 3-node frame*:*

1. ***Mechanisms activated by the KT plan***

Qualitative evidence allowed the identification of links between components of the middle-range theories. The following three mechanisms were most frequently reported to be strongly involved in the use of scientific knowledge among professionals:

- Perception of strategic utility (i.e., to legitimize practice):

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"That's it, we really need scientific data, proven data to support what they are saying to be taken seriously."

Albert, Ireps

- Perception of instrumental utility (i.e., to change or improve practice):

"It gives us reliable elements to be able to adapt, to build our actions, well… I see it like that"

Véronique, Organization

- Ability to master these data (i.e., ability to use data easily and independently):

"The data transmitted by TC-REG (the PBs) will be able to evolve as a support for work and validation of scientific data on the ground and to apply them concretely"

Fannie, ARS

Five other mechanisms were identified but less often reported as important in the use of scientific data:

- The ability to understand the scientific data
- The ability to identify and recognize the scientific knowledge
- The motivation to use it
- The perception of the conceptual utility of it (i.e., useful to create new frameworks for analyzing their practices)
- The perception of the processual utility of this knowledge in terms of partnerships, for example.

2. Activities of the KT plan influencing the mechanisms

The KT activities were grouped into 4 categories:

- Communication regarding scientific data,
- Adaptation to realities encountered in the field by the professionals,

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- Support activities for the use of these data
- Support activities enabling changes in professional practice

3. ***Elements of the context influencing the activities and the mechanisms***

Contexts that had an influence on activities were:

- Political will and organizational contexts facilitating or promoting the use of scientific knowledge
- Previous experience regarding the use of scientific evidence in practice.
- Gain in experience using scientific data
- Knowing where and how to find these data (dissemination channels)
- Previous training in the use of scientific data

Final middle-range theories

From these raw results eight final refined middle-range theories were defined (see Figure 3: Final MRTs). These theories were framed, conceptualizing the recurrence of the CMO configurations or semi-regularities observed. Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate these mechanisms and under what conditions they will be activated. These theories refine and enrich the initial middle-range theory.

1. Use of scientific knowledge (O) is facilitated if professionals **feel able to understand it (M)**. This perception is facilitated by activities that help to change practices (e.g., training, support, and seminars) (Ci), particularly if the organizational context facilitates these practices (Ce) (e.g. creating trained team dedicated to these activities) and, if there is a political will to encourage it (Ce), and if the professionals gain experience from it (Ce).
2. Use of scientific knowledge (O) is facilitated if professionals **feel able to autonomously become acquainted with or master (M)** it in their practice. This perception is facilitated by activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data (Ci), particularly when the organization

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facilitates this use (Ce), when there is an institutional policy promoting the transfer of knowledge (Ce), and when professionals gain experience from it (Ce). This perception is also increased by communication/dissemination activities based on scientific data (Ci), when they are adapted to the reality and needs of professionals (Ci). These activities are more effective if professionals are familiar with the dissemination channels (Ce).

3. Use of scientific knowledge (O) is facilitated if professionals **feel able to locate and identify** such knowledge (M). This perception is facilitated by communication activities regarding these data (Ci), especially if the professionals know where to find these activities (Ce). It is also facilitated by support activities that can lead to changes in behavior (e.g., training, support, and seminars) (Ci), especially if the organization facilitates their use (Ce), if the institution encourages it (Ce), and if the professionals have some experience in the specific topic (Ce).
4. Use of scientific knowledge (O) is facilitated if professionals **are motivated to use it (M)**. This motivation can be induced by communication activities (Ci) and support for changing practices (Ci), especially if the professionals know the dissemination channels (Ce) and have already attempted to integrate these data into their practice (Ce).
5. Use of scientific knowledge (O) is facilitated if professionals perceive them as **useful to improve their practice (M)**. This perception is activated by communication activities (Ci), adaptation of evidence-based data to their reality and needs (Ci), and activities supporting changes in practices (e.g., training, support, and seminars) (Ci), particularly if the organization facilitates the use of these data (Ce), the institution encourages it, and if the professionals have acquired experience in this practice.
6. Use of scientific knowledge (O) is facilitated if professionals **perceive it useful to create new frameworks for analyzing their practices (M)**. This perception is activated by communication activities regarding these data (Ci) and by an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This consideration is more effective if professionals have experience in the use of scientific knowledge (Ce), especially if they have been trained (Ce), and if the organization and institutional political policy are favorable toward KT (Ce).
7. Use of scientific data (O) is facilitated if professionals perceive them as **useful to legitimize or advocate their professional activity (M)**. This perception is facilitated by communication activities regarding these data (Ci), particularly when there is a

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political will in favor of KT (Ce) and when professionals are aware of the dissemination channels (Ce). This perception is also promoted by activities supporting changes in practices (e.g., training, support, and seminars) (Ci) that are supported by political will and professionals' experience (Ce); these are added favorable organizational conditions (Ce).

8. Use of scientific data (O) is facilitated if professionals perceive them as **useful in creating new partnerships (M)**, particularly within the research community. This perception is made possible by activities that support changes in practices (e.g., training, support, and seminars) (Ci), as well as by structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This perception is more effective when professionals can financially justify the use of scientific data (Ce), when the institutional political will is favorable toward KT (Ce), when organizations facilitate this transfer (Ce), and when the professionals have experience in the use of scientific knowledge (Ce).

Taking up in this way each activity present in these refined middle-range theories it is possible to draw up practical recommendations for the field professionals for the development of KT. We have thus elaborated seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Recommendation 1 - Favorable professional environment for KT

Use of scientific evidence is facilitated if the institution in which professionals work shows a clear political will in this area and if the environment makes it easier to understand and to use making it more practical and more rewarding.

Recommendation 2 - Learning experience

While the use of scientific evidence in practice requires a significant initial investment (e.g., cognitive and temporal), the study shows that more use of scientific data by professionals leads to more routine implementation. This constitutes a learning experience.

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Recommendation 3 - Short-term utility and independent appropriation

The mechanisms most strongly involved in anchoring KT use are linked to the possibility of direct use of scientific evidence in the activities of professionals. Indeed, professionals are more inclined to use scientific data when they perceive these data as useful to legitimize, advocate, or concretely modify their practices, as well as when they feel able to mobilize these data independently. This perception is accentuated if these data are accessible, in accordance with their needs (adapted), and if they have been trained in the use of these data.

Recommendation 4 –Promoting the perception of scientific data usefulness

Communication/dissemination of scientific data promotes perception of its usefulness, ability, and motivation to use scientific data, if the environmental working conditions allow for their use. Evidence-based dissemination activities are particularly crucial in:

- Motivation to use scientific evidence, as well as ability to identify and master it.
- Perception of the instrumental utility of scientific evidence in daily practice.
- Perception that use of scientific evidence will bring a new way of presenting their activity (conceptual utility).
- Perception that use of scientific evidence will legitimize their activities, supported by confidence in its added value (strategic utility).

Recommendation 5 – An adapted knowledge

Data transformation and adaptation activities have an impact on the capability to utilize the data and the perception that they allow for concrete changes, if the professional environment is favorable to such changes. Data transformation and adaptation activities for stakeholders, such as inclusion of evidence-based data (via typical communication tools: adaptation and dissemination of evidence through video vignettes, explicit and oriented guides, scientific documents, creation of bibliographical selections [evidence-based actions], and

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multidisciplinary and multi-professional co-construction of KT tools and processes), most notably influence:

- Ability to utilize scientific data in practice.
- Perception that use of scientific data will enable professionals to change their practices (instrumental utility).

Recommendation 6 – Structural activities as facilitator

These activities facilitate the use of scientific data influence, the perceived usefulness of scientific data, particularly in framing practices and mobilizing new partnerships with research or other organizations. Structural activities to facilitate KT (e.g., institutional communication regarding a KT program or plan; use of the KT program to develop specific partnerships ; identification of a style guide for KT activities; development of a support service for KT development; evaluation of promising practices, modification, reinforcement, or activity orientation of an existing KT plan; establishment of internal coordination meetings [how to use evidence] or systematic reminders of the importance [interest and added value] of using scientific data in team and/or project meetings or in professional or financial documents) influence:

- Perception that use of scientific data brings a new way of presenting activities (conceptual usefulness).
- Perception that use of scientific data will allow the development of new partnerships (process utility) with the research community.

Recommendation 7 – Activities to support KT influence the understanding and perceptions of the usefulness of these data

When the organizational and political environment within the institution is favorable, activities supporting KT will influence the capacity to understand and use scientific data and the

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perception of the usefulness of these data at multiple levels (i.e., entering into new partnerships, as well as legitimizing and/or renewing one's practices).

Activities to support KT (e.g., specific communication meetings on evidence-based science, awareness on the use of evidence-based data [meetings or seminars], and training to analyze and use scientific knowledge; analysis and exchange workshops; methodological support; existence of a proactive advocate for the deployment of KT [encouragement, mobilization, reminders, and support regarding the development of KT]; methodological support for deployment of KT; creation and dissemination of methodological tools based on scientific data [grids and repositories] to support autonomous use; development of a methodological guide to assist in the implementation of KT, and to facilitate the use of tools developed based on evidence [whether from PBs]) influence:

- Capacity of professionals to understand, become acquainted with, and identify evidence from science.
- Their motivation to use evidence from science.
- Their perception that use of scientific evidence will enable changes in practices (instrumental utility), legitimize activities, and convince others of its added value (strategic utility).
- Their perception that use of scientific evidence will enable development of partnerships with the research community if this interaction activity is supported and rewarded financially.

These recommendations and facilitators are made possible and catalyzed by professionals' experiences of evidence-informed practices and by the official (i.e., political, organizational, or institutional) position, which should be explicitly favorable toward and encourage use of such practices.

Discussion

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The aim of this study was to experiment and characterize the factors associated with the success of a KT plan in health promotion and disease prevention settings in the local context in France. Success was defined as the plan's ability to i) enable public health stakeholders to address the challenges of KT and ii) bring about changes in public health policy and practices (i.e., integration of evidence-informed public health and collaborative practices). We sought to explain the parameters and conditions of these strategies to determine their transferability into other contexts by expansion of the results obtained in the first seminar into eight more precise final theories.

Notably, by specifying the middle-range theories in the French context, the results were consistent with numerous studies regarding KT [19,24,40]. Indeed, they confirmed the need to (i) combine KT strategies [24,40–42], (ii) make actions sustainable [43], (iii) transform institutions beyond simply raising the awareness of professionals [44], (iv) adapt the evidence to ensure it could be transferred to each type of audience [41,45–47], and (v) support change [6]. More specifically, our study underlines the particular weight of three major types of activities: i) those which help to change practices and promote scientific data use (e.g., training, support, and seminars), ii) those which adapt scientific data (adapted emails, policy-briefs, advocacy, etc.), iii) and those providing support for changing practices by an institutional daily promotion of institutional structure (e.g. existence of a proactive referent for KT roll-out, development of a methodological guide to help KT implementation, development of methodological guides to assist in the use of tools developed using evidence, introducing specific exchange on evidence in current meetings, etc.). Moreover, they confirm four of most influencing contextual parameters to support KT: i) the political will in institution [48], ii) the professionals' experience in evidence use [49] ; iii) the organizational facilitators promoting evidence use (linked to person (adopter), specific practices or supports) help) [42,48], and iv) an immediate benefit in the use of evidence [2].

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In addition, this study highlighted the key mechanisms to be activated to enable changes in practice in the KT strategies. They can be grouped into three dimensions: i) capacities: finding, understanding, and appropriating evidence; ii) attitudes: motivation and feeling that evidence is useful; and iii) the perception of a direct interest in the use of evidence: changing practices, legitimizing the activity, advocacy, and formation of new partnerships. With reference to the interventional system concept [36], which emphasizes that mechanisms are the key functions of interventions, the results of these interventions must be transferable into other contexts. Our results confirm that the success of knowledge transfer results from "combinations of knowledge, relationship, and organizational characteristics contribute to knowledge transfer success" which are "dependent on the type of ecosystem partnership involved"[47].

Strengths and limitations:

Our study highlighted some crucial information from the analyses. The large amount of qualitative data allowed us to create a taxonomy [37] and to develop eight refined middle-range theories and seven recommendations that will be valuable for knowledge and decision-making challenges.

Due to the specificity of our study we made several adjustments to the initial protocol. Two rounds of interviews were initially planned. During the first seminar on May 2017, we were only able to develop a very generalist initial middle-range theory. Indeed, neither the exploratory survey nor the experience of the professionals mobilized in the seminar allowed us to define a more detailed level of KT activity, mechanisms, or external contextual elements of influence, which could be used to develop several theories. Furthermore, we did not find any taxonomy in the literature sufficiently operative to structure regional action plans. Because of these observations, we reviewed our investigation strategy in three rounds of interviews, rather than two. We developed a taxonomy of KT activities that allowed comparison of identical

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activities among regions [37]. These developments strongly mobilized the research team, thus mobilizing the project's resources. Thus, the last seminar could not be carried out.

The limit of this work remains its potential for generalization. The work has been carried out in a particular field and country, the prevention field in France. It would be interesting to check whether these middle range theories are verified in other fields and other countries where the KT development might be more advanced. These investigations could lead us to refine our middle range theories or open to other configurations. Indeed, we can hypothesize that other difficulties would have to be overcome and therefore other mechanisms to be activated.

Moreover, the follow-up was carried out over 18 months. No doubt that some activities will eventually prove to be not very effective and others will surprise by their effectiveness because they have a longer latency. In fact, both professional practices and their impact take a long time to modify. Moreover this impact could be difficult to observe due to the complexity of what is at stake. There is therefore a real interest in verifying the stability of these middle range theories over time.

Finally, we have not analyzed the potential synergy between Ci and Ce either, even if the observations show some leads. For example, we can observe that some external contextual elements (Ce) such as "pre-trained professionals" echo activities (Ci) "training of professionals in CT".

Notwithstanding these limits, the work carried out nevertheless offers concrete paths for the development of KT by having allowed the groups of activities to specify the conditions for their success and opens the way for further development in terms of research.

Conclusion and perspectives

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This study used a realist methodology to reveal the factors associated with the success of a KT plan, and elucidated the mechanisms by which such strategy can bring change in public health policy and practices. We sought to explain the parameters and conditions of these strategies to determine their potential transferability into other contexts through three types of mechanisms to be activated: i) the capacities (finding, understanding, and appropriating evidence) of field professionals; ii) the attitudes, (motivation and feeling that evidence is useful); and iii) the perception of a direct interest in the use of evidence (changing practices, legitimizing the activity, advocacy, and formation of new partnerships). We suggest they are the key functions of KT in prevention, which can be activated if a combination of activities and organizational characteristics are gathered.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, it follows the relevant French legislation of the research category on interventional research protocol involving the human person. An informed consent was obtained from all individual participants included in the study.

This study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

The English in this document has been checked by at least two professional editors, both native speakers of English

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Data statement

Not applicable

Authors' contribution

LC supervised the study. JMF, OA and LC drafted this article and all authors revised the manuscript. The project design was developed by LC and OA. OP, OA collected the data. OA and LC analyzed the data under the supervision of LC. JMF contributed to part of this analysis. All authors read and approved the final manuscript.

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List of abbreviations

ANSP: National Public Health Agency

ARS: regional health agency

Ce: Contextual factor not linked to the intervention

Ci: Contextual factor linked to the intervention

CMO: Context – Mechanism – Outcomes

INCa: National Cancer Institute

IREPS: Regional Authority for Education and Health Promotion

TC-REG: Knowledge transfer in regions

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Annex 1 Illustration of the KT plan for one region

An illustration of the contextualised knowledge translation (KT) scheme to be implemented in a region: KT activities to be implemented and expected outcomes according to several publics of professionals regionally involved in prevention and health promotion (IREPS professionals, ARS professionals, stakeholders, CRSA professionals).

Activities to implement with IREPS professionals and expected outcomes	
Activities	***Expected Outcomes***
Deliberative working group in order to develop a policy-brief for CRSA professionals and committee presidents	1, 5
Deliberative working group in order to develop a policy-brief for field professionals working in prevention and health promotion	1, 5
Training in the use of PBS and other evidence data use- Level 2 – (NB: Level 1 being for basic knowledge) for field professionals working in prevention and health promotion	1, 2, 3, 4, 5
Diffusion of communication tools (newsletters, inserts, etc.) highlighting research results	1, 2, 3, 4, 5
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 3, 4, 5
Organisation of a regular meeting between stakeholders and researchers, to discuss about research production and field needs, in order to be aware of issues of both parts	3, 4, 5

Expected outcomes:
1: Field professionals working in prevention and health promotion highlight PBS data use in their productions (presentations, reports, schemes, etc.)
2: Field professionals working in prevention and health promotion state evidence use (including PBS data use) in the conventions they have with funders and collaborators.
3: Field professionals working in prevention and health promotion use PBS data when developing their field projects.
4: Field professionals working in prevention and health promotion use PBS data when writing the action reports they send to funders.
5: IREPS teams adopt a shared culture on evidence use.

Activities to implement with ARS professionals and expected outcomes	
Activities	***Expected Outcomes***
Formation for PBS and other evidence data use- Level 2 – (NB: Level 1 being for basic knowledge)	1, 2, 3
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 2, 3
Organisation of a regular meeting between stakeholders and researchers, to discuss about research production and field needs, in order to be aware of issues of both parts	1, 2
Diffusion of policy-briefs in the ARS	1, 2, 3, 4
Redaction by the IREPS of notes based on PBS data and/or other evidence data or theoretical models in the call for proposals and conventions: political memo	2, 3, 4
To make official the collaboration between the ARS and the university research group “human health” (convention, charter, …)	2, 3, 4
Diffusion of communication tools (newsletters, inserts, etc.) that highlight research results	4
Presentation of the process in the ARS: meetings with the director general, the executive committee, the management committee, etc.	4
Political memo for the director general	4

Expected outcomes :
1: ARS professionals enhance PBS data in the documents, tools, etc. they produce (e.g. presentations, actions assessment, activities scheme, etc.)
2: Evidence (including PBS) requirement appears in the regional calls for projects
3: ARS professionals indicate evidence (including PBS) requirement in the conventional agreement they have with stakeholders
4: ARS teams adopt a shared culture on evidence use.

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Activities to implement with stakeholders and expected outcomes	
Activities	***Expected Outcomes***
Formation for stakeholders on evidence use and its adding value (Level 1)	1, 2, 3
Formation for stakeholders on evidence use in relation with identified needs previously collected (for example according to a given population, theme, etc.) (Level 2)	1, 2, 3
Methodological support for evidence use	1, 2
Diffusion of communication tools (newsletters, inserts, etc.) that highlight research results and PBS	1, 2
Deliberative working group in order to develop a policy-brief for field professionals working in prevention and health promotion	1, 2, 3
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 2, 3

Expected outcomes :
1: Stakeholders use PBS data when applying to calls for projects as well as in the actions funded on pluri-annual conventions they develop
2: Stakeholders use PBS data when developing their projects
3: Proximity advisors are able to help stakeholders with evidence use

Activities to implement with CRSA professionals and expected outcomes	
Activities	***Expected Outcomes***
Installation of awareness areas for evidence use among board, committee's presidents and prevention committee members	1, 2
Diffusion of policy briefs whose topics are in relation with the agenda of the prevention committee of the CRSA	1, 2
Diffusion of policy briefs whose topics are in relation with the agenda prevention of the CRSA plenary meetings	1, 2

Expected outcomes :
1: CRSA members adopt a shared culture on evidence use.
2: CRSA members include PBS data in the notices they deliver

KT: Knowledge transfer; IREPS: Instance Régionale d'Education et de Promotion de la Santé, Regional Authority of education and health promotion; ARS: Agence Régionale de santé, Regional health agency; CRSA: Conférence Régionale de la Santé et de l'autonomie - an advisory organism involved in regional health politics set up; PBS: Stratégies d'Intervention en Prevention, knowledge documents named "intervention strategies in prevention".

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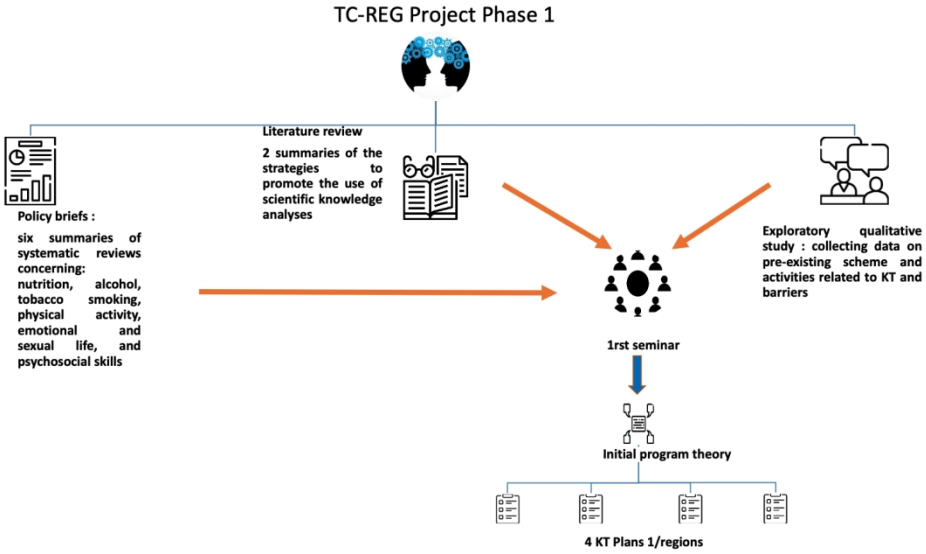

TC-REG Project Phase 1

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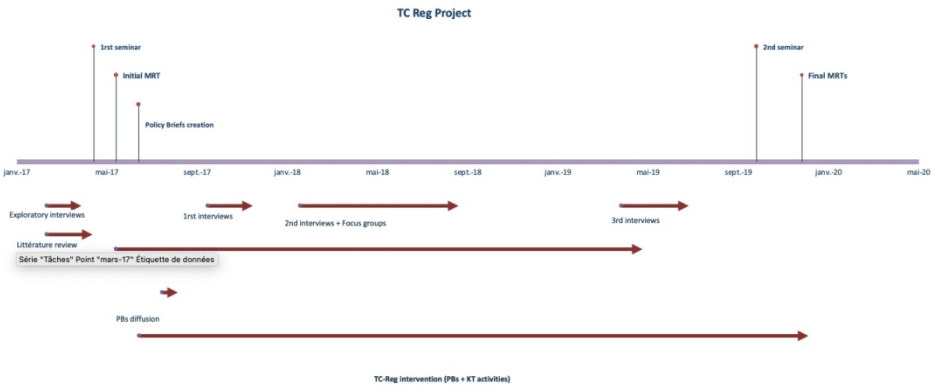

TC-REG project timeline

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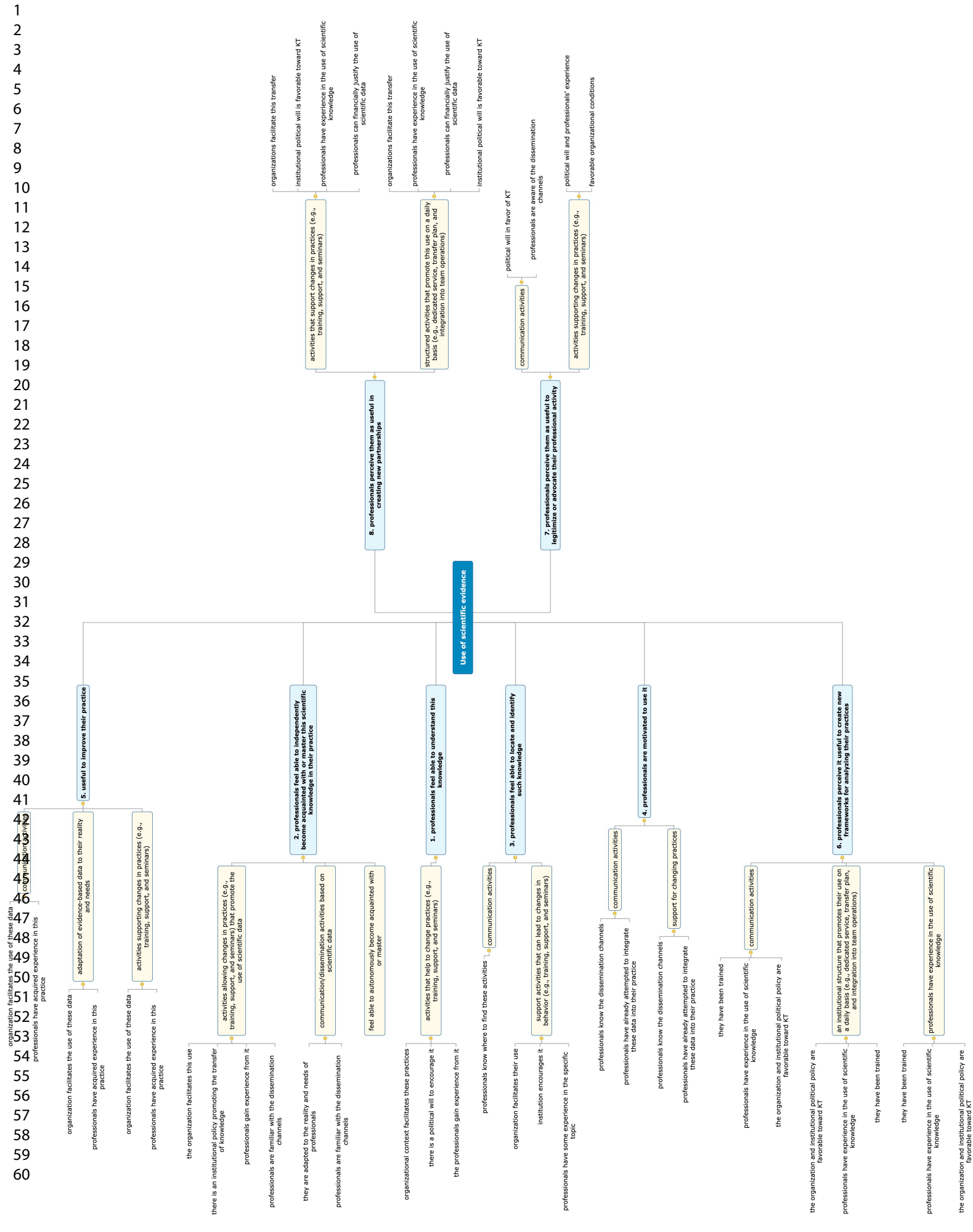
Use of scientific evidence
8. professionals perceive them as useful in creating new partnerships
7. professionals perceive them as useful to legitimize or advocate their professional activity
organizations facilitate this transfer
institutional political will is favorable toward KT
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
activities that support changes in practices (e.g., training, support, and seminars)
organizations facilitate this transfer
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
institutional political will is favorable toward KT
structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
political will in favor of KT
professionals are aware of the dissemination channels
communication activities
political will and professionals' experience
favorable organizational conditions
activities supporting changes in practices (e.g., training, support, and seminars)
5. useful to improve their practice
2. professionals feel able to independently become acquainted with or master this scientific knowledge in their practice
1. professionals feel able to understand this knowledge
3. professionals feel able to locate and identify such knowledge
4. professionals are motivated to use it
6. professionals perceive it useful to create new frameworks for analyzing their practices
organization facilitates the use of these data
professionals have acquired experience in this practice
adaptation of evidence-based data to their reality and needs
organization facilitates the use of these data
professionals have acquired experience in this practice
activities supporting changes in practices (e.g., training, support, and seminars)
organization facilitates the use of these data
professionals have acquired experience in this practice
the organization facilitates this use
there is an institutional policy promoting the transfer of knowledge
activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data
professionals gain experience from it
professionals are familiar with the dissemination channels
they are adapted to the reality and needs of professionals
communication/dissemination activities based on scientific data
professionals are familiar with the dissemination channels
feel able to autonomously become acquainted with or master
organizational context facilitates these practices
there is a political will to encourage it
activities that help to change practices (e.g., training, support, and seminars)
the professionals gain experience from it
professionals know where to find these activities
communication activities
organization facilitates their use
institution encourages it
support activities that can lead to changes in behavior (e.g., training, support, and seminars)
professionals have some experience in the specific topic
professionals know the dissemination channels
communication activities
professionals have already attempted to integrate these data into their practice
professionals know the dissemination channels
support for changing practices
professionals have already attempted to integrate these data into their practice
they have been trained
communication activities
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT
the organization and institutional political policy are favorable toward KT
an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
professionals have experience in the use of scientific knowledge
they have been trained
they have been trained
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT

		TITLE	Reported in document Y/N/Unclear	Page(s) in document
1		In the title, identify the document as a realist evaluation	Y	1
SUMMARY OR ABSTRACT				
2		Journal articles will usually require an abstract, while reports and other forms of publication will usually benefit from a short summary. The abstract or summary should include brief details on: the policy, programme or initiative under evaluation; programme setting; purpose of the evaluation; evaluation question(s) and/or objective(s); evaluation strategy; data collection, documentation and analysis methods; key findings and conclusions Where journals require it and the nature of the study is appropriate, brief details of respondents to the evaluation and recruitment and sampling processes may also be included Sufficient detail should be provided to identify that a realist approach was used and that realist programme theory was developed and/or refined	Y	2
INTRODUCTION				
3	Rationale for evaluation	Explain the purpose of the evaluation and the implications for its focus and design	Y	4
4	Programme theory	Describe the initial programme theory (or theories) that underpin the programme, policy or initiative	Y	4&9
5	Evaluation questions, objectives and focus	State the evaluation question(s) and specify the objectives for the evaluation. Describe whether and how the programme theory was used to define the scope and focus of the evaluation	Y	5
6	Ethical approval	State whether the realist evaluation required and has gained ethical approval from the relevant authorities, providing details as appropriate. If ethical approval was deemed unnecessary, explain why	Y	2 and 28
METHODS				
7	Rationale for using realist evaluation	Explain why a realist evaluation approach was chosen and (if relevant) adapted	Y	8
8	Environment surrounding the evaluation	Describe the environment in which the evaluation took place	Y	6
9	Describe the programme policy, initiative or product evaluated	Provide relevant details on the programme, policy or initiative evaluated	Y	9
10	Describe and justify the evaluation design	A description and justification of the evaluation design (i.e. the account of what was planned, done and why) should be included, at least in summary form or as an appendix, in the document which presents the main findings. If this is not done, the omission should be justified and a reference or link to the evaluation design given. It may also be useful to publish or make freely available (e.g. online on a website) any original evaluation design document or protocol, where they exist	Y	7 & 12
11	Data collection methods	Describe and justify the data collection methods – which ones were used, why and how they fed into developing, supporting, refuting or refining programme theory Provide details of the steps taken to enhance the trustworthiness of data collection and documentation	Y	11&12
12	Recruitment process and sampling strategy	Describe how respondents to the evaluation were recruited or engaged and how the sample contributed to the development, support, refutation or refinement of programme theory	Y	8
13	Data analysis	Describe in detail how data were analysed. This section should include information on the constructs that were identified, the process of analysis, how the programme theory was further developed, supported, refuted and refined, and (where relevant) how analysis changed as the evaluation unfolded	Y	19&20
RESULTS				
14	Details of participants	Report (if applicable) who took part in the evaluation, the details of the data they provided and how the data was used to develop, support, refute or refine programme theory	Y	9&12-18
15	Main findings	Present the key findings, linking them to contexts, mechanisms and outcome configurations. Show how they were used to further develop, test or refine the programme theory	y	21-24
DISCUSSION				
16	Summary of findings	Summarise the main findings with attention to the evaluation questions, purpose of the evaluation, programme theory and intended audience	y	28
17	Strengths, limitations and future directions	Discuss both the strengths of the evaluation and its limitations. These should include (but need not be limited to): (1) consideration of all the steps in the evaluation processes; and (2) comment on the adequacy, trustworthiness and value of the explanatory insights which emerged In many evaluations, there will be an expectation to provide guidance on future directions for the programme, policy or initiative, its implementation and/or design. The particular implications arising from the realist nature of the findings should be reflected in these discussions	y	30
18	Comparison with existing literature	Where appropriate, compare and contrast the evaluation's findings with the existing literature on similar programmes, policies or initiatives	y	23-25
19	Conclusion and recommendations	List the main conclusions that are justified by the analyses of the data. If appropriate, offer recommendations consistent with a realist approach	Y	24-27&31
20	Funding and conflict of interest	State the funding source (if any) for the evaluation, the role played by the funder (if any) and any conflicts of interests of the evaluators	Y	3

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Implementation Science

STUDY PROTOCOL Open Access

Evaluation of a knowledge transfer scheme to improve policy making and practices in health promotion and disease prevention setting in French regions: a realist study protocol

Linda Cambon[1,2,7*], Audrey Petit[1], Valery Ridde[3,4], Christian Dagenais[5], Marion Porcherie[1], Jeanine Pommier[1], Chrisine Ferron[6], Laetitia Minary[2] and François Alla[2]

Abstract

Background: Evidence-based decision-making and practice are pivotal in public health. However, barriers do persist and they relate to evidence properties, organisations and contexts. To address these major knowledge transfer (KT) issues, we need to rethink how knowledge is produced and used, to enhance our understanding of decision-making processes, logics and mechanisms and to examine the ability of public health services to integrate research findings into their decisions and operations. This article presents a realist evaluation protocol to assess a KT scheme in prevention policy and practice at local level in France.

Methods/design: This study is a comparative multiple case study, using a realist approach, to assess a KT scheme in regional health agencies (ARS) and regional non-profit organisations for health education and promotion (IREPS), by analysing the configurations contexts/mechanisms/outcomes of it. The KT scheme assessed is designed for the use of six reviews of systematic reviews concerning the following themes: nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life and psychosocial skills. It combines the following activities: supporting the access to and the adaptation of scientific and usable evidences; strengthening professionals' skills to analyse, adopt and use the evidences in the course of their practices and their decision-making process; facilitating the use of evidence in the organisations and processes. RAMESE II reporting standards for realist evaluations was used.

Discussion: The aims of this study are to experiment and characterise the factors related to the scheme's ability to enable public health stakeholders to address the challenges of KT and to integrate scientific knowledge into policy and practice. We will use the realist approach in order to document the parameters of successful KT strategies in the specific contexts of preventive health services in France, while seeking to determine the transferability of such strategies.

Keywords: Knowledge transfer, Realist evaluation, Complex intervention, Prevention, Public health

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Background

Evidence-based decision-making and practice are major issues in public health. For researchers, this means looking ahead to the dissemination of findings and integrating different types of knowledge and decision-making challenges [1]. It also implies greater collaboration between the research community and decision-makers [2]. Public health research issues have to be approached alongside societal and health issues too. It follows that evidence-based policy-making and planning in public health offer a way to improve the efficiency, credibility, and sustainability of health systems [1]. Furthermore, this can lead to a better social acceptance of the chosen decisions and interventions [3].

Despite the general agreement about the interest of evidence informed practices and policy-making (EIDM), barriers do persist in both the production and use of evidence. These barriers relate to people, organisations, contexts and properties of evidences [4]. To address this, it is necessary to rethink how knowledge is produced and used, to enhance our understanding of decision-making processes, logics and mechanisms and to examine the ability of public health services to integrate research findings into their decisions and operations. This requires a systemic approach, which includes the adaptation of scientific knowledge, the ability of users to capture, understand and apply the available evidence, as well as an accurate organisation and a supportive culture for using evidence. These are the major challenges of KT, defined by the National Public Health Institute of Quebec (INSPQ) as "the group of activities and interaction mechanisms that foster the dissemination, adoption and appropriation of the most up-to-date knowledge possible for use in professional practice and in healthcare management" [5].

What stands in the way of the use of scientific evidence in public health?

In France, there is no formal and structural KT scheme. There are a few initiatives led by the National Public Health Agency (ANSP) and the National Cancer Institute (INCA), which for instance produce literature reviews. But policy-makers and prevention professionals do not use them. It confirms that a passive diffusion of knowledge is not effective, and the effectiveness of KT strategies depends on the context in which they are implemented [6–10]. The contextualization of the KT strategies is necessary to remove barriers to knowledge use. According to Gervais et al. [3, 11], KT research on decision-making processes offers a number of explanatory factors which may be classified in three categories. The first relates to the specific properties of the evidence itself: nature, availability, accessibility, quality and credibility (data and sources), intelligibility, ability to meet needs, adaptability and transferability [3]. The second category relates to the personal characteristics of decision-makers: beliefs or personal values, political leanings, socio-demographics, level of education, previous experiences, motivation and ability to interpret data, etc. All of them may influence how new knowledge is addressed in the decision-making process.[12]. The third category refers to the characteristics of the organisations and local contexts in which knowledge producers and users work [4]: openness to change, material, human and financial resources available for KT, social and political context in the external environment, style of management, leadership, staffing, stakeholder coalitions, etc. Consequently, the multiple barriers to the adoption of evidence in the field of public health underline the non-linear process between knowledge production and knowledge use. If these barriers are to be overcome, we need to address all the parameters that affect the decision-making process. This is a focal point for KT research.

The mechanisms of an effective knowledge transfer

Various strategies are available to overcome barriers to the use of KT. A recent work conducted by Langer et al. identified six mechanisms involved in effective KT:

- "Awareness" (M1) is defined as building awareness for, and positive attitudes toward, evidence-informed decision-making (EIDM). This mechanism emphasises the importance of decision-makers' valuing the concept of EIDM.
- "Agree" (M2) is defined as the building mutual understanding and agreement on policy-relevant questions and the kind of evidence needed to answer them. This mechanism emphasises the importance of building mutual understanding and agreement on policy questions and what constitutes fit-for-purpose evidence.
- "Communication and access" is (M3) defined as providing communication of, and access to, evidence. This mechanism emphasises the importance of decision-makers receiving effective communication of evidence and convenient access to it.
- "Interact" (M4) is defined as the interaction between decision-makers and researchers. This mechanism emphasises the importance of decision-makers interacting with researchers in order to build trusted relationships based on mutual trust, collaborate, and gain exposure to a different type of social influence.
- "Skills" (M5) is defined as supporting decision-makers to develop skills in finding and making sense of evidence. This mechanism emphasises the importance of decision-makers' having the necessary skills to identify, appraise, synthesise evidence, and integrate it with other information and political needs.

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- "Structure and process" (M6) is defined as influencing decision-making structures and processes. This mechanism emphasises the importance of decision-makers' psychological, social and environmental structures and processes (e.g. personal models, professional norms, habits, organisational and institutional rules) in providing means and barriers to action.

The authors underline that these strategies are effective if combined and contextualized in their implementation setting, confirming previous work of Ridde et al. [13] and Barwick [14]. Consequently, we hypothesize that in France, as elsewhere, simple diffusion and "one size fits all" strategies are not effective.

In this paper, we present the protocol of a realist evaluation study of knowledge transfer strategies implemented in the field of health prevention at a local level in France. We have used RAMESE II reporting standards for realist evaluations [15].

Study objectives and location

The objective of the study is to identify the configurations contexts/mechanisms/outcomes of an effective KT scheme in local prevention sector. This study will be conducted in four French regions and within two types of organisation and their partners: regional health agencies (ARS), which are responsible for policy-making and prevention policies; and non-profit organisations (IREPS). IREPS develop health promotion and prevention programs and provide methodological supports to field professionals for the implementation of prevention interventions in different settings (work places, schools, care settings, recreation and community centres, rural or urban areas, etc.). ARS and IREPS work together to implement prevention and health policies in local contexts.

Methods/design

We have reported this manuscript in line with the RAMESES II reporting standards for realist evaluation.

Study design and conceptual framework

This study is a comparative multiple case study of a KT scheme in the field of health prevention using a realist approach [16, 17]. It concerns French public health services: ARS and IREPS. The case study design is the more suitable research strategy to investigate a phenomenon within its context and analyse this phenomenon's interactions with several other elements relevant for our area of study [18].

The realist approach [17] is increasingly used for appraising the interactions between an intervention, its mechanisms and its contexts. The overall aim is to achieve a better understanding of an intervention's success factors and how these may be replicated in other contexts. This type of evaluation examines what works, under what conditions and for whom, based on a middle-range theory (or configurational theory) which describes the interactions between outcomes, mechanisms and contexts [17, 19]. Thus, realist evaluation integrates the paradigm of black box evaluation [20]. While the experimental paradigm evaluates effectiveness without appraising an intervention's mechanisms of impact, realist evaluation answers the following question: did the intervention work according to the theory underpinning it? This type of evaluation seeks to understand the intervention by focusing on its mechanisms and the influence of context. The mechanism is defined in this case as the "part of a participant's response to an intervention, generally hidden and sensitive to variations in context, and which produces effects" [21]. In realist evaluation, causality is generative, meaning that what generates the effect relates specifically to the interactions between context and cause (here, the intervention methods) [19]. However, as we will study the patterns between these interactions in different contexts, we hypothesise that it is possible to isolate key elements that may apply across a set of contexts. These findings will thus generate intermediate theories that will be sharpened little by little as each case will be investigated.

To conduct a realist evaluation, we alternate theoretical and empirical stages (Cf. Fig. 1: The realist sequences). According to Langer's work [2] and many authors [7, 10, 13, 14, 22], we hypothesize that an effective KT scheme has to combine an access to and an adaption of knowledge, the development of professionals' skills to analyse, adopt and transfer knowledge into their contexts, the improvement of organisations and processes in order to facilitate the integration of knowledge. We also conducted an exploratory qualitative study in the four regions to collect data on the pre-existing scheme and activities related to KT and the potential local barriers. The questions were the following: what kind of KT activities are possible (types, timeline, duration, management)? Who may be involved? What structural/organisational mechanisms would be affected? What contextual factors, outside the control of those involved, would need to be addressed? Data will be collected by means of semi-structured interviews with IREPS directors and ARS public health directors (8 people). Based on the behaviour change wheel theory [23] and an exploration of the behavioural theories used in KT strategies [24], we hypothesize that the change of which will occur in knowledge use may be notably due to the motivation to use knowledge, the perception of its usefulness and practicality and the ability to adapt it in to fit different settings.

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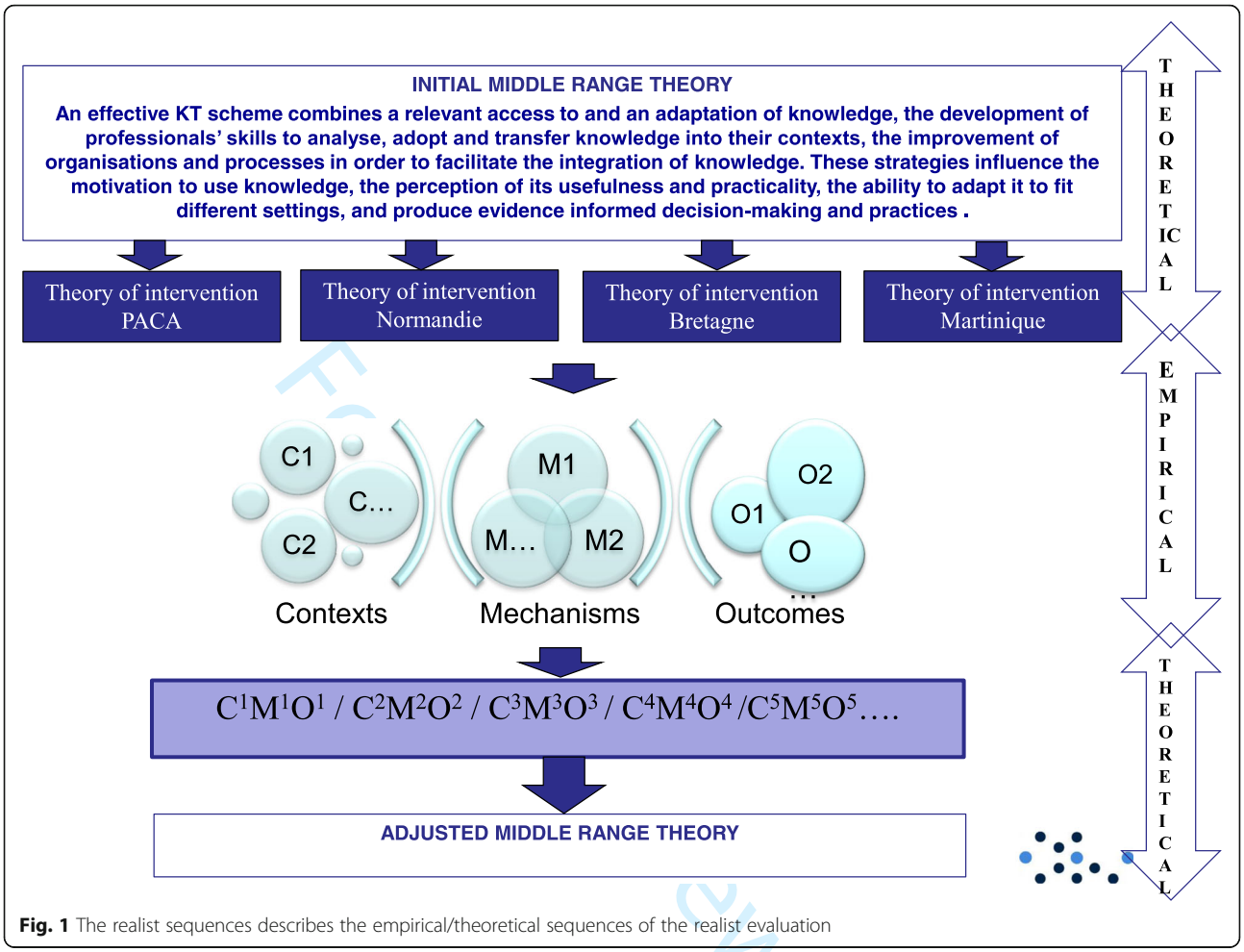

Fig. 1 The realist sequences describes the empirical/theoretical sequences of the realist evaluation

According to all the above scientific literature, and to support our realist evaluation, we built an initial middle range theory, defined as following: "An effective KT scheme combines a relevant access to and an adaptation of knowledge, the development of professionals' skills to analyse, adopt and transfer knowledge into their contexts, the improvement of organisations and processes in order to facilitate the integration of knowledge. These strategies influence the motivation to use knowledge, the perception of its usefulness and practicality, the ability to adapt it to fit different settings, and produce evidence informed decision-making and practices".

This initial middle range theory leads to the design of four theories of intervention one for each region describing the interventions, the expected outcomes, the contexts' parameters and the expected mechanisms. This work will be conducted in a preliminary 2-day workshop, gathering ARS and IREPS professionals. These theories will be applied in the 4 regions, for 12 months, and data will be collected in order to characterize the contexts, mechanisms and outcomes and to determine the effective CMO configurations.

Finally, a cross-sectional analysis of the case studies will be conducted allowing us to identify potential regular CMO patterns, which would constitute an adjusted middle-range theory. The different stages are presented in Fig. 1 (Cf Fig. 1: The realist sequences).

Intervention strategies

The intervention is a KT scheme designed for the use of policy briefs (PBs), which will be written on the basis of six reviews of systematic reviews (completed by international guidelines); an international scientific committee have carried out these reviews. They concern the following themes: nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life and psychosocial skills. These themes are primary in France. They present effective prevention practices.

Based on the report entitled "The science of using science: researching the use of research evidence in decision-making" [25], the scheme combines the following activities:

- Supporting the access to and the adaptation of scientific and usable evidences especially the policy briefs.
- Strengthening professionals' skills to analyse, adopt and use the policy briefs in the course of their practices and their decision-making process (training, journal club, tutoring, etc.).
- Facilitating the use of evidence in the organisations and processes (collaborative workshops, normative processes, incentives, nudge, etc.).

According to the initial middle range theory and the 4 theories of change, professionals will make an action plan to apply them in their local settings. Theses KT activities will be set up over a 12-month period.

Population

The targeted population is composed of prevention and public health services operating in French regions, namely, the ARS and IREPS and their partners. The study will focus on three groups of stakeholders:

- ARS public health professionals: five agents per region (deputy directors in charge of prevention, heads of strategy departments and project managers);
- IREPS professionals: ten people per region (directors, project managers and communication managers).
- Members of specialised prevention commissions within the Regional Conferences on Health and Autonomy (CRSA) and members of the Public Policy Coordination Commission (CCPP) both devoted to prevention in French regions (five people) and partners of IREPS and ARS.

We already have the agreement for the data collection given by the four ARS involved in the project since it began.

Data collection

Data will be collected to document the support scheme's mechanisms and contexts parameters involved in effectiveness. They will be collected before the implementation of the KT scheme at the end and throughout the implementation. They will be collected on the 3 categories of people described before; 20 people per each region (80 at all).

Collected data will characterise the context, the mechanisms relating to the organisation and to the individuals involved, the PBs and the set-up for KT.

A description of data collected and how and they will be collected are presented in Tables 1 and 2, but these variables will be adjusted according to the four theories of intervention and the action plans (Cf. Table 1 : Expected outcomes and Table 2 : Contexts and mechanisms expected).

Data will be collected by means of:

- Semi-structured interviews conducted with the above-mentioned population (20 people per region)
- The observation of health promotion meetings and collective events resulting from the scheme's implementation: project selection committees, selection processes, trainings, seminars, presentations etc. The aim of these observations is to study the types of interactions between the professionals who deal with KT strategies (for instance, leadership, uptake, bottom up or top down approaches).
- A documentary analysis (calls for project, action plans, projects applications, reports of meeting, etc.)

The observation and documentary analysis grids and the interview guideline will be designed based on the four intervention theories and tested on a sample of five stakeholders not involved in the process, but belonging to the IREPS network.

The collection will last 12 months.

Data analysis

Data will be processed through a content analysis [26] defined as "A set of systematic and objective procedures for analysing communication processes in order to obtain indicators (quantitative or not) inferring knowledge related to the conditions (inferred variables) under which meaningful information is both sent and received". This analysis will code, classify and grade content in order to identify patterns, trends and specific features. We will use a software program called *Nvivo* to assist us in conducting and integrating a thematic analysis of the interviews and an analysis of the observation reports. The qualitative analysis will lead to:

- Document the uptake of evidence and the practice changes triggered by the intervention. This will be carried out on a case-per-case basis in monographic format, in order to identify the mechanisms at play, the degree of intervention, the contextual contingencies and the changes arising in the three types of knowledge use (instrumental, conceptual, persuasive).
- Identify the most regular CMO configurations by a cross-analysis of the different cases and a combination of the different data collected according to their linkage with the "context" meanings, "mechanism" meanings and "outcomes" meanings (cf Tables 1 and 2).

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Table 1 Expected outcomes

Stakeholders	Outcomes	Indicators	Data collection
ARS	Agents use policy briefs (PBs) in discussions at committee level	Number of verbatims per meetings Type of PBs or extracts from PBs Ways of using PBs	Semi-structured interview Observation
	Agents use evidences from PBs as criteria of project assessment	Existing in assessment grids	Documentary analysis Semi-structured interview
	Agents use evidences from PBs as part of conventional tools agreed between the ARS and its implementers (e.g. integration into specialised library and reference services)	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
	Agents advocate evidences from PBs in their productions (communications, reports, action plans, etc.)	Number of communications, reports, action plans mentioning PBS or extracts from PBs	Semi-structured interview Observation Documentary analysis
IREPS	Professionals use evidences from PBs to design their projects	Number of projects mentioning PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs to evaluate their projects	Number of evaluation based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs to make reports to their sponsors	Number of reporting based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Professionals use evidences from PBs in the methodological supports for field professionals	Number of methodological supports based on PBs or extracts from PBs Ways of using PBs	Semi-structured interview Observation
	Professionals advocate evidences from PBs in their productions (communications, reports, action plans, etc.)	Number of communications, reports, action plans mentioning PBS or extracts from PBs	Semi-structured interview Observation Documentary analysis
	Professionals use evidences from PBs as part of conventional tools agreed with their sponsors, included ARS and partners.	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
Field professionals	Field professionals use evidences from PBs to design their projects	Number of projects mentioning PBs or extracts from PBs Ways of using PBs	Semi-structured interview Documentary analysis
	Field professionals use evidences from PBs to design their conventional tools with partners and sponsors	Existence of mentioned PBs or extracts from PBs in documents Ways of using PBs	Documentary analysis Semi-structured interview
CRSA	CRSA committee use evidences from PBs to make statements	Number of verbatim per meetings Type of PBs or extracts from PBs Ways of using PBs	Observation Documentary analysis Semi-structured interview
CCPP	CCPP committee use evidences from PBs to design their partnership aim, their common projects	Number of verbatim per meetings Type of PBs or extracts from PBs Ways of using PBs	Observation Documentary analysis Semi-structured interview

Based on the observed elements, we will classify the outcomes in three categories of use as recorded in the literature [27, 28].

- Instrumental use: knowledge users draw on the IBs to make decisions or to change their practice;
- Conceptual use which implies changes in understanding and thinking inspired by the IBs;
- Persuasive use (also called strategic or symbolic use) which refers to a use of knowledge as a means to justify decisions or actions.

We will process these data to characterise the mechanisms identified in the intervention theory and induced by the intervention. This will enable us to answer the following questions about several mechanisms related to knowledge, people and organisations: (1) were they present in the contexts studied? (2) Did they positively or negatively influence the outcomes from a user's perspective? (3) Which mechanism(s) was (were) actually active (which parameter influenced which other parameter and/or which outcome)? (4)Which outcome(s) was (were) produced?

Then, a secondary middle range theory will then be developed, leading to future guidelines.

Development of an adjusted middle range theory

Based on this analysis, we will compare the CMO configurations, which will be identify with the initial middle range theory, and we will figure out an adjusted middle range theory. This work will be conducted during a

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Table 2 Contexts and mechanisms expected

Types of variable	CMO	Types	Variables	Questions	Data collection
Context in each region (C)		Relating to regional policy-making and policy action on prevention	Leadership	Type of management Type of management structuring	Observation Documentary analysis Semi-structured interview
			How public health is organised	Funders Types of funding ways (competitive call for project, conventional agreement, etc.) Assessment of actions Main partnership between stakeholders.	Observation Documentary analysis Semi-structured interview
			Support mechanisms for stakeholders/ practitioners	Types of supporting process Who support the practitioners Who are supported Who fund the supporting activities	Observation Documentary analysis Semi-structured interview
			Opportunities	Opportunities to work with researchers, to use evidences from researchers in practices	Observation Documentary analysis Semi-structured interview
			Collaborative	Experiences of collaborating work with researchers Assessment of them	Observation Documentary analysis Semi-structured interview
			Specific decision-making and operational process	Description of decision-making process Description of designing, setting and assessment of interventions	Observation Documentary analysis Semi-structured interview
Parameters influencing the use of the PBs	Mechanisms (M)	Relating to the PBs	Acceptability of PBs Closeness between practices and PBs recommendations Convenience of PBs with context and practices Credibility perceived of PBs Other mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Relating to stakeholders/ professionals	Ability to integrate new practices in the context, in the habits (capabilities) Interest from PBS using Culture of change existing (previous experiences, awareness, agreement) Motivation of using PBs Levels of interaction between researchers and practitioners to discuss about evidence-informed practices Other mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Relating to organisations	Changes in ability to evolve (opportunities in functioning, hierarchical agreement, etc.) Temporality (opportunity to take time to introduce new knowledge coming from PBs) Other blocking or driving mechanisms not expected		Observation Documentary analysis Semi-structured interview
		Others	Other mechanisms not envisaged initially		Observation Documentary analysis

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Table 2 Contexts and mechanisms expected *(Continued)*

			Semi-structured interview
Conduct of the KT	Intervention (I) set up locally	Type of KT activity set up locally Duration of these activities (action plans) Types of activity carried out Stage of completion of the expected activities Contributors involved in KT strategies Partnerships involved in KT strategies Financial resources in KT strategies Material resources in KT strategies	Observation Documentary analysis Semi-structured interview

second interdisciplinary workshop, based on a discussion about analysis from data collected, gathering all ARS staff responsible for prevention and public health, IREPS directors and project officers, plus agents from ANSP and INCA.

KT development guidelines in France will emerge from this meeting.

Communication and dissemination of results

Different types of actors will be involved throughout the study: prevention professionals, policy-makers and researchers. Thus, multiple methods will be used to communicate research results:

- Developing short and practical policy briefs about knowledge transfer to national policy-makers and practitioners
- Delivering presentations at local, national meetings in France and relevant international meetings for professionals and researchers
- Regular project review meetings and continuous engagement with key decision-makers and practitioners, in particular as part of the Public Health Initiative for the Interaction between Research, Intervention and Decision-*Initiative en Santé Publique pour l'Interaction entre la Recherche, l'Intervention et la Décision* (InSPIRe-ID), a knowledge transfer consortium, led by the French Ministry of Health.
- Delivering presentations at national and international conferences and publishing articles in peer-reviewed academic journals with emphasis on open access
- Developing a project research report for the funder, with a publishable executive summary

Discussion

This article describes a protocol using a realist design to understand how a KT scheme works, for whom and in what circumstances. In research, realist evaluation is valuable for evaluating interventions in their contexts; it addresses contextual factors in relation to the mechanisms and outcomes of these interventions. Thus, partial patterns can be revealed to explain how interventions may foster enhanced KT.

However, even if there is weak support in France to develop KT at a local level, KT is highly recommended by health national authorities. Consequently, we need to address a potential social desirability bias, resulting both from the subject and the fact that the data are not self-reported [28]. This bias results from the tendency of survey respondents to answer questions in a manner that will be viewed favorably by others. Moreover, we will design the interventional scheme with the different stakeholders. Researchers are thus involved in the assessed process. This contextual parameter must be taken into account in the evaluation.

The aim of this study is to experiment and characterise the success factors of a KT scheme in health promotion and disease prevention settings. By success, we mean the scheme's ability to (1) enable public health stakeholders to address the challenges of KT and (2) bring about changes in public health policy and practice: integration of evidence-informed public health, collaborative practices etc. We will seek to explain the parameters and conditions of these strategies in order to determine their transferability into other contexts. This will provide a basis for the production of operational and contextualised guidelines in order to develop KT to inform regional policy-making on health promotion and disease prevention. Ultimately, this research aims at enhancing overall policy-making and quality of implementation in the sector. With this in mind, this project will be of great interest for public policy-makers who are currently moving towards evidence-informed health promotion and disease prevention in France.

Abbreviations

ANSP: Agence Nationale de Santé Publique (National Agency for Public Health); ARS: Agence Régionale de Santé (Regional Health Agency); CCPP: Commission de Coordination des Politiques Publiques (Public Policy Coordination Committee); CRSA: Conférence Régionale de la Santé et de l'Autonomie (Regional Conference on Health and Autonomy); FNES: Fédération Nationale d'Education et de promotion de la Santé (National Federation for Health Education and Promotion); I: Intervention; IB: Intervention brief; INCa: Institut National du Cancer (National Cancer

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Institute); InSPIRe-ID: Initiative en Santé Publique Pour l'Interaction entre la Recherche, l'Intervention et la Décision (a public health initiative dealing with the interaction between research, intervention and decision-making); INSPQ: Institut National de santé publique du Québec (Quebec Public Health Expertise and Reference Centre); IREPS: Instance Régionale d'Education et de Promotion de la Santé (a non-profit organisation promoting health at a regional level); KT: Knowledge translation; PACA: Provence-Alpes-Côte-d'Azur (region in the south of France)

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Not applicable

Authors' contributions
LC and AP drafted this article and all authors revised the manuscript. The project design was developed by LC and AP. LM, FA, JP, MP and CF were involved in implementing the project and in developing the evaluation design. VR and CD were involved in the design of the middle range theory. All authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

Consent for publication
Not applicable

Ethics approval and consent to participate
The project will be carried out with full respect of current relevant legislation (e.g. the Charter of Fundamental Rights of the EU) and international conventions (e.g. Helsinki Declaration). The methods development, data collection and analysis will take account of the following issues:

- Anonymity of study respondents will be preserved and ensured at all times as respondent(s) request. Unnecessary collection of personal data will be avoided, and respondents will have the right to review outputs and withdraw consent. All personal data will be coded, removed from the data for analysis and stored separately. Only designated research staff will have access to the keys linking the data with the personal information.
- Informed consent will be obtained from all study participants, and in the case of refusal, alternative means of data collection will be explored (e.g. alternative respondents).

In addition, this study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Evaluation of a knowledge translation strategy to improve policy making and practices in health promotion and disease prevention setting in French regions: TC-REG, a realist study

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Abstract:

Objective: This paper presents the results of a realist evaluation of a knowledge translation (KT) intervention implemented in the field of health promotion and disease prevention at the local level in France.

Design: Realist evaluation study**.**

Setting: The target population comprised decision makers and field professionals working in prevention and public health services operating in regions of France (i.e., ARS, IREPS, and their partners).

Participants: This evaluation was based on data collected from 2 seminars, 82 interviews, 18 observations, and 4 focus groups over 18 months.

Intervention: the TC-REG intervention aimed to increase the use of evidence in cancer prevention, health promotion and disease prevention across four geographic regions in France. The intervention combined various activities: Supporting access to and adaptation of usable evidence, Strengthening professionals' skills in analyzing in analyzing, adopting, and using policy briefs, and Facilitating the use of evidence in organizations and processes.

Results: The collected data was used to define favorable/unfavorable contexts for the use of scientific data and mechanisms to be activated to encourage the use of scientific knowledge. From these raw results eight final refined middle-range theories were defined. Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate knowledge and under what conditions. These analyses provided a basis for the production of seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Conclusion: The results obtained from the analyses led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion.

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Strengths and limitations of this study'

- The large amount of qualitative data allowed us to create a knowledge translation (KT) taxonomy and to develop eight middle-range theories illustrating how to activate mechanisms and under what conditions.
- This study provided a basis for the production of seven operational and contextualized recommendations to develop KTto inform regional policy-making regarding health promotion and disease prevention.
- The results obtained from the analyses described here led us to formulate two perspectives of an operational nature for the benefit of those involved in prevention and health promotion
- A limitation of this work remains its potential for generalization, as this work has been carried out in a particular field and country, the prevention field in France.

KEYWORDS: Knowledge transfer; Realist evaluation; France; Prevention; Public health, Cancer

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Competing interests

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Introduction

Evidence-based decision-making and practice are major issues in public health. For researchers, this means looking ahead to the dissemination of findings and integrating different types of knowledge and decision-making challenges [1]. It also implies a need for greater collaboration between the research community and decision-makers [2]. Even if decision-makers, stakeholders, and researchers mostly agree that it is necessary to move forward with evidence-informed practices and policy-making, some barriers persist related to people, organizations, contexts, and evidence's attributes [3–5]. Gervais et al. [3,6] suggested that KT research concerning decision-making processes offers multiple explanatory factors, which can be classified in three categories. The first category relates to the specific properties of the evidence itself: nature, availability, accessibility, quality and credibility, intelligibility, ability to meet needs, adaptability, and transferability [6]. The second category relates to the characteristics of decision-makers: beliefs or personal values, political leanings, sociodemographic characteristics, level of education, previous experiences, motivation, and ability to interpret data. These characteristics may influence how new knowledge is addressed during the decision-making process [7]. The third category relates to the characteristics of the organizations and local contexts in which knowledge producers and users perform their work [3]: openness to change; material, human, and financial resources available for KT; social and political context in the external environment; style of management; leadership; staffing; and stakeholder coalitions. Multiple barriers to the adoption of evidence in the field of public health underline the nonlinear process between knowledge production and knowledge use. These barriers prevent optimal production and use of evidence. To address this, it is necessary to assess how knowledge is produced and used; to enhance the understanding of decision-making processes and mechanisms; and to examine the abilities of public health services to integrate research findings into their decisions and operations. This assessment requires a systematic approach

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that includes the adaptation of scientific knowledge; the abilities of users to capture, understand, and apply available evidence; and the presence of an organizational and supportive culture for use of this evidence. These are the major challenges of knowledge translation (KT)[8], defined as "the group of activities and interaction mechanisms that foster the dissemination, adoption and appropriation of the most up-to-date knowledge possible for use in professional practice and in healthcare management" [9].

Over the past several decades, a growing body of literature has been published regarding KT [8,10,11]. Facilitators and barriers related to KT have been studied in several contexts [12–14]; several KT frameworks that provide a mapping of KT processes have been described [15]. Although these frameworks are helpful for understanding the key elements involved in KT, they lack consistency regarding implementation of KT schemes in local contexts because they provide broad concepts without concrete examples of KT activities to implement. The literature highlights the insufficient dissemination of scientific knowledge [16–20]; it also emphasizes that, to be effective, KT modalities must be contextualized to the environment in which knowledge dissemination is required. Thus, the effectiveness of KT strategies depends on the context in which they are implemented [8,21–24]. The contextualization of KT strategies is therefore necessary to remove barriers to knowledge use.

This paper presents the results of a realist evaluation study of KT strategies implemented in the field of health promotion and disease prevention at the local level in France. By disease prevention we mean specific, population-based and individual-based interventions for primary and secondary prevention, aiming to minimize the burden of diseases and associated risk factors [25].

The TC-REG ("Transfert de Connaissances en REGion") intervention (referred to in this paper as the intervention) is a knowledge translation plan implemented in 4 French regions consisting of an accompanying support process for the use of evidence in cancer prevention. The

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intervention combined various activities: Supporting access to and adaptation of usable evidence, Strengthening professionals' skills in analyzing in analyzing, adopting, and using policy briefs, and Facilitating the use of evidence in organizations and processes. The aim of the TC-REG study was to evaluate the reported impact of this support process to influence the decisions and preventive practices in four regions of France. This study documented the mechanisms, processes, the configurations (i.e., Contexts/Mechanisms/Outcomes [CMOs]) [26] and the conditions of reported effectiveness established as a result of this support to ensure KT.

RAMESES II reporting standards for realist evaluations were used [27].

Methods/design

Theoretical framework

The realist approach [26] is increasingly used for appraising the interactions among an intervention, its mechanisms, and its contexts. The overall aim is to achieve a better understanding of an intervention's success factors and how these may be replicated in other contexts. In realist evaluation, developed by Pawson and Tilley [26], the effectiveness of the intervention depends on the underlying mechanisms that contribute within a given context. Realist evaluation involves identification of CMOs configurations. The aim comprises understanding how and why an intervention works. A middle-range theory (i.e., a theory aimed toward describing interactions among outcomes, mechanisms, and contexts and therefore CMOs configurations) is established to highlight the mutual influences of intervention and context [28,29]. This approach is linked to the black box paradigm [30] and differs from the experimental paradigm, which evaluates effectiveness without analysis of the mechanism by which an intervention is successful, as well as without the influence of context. Realist evaluation determines whether an intervention worked in a manner consistent with its

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underpinning theory. The generative causality works via three assumptions [31]: i) an intervention is not successful in isolate, and is not the source of a given outcome; ii) all interventions trigger a mechanism or a set of mechanisms that produce an outcome; and iii) all interventions are delivered within specific contexts.

Hence, realist evaluation involves identification of middle-range theories. Hypothesized and validated by empirical investigations, these CMOs configurations help to understand how an intervention causes change, considering both context and target group [28,29]. The recurrence of CMOs is observed in successive case studies [29]. To consider context, realist evaluators observe successive cases, which Lawson (quoted by Pawson in 2006 [31]) has described as "demi-regularities of CMOs" (i.e., regular, not necessarily permanent occurrences of an outcome when an intervention triggers one or more mechanisms in a given context) [29]. Analysis of these recurrences in different contexts allows the isolation of key elements that can be replicated in a family of contexts. This yields middle-range theories that become increasingly robust with progression among cases. "These middle-range theories, in certain conditions, predict possible intervention outcomes in contexts different from the one in which the intervention was tested" [29,32].

Applied to our case

As the realist principle is suitable for studying non-linear interactions in complex systems, we adopted this approach [33]. In our study, each region involved in the TC-REG intervention, with its own context, constituted a case. For each case, the intervention was studied to identify contributory mechanisms in a given context, along with the variation in outcomes. CMOs configurations were identified through analyses of successive cases. A cross-case analysis was performed to highlight recurrent CMOs configurations and thus identify key features for possible replication.

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Mechanisms were identified qualitatively, in accordance with the definition of Ridde et al.: "a mechanism is an element of reasoning and reaction of an agent with regard to an intervention productive of an outcome in a given context" [34,35], and in accordance with the definition of Cambon et al.: "What characterizes and punctuates the process of change and hence, the production of outcomes"[36].

In a realist approach, interventional elements contribute to the context. Contextual elements have been included among all elements collected qualitatively that satisfy the following definition: elements located in time and space that may affect the intervention and the outcomes produced. Therefore, this study distinguished between Ci (for contextual factors linked to the intervention) and Ce (for external contextual factors that are not linked to the intervention).

The TC-REG intervention

The TC-REG intervention aiming to improve the use of scientific knowledge among decision-makers across four geographic regions in France. It combined various activities: Supporting access to and adaptation of usable evidence, Strengthening professionals' skills in analyzing in analyzing, adopting, and using policy briefs, and Facilitating the use of evidence in organizations and processes.

The intervention was elaborated through a collaborative process creating tailor made knowledge translation plan implemented differently in four regions It aimed to collectively become acquainted with and master the concept of KT, and to identify effective strategies highlighted in the literature and their conditions of transferability. As presented in Figure 1, two kinds of literature review were carried out simultaneously: a review of the existing literature with the aim of extracting knowledge on successful KT activities and effective mechanisms in KT, and the drafting of Policy briefs (PBs) consisting of six summaries of systematic reviews presenting effective prevention practices concerning nutrition, alcohol, tobacco smoking, physical activity, emotional and sexual life, and psychosocial skills. We also conducted an

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exploratory qualitative study (14 non-directive interviews) in the four regions to collect data on the pre-existing scheme as well as activities related to KT and the potential local barriers. Next, a seminar allowed us to consensually define the initial middle-range theory (CMO) based on the existing literature, the results from the exploratory study, the presentation of the PBs and the project team insights (Cf. box 1). Four different KT plans were designed during this seminar and implemented in each of the 4 regions over a 12-month period. Each KT plan aims to improve the use of scientific knowledge. This intervention ended in December 2019.

Figure 1: TC-REG Project Phase 1

In each of the 4 regions the following categories of activities were combined: i) Supporting access to and adaptation of scientific and usable evidence, especially policy briefs, ii) Strengthening professionals' skills in analyzing, adopting, and using the policy briefs in the course of their practices and decision-making processes (e.g., training, journal club, and tutoring); iii) Facilitating the use of evidence in organizations and processes (e.g., collaborative workshops, normative processes, and incentives). An illustration of the KT plan for one region is detailed in annex 1. The detailed activities implemented in regions and corresponding to these operational objectives have been transcribed into a standardized taxonomy published by Affret et al. [37].

Initial middle-range theory

Drawing on the literature and experience of professionals locally involved in the intervention, the initial middle-range theory was established [26,31], then tested in each case (i.e., region) through collection of qualitative data [29].

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Box 1: The TC-REG Initial middle-range theory

Initial middle-range theory

"The modalities of an effective knowledge transfer scheme combine levers that:

- promote access to information and an adaptation of it (Ci)*,
- promote the development of capacities to understand and use them (Ci)*,
- allow the modification of organizational processes (Ci)* in order to facilitate their production and their appropriation in practice settings.

These modalities of KT produce an increasing use of scientific knowledge (O)*** by reinforcing:

- the perception of their usefulness (M)**,
- the motivation to use them (M)**,
- the ability to adapt them to the issues present in practical settings (M)**".

*Ci=contextual factors linked to the intervention
**M= Mechanism
***O= Outcome

At this point, no external contextual factors (i.e. Ce for external contextual factors that are not linked to the intervention) were identified, because there was no consensus on this topic among participants. This process was described in the published study protocol [38].

Population

This study was conducted in four regions of France[1] and within different types of organizations and their partners: regional health agencies (ARS[2]), which are responsible for policy-making and prevention policies; and non-profit organizations (IREPS[3]). IREPS develop health promotion and prevention programs; they also provide methodological supports to field professionals for the implementation of prevention interventions in different settings (e.g., workplaces, schools, care settings, recreation and community centers, and rural or urban areas). ARS and IREPS work collaboratively to implement prevention and health policies in local contexts.

[1] Paca, Brittany, Martinique, Normandy
[2] Agence Régionale de Santé: regional health agency
[3] Instance Régionale d'Education et de Promotion de la Santé pour tous: Regional organization for health promotion and education

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This study focused on stakeholders who agreed to implement the intervention in the 4 regions. The sample of this study is composed of :

- ARS public health professionals: five agents per region (deputy directors in charge of prevention, heads of strategy departments, and project managers);
- IREPS professionals: 10 people per region (directors, project managers, and communication managers);
- Members of specialized prevention commissions within the Regional Conferences on Health and Autonomy and members of the Public Policy Coordination Commission, both dedicated to prevention in various regions of France (five people) and partners of IREPS and ARS.

These 65 persons will be named TC-REG project manager in this article.

For all interviews, professionals were selected according to the following criteria: i) Participation in TC-REG study ; ii) Agreement to participate in the interviews; iii) Agreement with this use of the data extracted from the interviews ; iv) Diversity among institutes and professions (i.e., managerial and non-executive positions).

Data collection

This study alternated between theoretical and empirical stages. Data collection consisted of qualitative investigations through interviews and observations. The results were discussed and enriched during a seminar on 18 October 2019 with the TC-REG project manager of the four regions involved. More details regarding this study are available in the published study protocol [38].

Based on the initial middle-range theory (developed during the seminar in May 2017, cf. box 1) and to collect CMOs related to the realist analysis, three series of interviews and one series of observations were conducted.

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The first round of non-directive interviews aimed to collect and specify, with reference to the initial middle-range theory, the potential mechanisms to be activated and the external contextual elements (so-called Ce) missing in our initial middle-range theory. Thirty-six face to face interviews were conducted in October/November 2017. We asked the following question: "What do you think about the use of data from science and what would you place in this category?" and "Has your thinking evolved? How? How do you explain these evolutions?", which led to the identification of several mechanisms such as the perception of usefulness of the use of scientific knowledge, the perception of the ability to use them and the motivation to use them; and several contexts elements related to personal characteristics, organization.

In the second round, the interviews were semi-directive and aimed to identify a list of KT activities (so-called Ci) actually carried out in the regions, thereby determining a taxonomy that would enable them to be compared among regions. Ten semi-directive face to face interviews with the TC-REG project managers in the regions and four focus groups were conducted between February 2018 and August 2018. This round of data collection allowed precise determination of KT activities carried out in the regions, in accordance with the KT plans defined in August 2017, as well as collection of Cis.

The third round of interviews aimed to test our initial middle-range theory and to confirm Ce-Ci-M-O configurations, but also to identify new emerging configurations. These configurations were elaborated from the previous interviews and observations. During this round of interviews, we asked participants, "Since the beginning of the TC-REG intervention, do you use data from science? How? How do you explain that?" Then we asked more precise questions aiming to evaluate the reported impact of the KT plans in terms of using scientific knowledge (the Outcome="O"). Initially, we planned to classify the outcomes into three categories of use (instrumental use; conceptual use; persuasive use [38]), but since it appeared that these

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categories were in fact mechanisms leading to the use of scientific knowledge, our sole outcome is the reported use of scientific knowledge.

This third round of interviews aimed to test our initial middle-range theory and identify CMO configurations, i.e., to answer this question: through which mechanism(s) does the increased use of evidence take place and what activities and contextual circumstances can influence it?

In total, thirty-six semi-directive telephone interviews were conducted between April and June 2019.

The observations aimed to identify local contextual elements (Ce) and mechanisms (M) activated by the use of evidence-based data (PBs or other). Eighteen observations were conducted during the TC-REG project (Table 1: Objective, data, and qualitative investigation methods).

Table 1: Objective, data, and qualitative investigation methods

Round	Objective	Sample	Data collected
1st round of interviews October/November 2017	Specify: mechanisms and contextual elements	36 interviews with TC-REG project managers in these regions: - Brittany: 8 - Martinique: 12 - Normandy: 9 - PACA: 7	**O:** The current use of scientific data **M:** 13 Mechanisms **Ce:** 7 Contextual elements related to**:** People/ Organization
Observations Throughout TC-REG project	Identify local contextual elements and mechanisms	18 Non participating observations: - Brittany (n = 1) - Martinique (n = 2) - Normandy (n = 12) - PACA (n = 3)	
2nd round of interviews February/August 2018	determine taxonomy of KT activities currently carried out among regions	10 Semi-directive interviews with TC-REG project managers in these regions: - Brittany n = 2 - Martinique n = 2 - Normandy n = 3 - PACA n = 3 4 focus groups (1/region)	**Ci**: Determine KT activities carried out among regions according to transfer plan defined in August 2017.

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3rd round of interviews April/June 2019	Identify the evolution in the use of scientific data and **Ci-Ce-M-O** configurations	36 Semi-directive interviews with TC-REG project managers in these regions: - Brittany: 7 - Martinique: 10 - Normandy: 10 PACA: 9	**O:** The use of scientific data and its evolution (Pbs or other) Ci-Ce-M-O configurations

Data analysis

The data collected were coded and analyzed with the NVivo® software. Because the three series of interviews and the single set of observations comprised different types of information, they helped to iteratively establish information regarding the CMO configurations at stake. Data were analyzed step by step, allowing an inductive-deductive approach. The data were analyzed by two researchers (LC and OA), then compared and reanalyzed to reach a consensus between the two.

Data were coded to identify different levels of information. A first level of coding and analysis was used to identify and separate:

i) favorable/unfavorable contexts element to use scientific data, especially the data in PBs (Ce), ii) arguments evocated by the panel pro or cons the use of scientific data (foreshadowing the mechanisms to be activated, M).

Then, a second, more detailed level of coding allowed specification of the Ce and M to be activated in the use of scientific knowledge.

More precisely, the first round of interviews led to the identification of 7 external contextual elements (Ce): The existence of training prior to the use of scientific data; The financial valuation of KT; A favorable organizational context ; A favorable political context; A technical and logistical context that makes access to the data easier; Previous experiences with the use of evidence from science; Work time freed up for the use of scientific data in the professional

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activity. 13 mechanisms were also identified: 3 linked to personal abilities, 2 regarding personal motivations and 8 types of perceived usefulness.

The content analysis of the second wave of interviews identified a list of activities carried out in the 4 regions. This list was presented at the 2nd steering committee meeting on 13 February 2019 to establish a consensus regarding the wording of the activities. In this way, 18 distinct KT actions were identified; these were grouped into 11 strategic categories, thus constituting a taxonomy. The elaboration of a standardized taxonomy helped us to use the same definition of the activities. More details have been described in Affret et al [37].

Before the analysis of the 3rd round of interviews, the mechanisms and activities identified were grouped by type or theme (mechanisms were regrouped into 8 categories and KT activities in 4 groups).

The third round of reviews allowed the researchers to identify the Ce-Ci-MO configurations. For each mechanism (those identified following the second round of interviews or newly cited) mentioned by professionals as having evolved, the content analysis focused on the activities and contextual elements that had enabled its evolution. This round of interviews also served to identify the evolution of scientific knowledge use in these four regions (O).

The analysis was based on 3 nodes of analysis: 1) which mechanisms are activated by the KT plan, 2) for each mechanism, which activity in the KT plan was influenced (based on the KT taxonomy evocated before) it, 3) by each activity, which element of the context influenced it (in the list drawn up after the 1st round of interviews or newly cited).

This analysis allowed us to determine a list of different Ce-Ci-M-O, by region (the four) or by type of respondent (policymakers or field professionals). We then carried out a transversal analysis of the different Ce-Ci-M-O in order to define the configurational recurrences or demi-regularities (i.e., not perfect regularities but the repetitive Ce-Ci-M-O observed generating a

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perceptible uniformity [39]) according this rule: activities [Ci] in which the association's frequency with mechanisms [M] was higher than the average of the associations; contexts [Ce] in which the association's frequency with mechanisms [M] AND with activities [Ci] was higher than the average of the associations. This allowed us to produce a shared list of interregional (most generalizable) Ce-Ci-MOs.

The results of the analysis of the series 2 and series 3 interviews were discussed during a seminar on 18 October 2019, which brought together two people per ARS and IREPS from each of the four regions. This discussion allowed validation of the final CeCiMO configurations (middle-range theories) defined by the analysis. Figure 2 illustrates the timeline of the TC-REG project.

Figure 2: TC-REG project timeline

Patient and Public Involvement

The TC-REG study does not include any patient or public involvement in terms of setting research priorities, defining research questions or outcomes, providing input into the study design, or disseminating the results. The research participants answered interviews.

Results

As outlined previously, the analysis followed a 3-node frame*:*

1. ***Mechanisms activated by the KT plan***

Qualitative evidence allowed the identification of links between components of the middle-range theories. The following three mechanisms were most frequently reported to be strongly involved in the use of scientific knowledge among professionals:

- Perception of strategic utility (i.e., to legitimize practice):

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"That's it, we really need scientific data, proven data to support what they are saying to be taken seriously."[4]

Albert, Ireps

- Perception of instrumental utility (i.e., to change or improve practice):

"It gives us reliable elements to be able to adapt, to build our actions, well… I see it like that"

Véronique, Organization

- Ability to master these data (i.e., ability to use data easily and independently):

"The data transmitted by TC-REG (the PBs) will be able to evolve as a support for work and validation of scientific data on the ground and to apply them concretely"

Fannie, ARS

Five other mechanisms were identified but less often reported as important in the use of scientific data:

- The ability to understand the scientific data
- The ability to identify and recognize the scientific knowledge
- The motivation to use it
- The perception of the conceptual utility of it (i.e., useful to create new frameworks for analyzing their practices)
- The perception of the processual utility of this knowledge in terms of partnerships, for example.

2. Activities of the KT plan influencing the mechanisms

The KT activities were grouped into 4 categories:

[4] These verbatim were first transcribed in French, then translated by two native translators and then checked again by native French speaker researchers.

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- Communication regarding scientific data,
- Adaptation to realities encountered in the field by the professionals,
- Support activities for the use of these data
- Support activities enabling changes in professional practice

3. ***Elements of the context influencing the activities and the mechanisms***

Contexts that had an influence on activities were:

- Political will and organizational contexts facilitating or promoting the use of scientific knowledge
- Previous experience regarding the use of scientific evidence in practice.
- Gain in experience using scientific data
- Knowing where and how to find these data (dissemination channels)
- Previous training in the use of scientific data

Final middle-range theories

From these raw results eight final refined middle-range theories were defined (see Figure 3: Final MRTs). These theories were framed, conceptualizing the recurrence of the CMO configurations or semi-regularities observed. Organized around the mechanisms to be activated, these middle-range theories illustrate how to activate these mechanisms and under what conditions they will be activated. These theories refine and enrich the initial middle-range theory.

1. Use of scientific knowledge (O) is facilitated if professionals **feel able to understand it (M)**. This perception is facilitated by activities that help to change practices (e.g., training, support, and seminars) (Ci), particularly if the organizational context facilitates these practices (Ce) (e.g. creating trained team dedicated to these activities) and, if there is a political will to encourage it (Ce), and if the professionals gain experience from it (Ce).
2. Use of scientific knowledge (O) is facilitated if professionals **feel able to autonomously become acquainted with or master (M)** it in their practice. This perception is

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facilitated by activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data (Ci), particularly when the organization facilitates this use (Ce), when there is an institutional policy promoting the transfer of knowledge (Ce), and when professionals gain experience from it (Ce). This perception is also increased by communication/dissemination activities based on scientific data (Ci), when they are adapted to the reality and needs of professionals (Ci). These activities are more effective if professionals are familiar with the dissemination channels (Ce).

3. Use of scientific knowledge (O) is facilitated if professionals **feel able to locate and identify** such knowledge (M). This perception is facilitated by communication activities regarding these data (Ci), especially if the professionals know where to find these activities (Ce). It is also facilitated by support activities that can lead to changes in behavior (e.g., training, support, and seminars) (Ci), especially if the organization facilitates their use (Ce), if the institution encourages it (Ce), and if the professionals have some experience in the specific topic (Ce).
4. Use of scientific knowledge (O) is facilitated if professionals **are motivated to use it (M)**. This motivation can be induced by communication activities (Ci) and support for changing practices (Ci), especially if the professionals know the dissemination channels (Ce) and have already attempted to integrate these data into their practice (Ce).
5. Use of scientific knowledge (O) is facilitated if professionals perceive them as **useful to improve their practice (M)**. This perception is activated by communication activities (Ci), adaptation of evidence-based data to their reality and needs (Ci), and activities supporting changes in practices (e.g., training, support, and seminars) (Ci), particularly if the organization facilitates the use of these data (Ce), the institution encourages it, and if the professionals have acquired experience in this practice.
6. Use of scientific knowledge (O) is facilitated if professionals **perceive it useful to create new frameworks for analyzing their practices (M)**. This perception is activated by communication activities regarding these data (Ci) and by an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This consideration is more effective if professionals have experience in the use of scientific knowledge (Ce), especially if they have been trained (Ce), and if the organization and institutional political policy are favorable toward KT (Ce).

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7. Use of scientific data (O) is facilitated if professionals perceive them as **useful to legitimize or advocate their professional activity (M)**. This perception is facilitated by communication activities regarding these data (Ci), particularly when there is a political will in favor of KT (Ce) and when professionals are aware of the dissemination channels (Ce). This perception is also promoted by activities supporting changes in practices (e.g., training, support, and seminars) (Ci) that are supported by political will and professionals' experience (Ce); these are added favorable organizational conditions (Ce).
8. Use of scientific data (O) is facilitated if professionals perceive them as **useful in creating new partnerships (M)**, particularly within the research community. This perception is made possible by activities that support changes in practices (e.g., training, support, and seminars) (Ci), as well as by structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations) (Ci). This perception is more effective when professionals can financially justify the use of scientific data (Ce), when the institutional political will is favorable toward KT (Ce), when organizations facilitate this transfer (Ce), and when the professionals have experience in the use of scientific knowledge (Ce).

Figure 3 : Final MRTs

Taking up in this way each activity present in these refined middle-range theories it is possible to draw up practical recommendations for the field professionals for the development of KT. We have thus elaborated seven operational and contextualized recommendations to develop KT to inform regional policy-making regarding health promotion and disease prevention.

Recommendation 1 - Favorable professional environment for KT

Use of scientific evidence is facilitated if the institution in which professionals work shows a clear political will in this area and if the environment makes it easier to understand and to use making it more practical and more rewarding.

Recommendation 2 - Learning experience

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While the use of scientific evidence in practice requires a significant initial investment (e.g., cognitive and temporal), the study shows that more use of scientific data by professionals leads to more routine implementation. This constitutes a learning experience.

Recommendation 3 - Short-term utility and independent appropriation

The mechanisms most strongly involved in anchoring KT use are linked to the possibility of direct use of scientific evidence in the activities of professionals. Indeed, professionals are more inclined to use scientific data when they perceive these data as useful to legitimize, advocate, or concretely modify their practices, as well as when they feel able to mobilize these data independently. This perception is accentuated if these data are accessible, in accordance with their needs (adapted), and if they have been trained in the use of these data.

Recommendation 4 –Promoting the perception of scientific data usefulness

Communication/dissemination of scientific data promotes perception of its usefulness, ability, and motivation to use scientific data, if the environmental working conditions allow for their use. Evidence-based dissemination activities are particularly crucial in:

- Motivation to use scientific evidence, as well as ability to identify and master it.
- Perception of the instrumental utility of scientific evidence in daily practice.
- Perception that use of scientific evidence will bring a new way of presenting their activity (conceptual utility).
- Perception that use of scientific evidence will legitimize their activities, supported by confidence in its added value (strategic utility).

Recommendation 5 – An adapted knowledge

Data transformation and adaptation activities have a reported impact on the capability to utilize the data and the perception that they allow for concrete changes, if the professional environment is favorable to such changes. Data transformation and adaptation activities for stakeholders,

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such as inclusion of evidence-based data (via typical communication tools: adaptation and dissemination of evidence through video vignettes, explicit and oriented guides, scientific documents, creation of bibliographical selections [evidence-based actions], and multidisciplinary and multi-professional co-construction of KT tools and processes), most notably influence:

- Ability to utilize scientific data in practice.
- Perception that use of scientific data will enable professionals to change their practices (instrumental utility).

Recommendation 6 – Structural activities as facilitator

These activities facilitate the use of scientific data influence, the perceived usefulness of scientific data, particularly in framing practices and mobilizing new partnerships with research or other organizations. Structural activities to facilitate KT (e.g., institutional communication regarding a KT program or plan; use of the KT program to develop specific partnerships ; identification of a style guide for KT activities; development of a support service for KT development; evaluation of promising practices, modification, reinforcement, or activity orientation of an existing KT plan; establishment of internal coordination meetings [how to use evidence] or systematic reminders of the importance [interest and added value] of using scientific data in team and/or project meetings or in professional or financial documents) influence:

- Perception that use of scientific data brings a new way of presenting activities (conceptual usefulness).
- Perception that use of scientific data will allow the development of new partnerships (process utility) with the research community.

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Recommendation 7 – Activities to support KT influence the understanding and perceptions of the usefulness of these data

When the organizational and political environment within the institution is favorable, activities supporting KT will influence the capacity to understand and use scientific data and the perception of the usefulness of these data at multiple levels (i.e., entering into new partnerships, as well as legitimizing and/or renewing one's practices).

Activities to support KT (e.g., specific communication meetings on evidence-based science, awareness on the use of evidence-based data [meetings or seminars], and training to analyze and use scientific knowledge; analysis and exchange workshops; methodological support; existence of a proactive advocate for the deployment of KT [encouragement, mobilization, reminders, and support regarding the development of KT]; methodological support for deployment of KT; creation and dissemination of methodological tools based on scientific data [grids and repositories] to support autonomous use; development of a methodological guide to assist in the implementation of KT, and to facilitate the use of tools developed based on evidence [whether from PBs]) influence:

- Capacity of professionals to understand, become acquainted with, and identify evidence from science.
- Their motivation to use evidence from science.
- Their perception that use of scientific evidence will enable changes in practices (instrumental utility), legitimize activities, and convince others of its added value (strategic utility).
- Their perception that use of scientific evidence will enable development of partnerships with the research community if this interaction activity is supported and rewarded financially.

These recommendations and facilitators are made possible and catalyzed by professionals' experiences of evidence-informed practices and by the official (i.e., political, organizational, or

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institutional) position, which should be explicitly favorable toward and encourage use of such practices.

Discussion

The aim of this study was to experiment and characterize the factors associated with the success of a KT plan in health promotion and disease prevention settings in the local context in France. Success was defined as the plan's ability to i) enable public health stakeholders to address the challenges of KT and ii) bring about changes in public health policy and practices (i.e., integration of evidence-informed public health and collaborative practices). We sought to explain the parameters and conditions of these strategies to determine their transferability into other contexts by expansion of the results obtained in the first seminar into eight more precise final theories.

Notably, by specifying the middle-range theories in the French context, the results were consistent with numerous studies regarding KT [19,24,40]. Indeed, they confirmed the need to (i) combine KT strategies [24,40–42], (ii) make actions sustainable [43], (iii) transform institutions beyond simply raising the awareness of professionals [44], (iv) adapt the evidence to ensure it could be transferred to each type of audience [41,45–47], and (v) support change [6]. More specifically, our study underlines the particular weight of three major types of activities: i) those which help to change practices and promote scientific data use (e.g., training, support, and seminars), ii) those which adapt scientific data (adapted emails, policy-briefs, advocacy, etc.), iii) and those providing support for changing practices by an institutional daily promotion of institutional structure (e.g. existence of a proactive referent for KT roll-out, development of a methodological guide to help KT implementation, development of methodological guides to assist in the use of tools developed using evidence, introducing specific exchange on evidence in current meetings, etc.). Moreover, they confirm four of most

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influencing contextual parameters to support KT: i) the political will in institution [48], ii) the professionals' experience in evidence use [49] ; iii) the organizational facilitators promoting evidence use (linked to person (adopter), specific practices or supports) help) [42,48], and iv) an immediate benefit in the use of evidence [2].

In addition, this study highlighted the key mechanisms to be activated to enable changes in practice in the KT strategies. They can be grouped into three dimensions: i) capacities: finding, understanding, and appropriating evidence; ii) attitudes: motivation and feeling that evidence is useful; and iii) the perception of a direct interest in the use of evidence: changing practices, legitimizing the activity, advocacy, and formation of new partnerships. With reference to the interventional system concept [36], which emphasizes that mechanisms are the key functions of interventions, the results of these interventions must be transferable into other contexts. Our results confirm that the success of KT results from "combinations of knowledge, relationship, and organizational characteristics contribute to KT success" which are "dependent on the type of ecosystem partnership involved"[50].

Strengths and limitations:

Our study highlighted some crucial information from the analyses. The large amount of qualitative data allowed us to create a taxonomy [37] and to develop eight refined middle-range theories and seven recommendations that will be valuable for knowledge and decision-making challenges.

Due to the specificity of our study we made several adjustments to the initial protocol. Two rounds of interviews were initially planned. During the first seminar on May 2017, we were only able to develop a very generalist initial middle-range theory. Indeed, neither the exploratory survey nor the experience of the professionals mobilized in the seminar allowed us to define a more detailed level of KT activity, mechanisms, or external contextual elements of

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influence, which could be used to develop several theories. Furthermore, we did not find any taxonomy in the literature sufficiently operative to structure regional action plans. Because of these observations, we reviewed our investigation strategy in three rounds of interviews, rather than two. We developed a taxonomy of KT activities that allowed comparison of identical activities among regions [37]. These developments strongly mobilized the research team, thus mobilizing the project's resources. Thus, the last seminar could not be carried out.

The limit of this work remains its potential for generalization. The work has been carried out in a particular field and country, the prevention field in France. It would be interesting to check whether these middle range theories are verified in other fields and other countries where the KT development might be more advanced. These investigations could lead us to refine our middle range theories or open to other configurations. Indeed, we can hypothesize that other difficulties would have to be overcome and therefore other mechanisms to be activated.

Moreover, the follow-up was carried out over 18 months. No doubt that some activities will eventually prove to be not very effective and others will surprise by their effectiveness because they have a longer latency. In fact, both professional practices and their impact take a long time to modify. Moreover this impact could be difficult to observe due to the complexity of what is at stake. There is therefore a real interest in verifying the stability of these middle range theories over time.

Finally, we have not analyzed the potential synergy between Ci and Ce either, even if the observations show some leads. For example, we can observe that some external contextual elements (Ce) such as "pre-trained professionals" echo activities (Ci) "training of professionals in CT".

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Notwithstanding these limits, the work carried out nevertheless offers concrete paths for the development of KT by having allowed the groups of activities to specify the conditions for their success and opens the way for further development in terms of research.

Conclusion and perspectives

This study used a realist methodology to reveal the factors associated with the success of a KT plan, and elucidated the mechanisms by which such strategy can bring change in public health policy and practices. We sought to explain the parameters and conditions of these strategies to determine their potential transferability into other contexts through three types of mechanisms to be activated: i) the capacities (finding, understanding, and appropriating evidence) of field professionals; ii) the attitudes, (motivation and feeling that evidence is useful); and iii) the perception of a direct interest in the use of evidence (changing practices, legitimizing the activity, advocacy, and formation of new partnerships). We suggest they are the key functions of KT in prevention, which could be activated if a combination of activities and organizational characteristics are gathered.

Compliance with Ethical Standards and ethics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, it follows the relevant French legislation of the research category on interventional research protocol involving the human person. An informed consent was obtained from all individual participants included in the study.

This study has received approval from the national agency for data protection *Commission Nationale Informatique et Libertés* (NS no. 43, registered under number 2028640 v 0).

The English in this document has been checked by at least two professional editors, both native speakers of English

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Data statement

No additional data available

Authors' contribution

LC supervised the study. JMF, OA and LC drafted this article and all authors (JMF, OA, OP, MP, VR, LC) revised the manuscript. The project design was developed by LC and OA. OP, OA collected the data. OA and LC analyzed the data under the supervision of LC. JMF contributed to part of this analysis. All authors (JMF, OA, OP, MP, VR, LC) read and approved the final manuscript.

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List of abbreviations

ANSP: National Public Health Agency

ARS: regional health agency

Ce: Contextual factor not linked to the intervention

Ci: Contextual factor linked to the intervention

CMO: Context – Mechanism – Outcomes

INCa: National Cancer Institute

IREPS: Regional Authority for Education and Health Promotion

TC-REG: Knowledge transfer in regions

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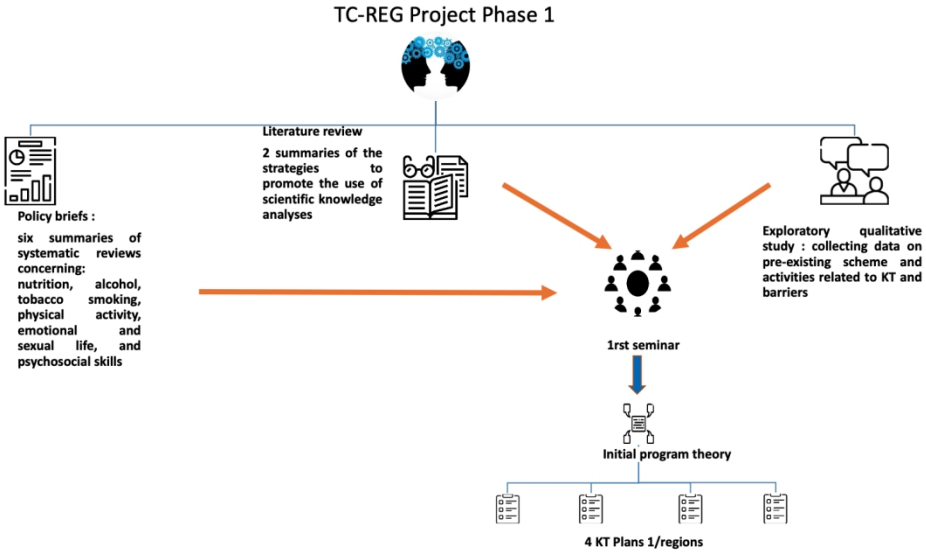
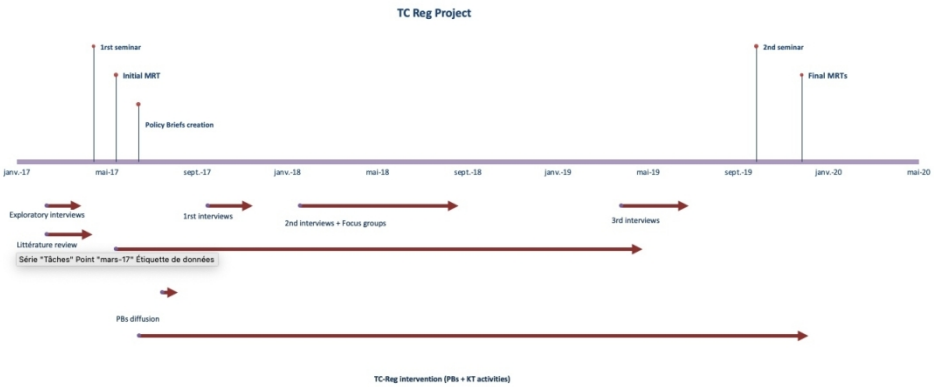
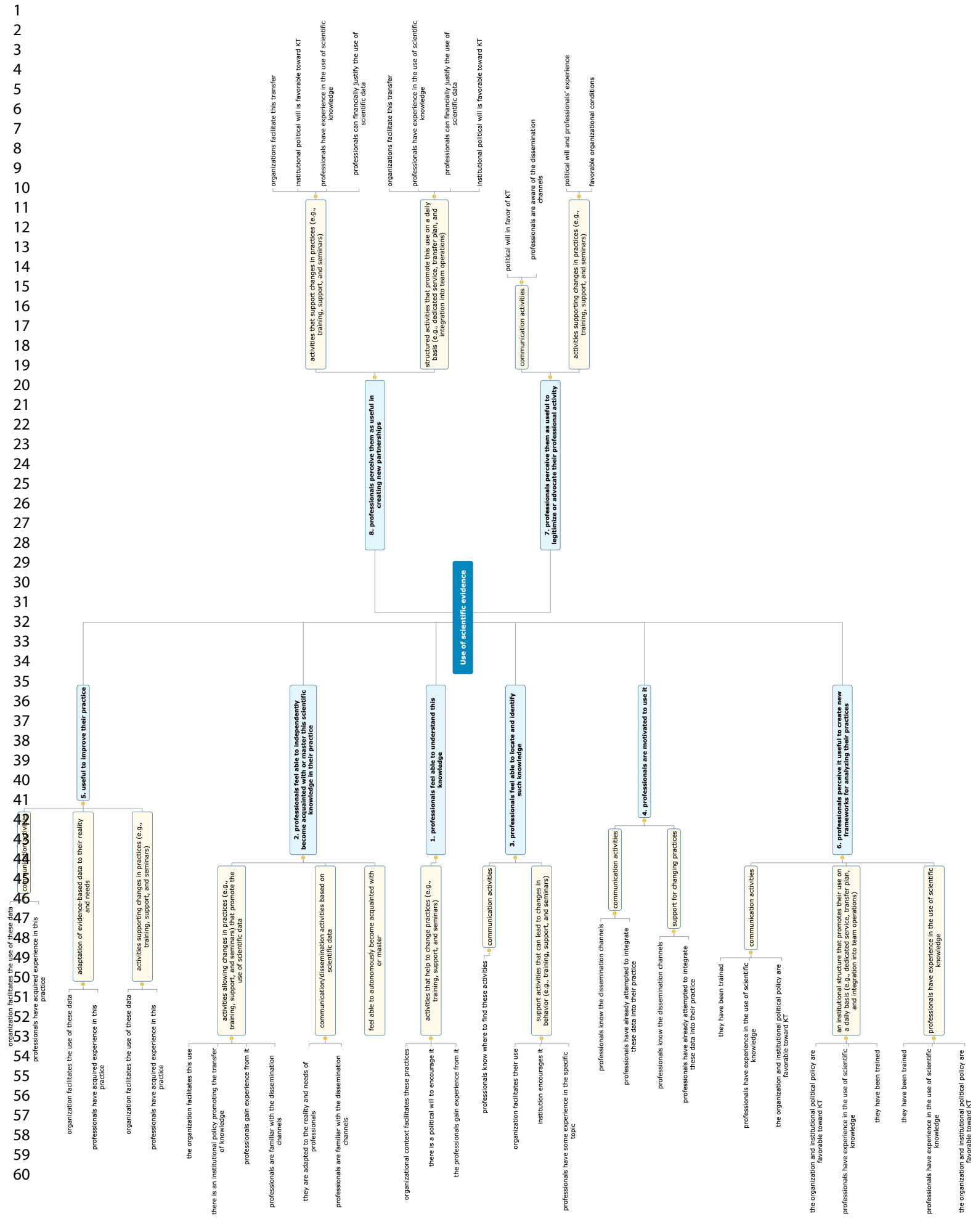


TC-REG Project Phase 1



TC-REG project timeline

504x208mm (72 x 72 DPI)


Use of scientific evidence
8. professionals perceive them as useful in creating new partnerships
activities that support changes in practices (e.g., training, support, and seminars)
organizations facilitate this transfer
institutional political will is favorable toward KT
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
structured activities that promote this use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
organizations facilitate this transfer
professionals have experience in the use of scientific knowledge
professionals can financially justify the use of scientific data
institutional political will is favorable toward KT
7. professionals perceive them as useful to legitimize or advocate their professional activity
communication activities
political will in favor of KT
professionals are aware of the dissemination channels
activities supporting changes in practices (e.g., training, support, and seminars)
political will and professionals' experience
favorable organizational conditions
5. useful to improve their practice
adaptation of evidence-based data to their reality and needs
organization facilitates the use of these data
professionals have acquired experience in this practice
activities supporting changes in practices (e.g., training, support, and seminars)
organization facilitates the use of these data
professionals have acquired experience in this practice
2. professionals feel able to independently become acquainted with or master this scientific knowledge in their practice
activities allowing changes in practices (e.g., training, support, and seminars) that promote the use of scientific data
the organization facilitates this use
there is an institutional policy promoting the transfer of knowledge
professionals gain experience from it
professionals are familiar with the dissemination channels
communication/dissemination activities based on scientific data
they are adapted to the reality and needs of professionals
professionals are familiar with the dissemination channels
feel able to autonomously become acquainted with or master
1. professionals feel able to understand this knowledge
activities that help to change practices (e.g., training, support, and seminars)
organizational context facilitates these practices
there is a political will to encourage it
the professionals gain experience from it
3. professionals feel able to locate and identify such knowledge
communication activities
professionals know where to find these activities
support activities that can lead to changes in behavior (e.g., training, support, and seminars)
organization facilitates their use
institution encourages it
professionals have some experience in the specific topic
4. professionals are motivated to use it
communication activities
professionals know the dissemination channels
professionals have already attempted to integrate these data into their practice
support for changing practices
professionals know the dissemination channels
professionals have already attempted to integrate these data into their practice
6. professionals perceive it useful to create new frameworks for analyzing their practices
communication activities
they have been trained
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT
an institutional structure that promotes their use on a daily basis (e.g., dedicated service, transfer plan, and integration into team operations)
the organization and institutional political policy are favorable toward KT
professionals have experience in the use of scientific knowledge
they have been trained
professionals have experience in the use of scientific knowledge
they have been trained
professionals have experience in the use of scientific knowledge
the organization and institutional political policy are favorable toward KT

Annex 1: Illustration of the KT plan for one region

An illustration of the contextualised knowledge translation (KT) scheme to be implemented in a region: KT activities to be implemented and expected outcomes according to several publics of professionals regionally involved in prevention and health promotion (IREPS professionals, ARS professionals, stakeholders, CRSA professionals).

Activities to implement with IREPS professionals and expected outcomes

Activities	*Expected Outcomes*
Deliberative working group in order to develop a policy-brief for CRSA professionals and committee presidents	1, 5
Deliberative working group in order to develop a policy-brief for field professionals working in prevention and health promotion	1, 5
Training in the use of PBS and other evidence data use- Level 2 – (NB: Level 1 being for basic knowledge) for field professionals working in prevention and health promotion	1, 2, 3, 4, 5
Diffusion of communication tools (newsletters, inserts, etc.) highlighting research results	1, 2, 3, 4, 5
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 3, 4, 5
Organisation of a regular meeting between stakeholders and researchers, to discuss about research production and field needs, in order to be aware of issues of both parts	3, 4, 5

Expected outcomes:

1: Field professionals working in prevention and health promotion highlight PBS data use in their productions (presentations, reports, schemes, etc.)
2: Field professionals working in prevention and health promotion state evidence use (including PBS data use) in the conventions they have with funders and collaborators.
3: Field professionals working in prevention and health promotion use PBS data when developing their field projects.
4: Field professionals working in prevention and health promotion use PBS data when writing the action reports they send to funders.
5: IREPS teams adopt a shared culture on evidence use.

Activities to implement with ARS professionals and expected outcomes

Activities	*Expected Outcomes*
Formation for PBS and other evidence data use- Level 2 – (NB: Level 1 being for basic knowledge)	1, 2, 3
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 2, 3
Organisation of a regular meeting between stakeholders and researchers, to discuss about research production and field needs, in order to be aware of issues of both parts	1, 2
Diffusion of policy-briefs in the ARS	1, 2, 3, 4
Redaction by the IREPS of notes based on PBS data and/or other evidence data or theoretical models in the call for proposals and conventions: political memo	2, 3, 4
To make official the collaboration between the ARS and the university research group “human health” (convention, charter, …)	2, 3, 4
Diffusion of communication tools (newsletters, inserts, etc.) that highlight research results	4
Presentation of the process in the ARS: meetings with the director general, the executive committee, the management committee, etc.	4
Political memo for the director general	4

Expected outcomes :

1: ARS professionals enhance PBS data in the documents, tools, etc. they produce (e.g. presentations, actions assessment, activities scheme, etc.)
2: Evidence (including PBS) requirement appears in the regional calls for projects
3: ARS professionals indicate evidence (including PBS) requirement in the conventional agreement they have with stakeholders
4: ARS teams adopt a shared culture on evidence use.

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Activities to implement with stakeholders and expected outcomes	
Activities	***Expected Outcomes***
Formation for stakeholders on evidence use and its adding value (Level 1)	1, 2, 3
Formation for stakeholders on evidence use in relation with identified needs previously collected (for example according to a given population, theme, etc.) (Level 2)	1, 2, 3
Methodological support for evidence use	1, 2
Diffusion of communication tools (newsletters, inserts, etc.) that highlight research results and PBS	1, 2
Deliberative working group in order to develop a policy-brief for field professionals working in prevention and health promotion	1, 2, 3
Reflexive working groups/journal clubs about policy-briefs conception and appropriation: critical analysis, analysis of transferability and practical examples	1, 2, 3

Expected outcomes :
1: Stakeholders use PBS data when applying to calls for projects as well as in the actions funded on pluri-annual conventions they develop
2: Stakeholders use PBS data when developing their projects
3: Proximity advisors are able to help stakeholders with evidence use

Activities to implement with CRSA professionals and expected outcomes	
Activities	***Expected Outcomes***
Installation of awareness areas for evidence use among board, committee's presidents and prevention committee members	1, 2
Diffusion of policy briefs whose topics are in relation with the agenda of the prevention committee of the CRSA	1, 2
Diffusion of policy briefs whose topics are in relation with the agenda prevention of the CRSA plenary meetings	1, 2

Expected outcomes :
1: CRSA members adopt a shared culture on evidence use.
2: CRSA members include PBS data in the notices they deliver

KT: Knowledge transfer; IREPS: Instance Régionale d'Education et de Promotion de la Santé, Regional Authority of education and health promotion; ARS: Agence Régionale de santé, Regional health agency; CRSA: Conférence Régionale de la Santé et de l'autonomie - an advisory organism involved in regional health politics set up; PBS: Stratégies d'Intervention en Prevention, knowledge documents named "intervention strategies in prevention".

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