Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

The need for retroductive thinking in implementation sciences

Ferdinand C. Mukumbang (mukumbang@gmail.com)

Methodology

Keywords: Retroduction, abduction, deduction, induction, inference making, theory, implementation science

Posted Date: February 25th, 2020

DOI: https://doi.org/10.21203/rs.2.24309/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Abstract

Background Evidence informing the practice of healthcare and health-related policymaking is predominantly obtained via deduction and induction. While the evidence obtained through these forms of reasoning, mostly from methodologically sound and controlled research environments, are in most part considered robust, they are usually decontextualized, making their adoption and implementation in open systems challenging. We illustrate how the use of retroduction in theoretically-informative empirical research provides evidence linked to the contextual features of its discovery, thus, enhancing learning and implementation.

Methods Using a critical realist-informed evaluation study, we illustrate the application of retroductive thinking as a theoretically informative inferencing approach to develop mechanism-based causality context-linked explanatory theories. We expatiate on the application of counterfactual thinking, abductive reasoning and extreme case selection as valuable tools to enhance retroductive thinking.

Results The application of counterfactual thinking, abductive reasoning and extreme case selection as tools of retroductive thinking are conceptualized to demonstrate how studies using retroduction can obtain context-linked evidence that can facilitate learning and implementation.

Conclusion Obtaining evidence with discovery context provides practical knowledge for implementers to make contextual judgments about what is likely to work in under what likely contextual conditions, for what section of the population. The transcendental philosophical foundation of critical realism makes it favorable for obtaining context-linked explanatory theories through retroduction.

Contributions To The Literature

Induction and deduction dominate inferencing making in evidence-based healthcare, however, both forms of reasoning contribute little to the development of context-linked evidence to improve learning and implementation.
Although there are increasing calls to improve theorizing in implementation sciences, there is less emphasis on what inferencing approach would lead to robust explanatory theories.
Retroduction, a theoretically informative inferencing approach, is presented as a favorable approach to generate explanatory theories linked to the contextual features of their discovery to improve usability.
The application of counterfactual thinking, abductive reasoning and extreme case selection as tools of retroduction are conceptualized and illustrated.

Introduction

Inference making – the process of drawing conclusions based on what is already known – forms the foundation of sciences and is central to obtaining sound evidence to inform implementation. Implementing evidence-based healthcare requires obtaining robust evidence from methodologically rigorous studies with sound conclusions. Although inductive, deductive, abductive and retroductive forms

of inferencing are identified in the literature [1, 2], the evidence (largely non-theoretical) informing evidence-based healthcare is based primarily on inductive and deductive approaches of inferencing [3, 4]. Theoretically informative forms for reasoning such as abduction and retroduction have received lesser consideration.

Recently, there has been a burgeoning number of calls for the application of abductive and retroductive forms of reasoning – theoretical explanations [3, 5], coinciding with the calls for rich theorizing to improve the nature and uptake of evidence into practice [6–8]. Kislov et al. [6] proposed that theoretical traditions, theory-driven approaches, and methods should be adopted to (1) approach empirical data in an informative way and (2) establish the dynamic relationships between interventions, contexts, and actors, through mechanism-based explanations. While induction and deduction are largely used to develop evidence informing implementation sciences, they are limited regarding theorizing [9] especially in the context of complex systems characterized by dynamically changing inter-relationships [8].

In deductive reasoning, the researcher starts with the hypotheses of abstract rules and deduces from these rules the understanding of the particular phenomenon (observation). For instance, using the information-Motivation-Behavior model to deduce the adherence behavior of people living with HIV (PLHIV) on antiretroviral therapy (ART) [10–13]. The IMB model is the general rule, statement, or hypothesis and the findings of the adherence behavior of a population of PLHIV is the observation. In this case, the researcher predicts what the observations (adherence behavior) should be if the theory were correct. Therefore, in deductive inferencing, the researcher moves from the general (the theory) to the specific (the observations). Deductive reasoning as applied in positivist informed research is used to explain causal relationships, measure concepts quantitatively and generalize findings to a certain extent. In constructivist/interpretivist informed research, deduction is used to provide explanations or contextualize a phenomenon drawing from a pre-identified guiding theory or perspective. For this reason, it has been described as a ‘theoretical’ approach to data analysis and inferencing [14].

Inductive reasoning, on the other hand, involves projecting from what we know to what we do not know [15]. It starts with a specific observation to make broad generalizations. For instance, Getahun et al. [16] used the hospital registries for TB patients to induce that patients registered into Direct Observation Treatments program between July 2004 and June 2005 were more likely to have treatment success compared to patients registered into the Direct Observation Treatments program between July 2005 and June 2006. As identified in the example above, in positivist-informed research, the observations were made, and a pattern was discerned leading to generalization based on the data. Similarly, in constructivist/interpretivist approaches, thematic content data analysis and conclusions are drawn predominantly informed by the data themselves [14]. In some instances, an explanation or a theory can be inferred through the inductive process as applied in grounded theory methodology.

Inductive and deductive forms of inferencing, whether informed by positivist or constructivist paradigms are predominantly applied to describe, explain, generalize and predict based on specific (empirical) observations. Deductive reasoning is applied to derive logically valid conclusions from given premises or

established theories and can contribute to the validity of the reasoning itself and confirm certain facts. Inductive reasoning, on the other hand, has been predominantly applied to identify patterns in some observations and draw the conclusion based on these patterns to non-studied cases [2]. From observed co-variates and associations (positivist paradigm) and identified themes (constructivist paradigm), conclusions are drawn about law-like relations. Therefore, inductive reasoning allows researchers to use existing knowledge to make predictions and insinuations about novel cases [15]. In spite of these critical roles that both inductive and deductive forms of reasoning play in evidence generation, they contribute little to the development of explanatory theories [17].

Studies adopting induction and deduction are expected to apply strict structured and standardized designs to ensure generalizability and validity. In this way, evidence obtained from these studies is characterized by over-simplification and abstraction, breaking problems down into analyzable parts, thus making adoption challenging [8]. According to Greenhalgh and Kapoutsi [8], research evidence that draws parts of the problem together to produce a rich, nuanced picture of what is going on and why increase the adoption and usability of the evidence. Kislov et al. [6] suggested that explanatory evidence has the potential to draw the problem, context and findings in an informative package that can guide successful implementation.

In this article, we argue that retroduction, which involves working from ‘observed phenomena to the generation of alternative explanations for the phenomena and comparing the alternatives to select the best possible explanation’ [3] is a suitable alternative mode of inferencing to increase implementation. Despite arguments that retroduction is the most suitable form of inferencing for theorizing [18], and its ability to link evidence and social theory in an evolving and dynamic process [19], the application of the retroduction for evidence generation remains parsimonious. We, therefore, illustrate and argue for the application of retroductive thinking towards the development of robust mechanism-based theories to improve generative learning and theoretical transferability.

Retroduction

Retroduction is an empirical process of devising a theory and requires moving from an observation of concrete phenomena to reconstruct the basic conditions for these phenomena [2]. The retroductive logic starts with an observed behavior or pattern from which one deduces the rule – a general statement suggested by the observation. From the rule, a conclusion or case is made. The observation is explained by fitting the rule into the general pattern. In this way, the explanation accounts for the phenomenon at stake [9]. In retroductive arguments, an explanation is proposed to account for an observation or group of facts, based upon co-occurrence, including (but not limited to) location in space and time. For instance, using HIV experts or experienced patients to counsel naïve PLHIV improves their self-efficacy and adherence to ART (observation). Patient counseling enhances self-efficacy towards ART adherence (rule). In the context of HIV treatment, patient counseling improves the self-efficacy and thus medication adherence of naïve patients (case).

Retroductive thinking progresses from empirical observation of events, arriving at transfactual conditions – going beyond the empirical [1]. Therefore, at the core of retroduction is the transcendental argumentation, which seeks to clarify the basic prerequisites or conditions – circumstances without which something cannot exist [5] – for a phenomenon to occur. Lawson [20] suggests that retroduction involves moving from a surface phenomenon to a deeper causal understanding.

The application of retroduction as a tool for inference making is essentially for developing theories. As Peirce [21] puts it, 'the provisional adoption of a hypothesis'. Unlike deduction and induction, retroduction suggests new ideas, some of which may, after testing using induction, turn out to be true. In this way, retroduction is used to originate ideas that can be further developed and tested [22]. Therefore, retroduction as a method of inference making is applied to produce hypotheses and construct theories, providing an alternative form of inference-making [9]. Three important tools are critical to retroductive inferencing – abductive reasoning, counterfactual thinking and studying extreme cases.

Counterfactual thinking

Counterfactual thinking involves mental representations or thinking through alternatives to facts and events [23] and is pivotal for retroduction [1]. The basic question that goes through one's mind when applying counterfactual thinking is 'what might have been' [24]. The fundamental role of counterfactual thinking in retroduction is to identify those elements or entities that should be present for an outcome to occur by looking at alternative scenarios. Could the same outcome occur under other circumstances? Counterfactual means contrary to the facts [24], therefore, the researcher searches for or postulates alternative scenarios using conditional propositions to draw conclusions on the basic prerequisites for an event to take place. For instance, knowing what outcomes would have occurred in the absence of (aspects of) the intervention or in the presence of different context conditions is an important approach to applying counterfactual thinking in implementation sciences and is important for elucidating causal relationships [25].

In retroduction, causal claims can be explained in terms of counterfactual conditionals of the form "If A had not occurred, C would not have occurred". Most counterfactual analyses have focused on claims of the form "event c caused event e", insinuating 'actual' causation. In this way, through counterfactual thinking, the researcher brings assumptions to the research. Counterfactual thinking can go beyond are mental representations and observations of empirical investigations. Ferraro [25] suggested that counterfactual thinking can be advanced through experimental and quasi-experimental designs that control for confounding factors to eliminate plausible rival interpretations of the observed outcomes.

Studying extreme cases

The study of extreme cases is another important tool in retroductive thinking. To answer the question 'How is X possible?', various cases where the preconditions for X appear much more clearly than in others and/or cases where X is absent can be studied [1]. Outliers offer great potentials for retroductive inferencing as they offer the researcher many cases assumed to manifest the structure s/he wishes to

describe, but which are very different in other aspects. These cases could be named ‘extreme’, ‘deviant’, or ‘paradigmatic’ based on whether the researcher seeks to generalize, elucidate, reveal, critique, or emancipate [9]. Comparing varying cases including extreme cases provides counterfactual conditions and a foundation to sort out contingent differences to arrive at a functional theory [26]. While closed systems offer the opportunity for researchers to study mechanisms in their purest form, extreme cases offer a similar feat to social scientists working in open systems [1].

Abductive reasoning

Abductive reasoning is identified by some authors as the fourth approach to inference making in empirical research [1, 2] while others consider it synonymous with retroduction [27]. While retroduction is focused on identifying the basic characteristics of the general structures from which we start, in abduction, we interpret and re-contextualize particular actions and events [1]. Abductive reasoning typically begins with an incomplete set of observations and proceeds to obtaining the likeliest possible explanation for the set. Abductive reasoning is underpinned by the notion that data are never complete or perfect, therefore, inferences are drawn in situations of incomplete or contested data. Abductive reasoning is thus characterized by a lack of completeness in the evidence that the data provides [28]. Considering the role of abductive reasoning, the goal of the researcher is to collect as much relevant information as possible so that the focus of retroduction is on creating meaningful understanding based on the available data. By interpreting and re-contextualizing observed actions and events, the researcher strives to identify the basic conditions under which the observed phenomenon occurs – moving from some observations to the "best explanation" of those observations.

Applying the tools of retroduction

In general, retroduction starts with a surprising or puzzling observation. The goal of the researcher is to explain or provide a plausible explanation of the observation. Selecting and studying those cases or the case that demonstrates the phenomenon most prominently (extreme case selection) is an important step toward understanding the phenomenon. Then, the investigator applies counterfactual thinking within the contrastives to explore other possible explanations of the observed phenomenon and establish causal relationships based on identified counterfactuals. Finally, based on the available observations, causal links, and counterfactuals, the investigator generates the best possible explanation (abductive thinking) to explain the observed phenomenon. These retroductive tools can be applied via quantitative and/or qualitative data collection and analysis methods. These tools should be applied in an iterative manner and there is no prescribed starting point. The role of each tool to inform retroduction is illustrated in Fig. 1.

Figure 1

Retroductive process to theorizing

Retroduction and critical realist-informed evidence

While there is an overall dearth in the application of retroduction, its increasing application in the recent times coincides with the mounting calls for theorizing, and the improved application of the critical realist meta-theory to guide inquiries in implementation sciences [29–32]. Although there has been an increase in the application of retroductive thinking, particularly in realist-informed studies, exactly how retroduction is applied to obtain the study findings remains unclear.

Critical realism as a metatheory – making claims regarding the nature of reality [33], offers researchers an avenue for causality-based theorizing, whereby generative mechanisms and relevant context take the central stage. The centrality of generative mechanisms and context in realist-informed research follows from the ontological position of critical realism, viewing reality as stratified [34] (Fig. 2).

Figure 2

Stratified ontology of critical realism (Source Mukumbang et al. [28])
Ontologically, Critical realism, as opposed to positivism and constructivism, proposes a stratified reality: the real, the actual, and the empirical [34, 35]. The “real” is the greater domain encompassing the “actual”, which in turn includes the “empirical” [36]. The “real” relates to the existence of (usually) invisible mechanisms with generative power causing what is observed. The “actual” defines what happens when the causative powers existing in the entities are activated [37]. What happens (event) may or may not be experienced by the relevant actor(s) [38, 39]. The “actual” domain includes actual events generated by mechanisms [40]. The “empirical” relates to human perception and experiences of what happens in the “actual” domain – the day-to-day experience of human beings.

Epistemologically, Critical realism proposes a transcendental approach to research [41] – unraveling the basic structures and conditions under which a phenomenon occurs. This is achieved primarily by identifying and making explicit the causal mechanisms underlying the observation. This generative mechanism-orientation tilts critical realist-informed research towards theory and model development to explicate how and why an observed phenomenon occurs. The transcendentalism of critical realist research, therefore, speaks to moving from the “empirical” realm, via the “actual” realm to the “real”, where the “real” represents the explanation of the basic structures and mechanisms explicating how and why a phenomenon experienced (by the actor) and observed (by the researcher) in the “empirical” occurred.

The transcendental approach to research inquiry proposed in Critical realism epistemologically aligns with the retroductive approach to inference-making as retroduction seeks to uncover the prerequisites or the basic conditions for the existence of a phenomenon. Retroduction, as applied in Critical realism, is a "...mode of inference in which events are explained by postulating mechanisms, which are capable of producing them..." [42]. Therefore, an essential strategy of the realist researcher is to identify and make explicit the mechanisms that propagate the observed behavior. These mechanisms – causal powers – are possessed by ‘both human individuals and social structures (and indeed entities of other kinds) …, and that both (or all) interact to determine social events, even though human individuals are the parts of

the social structures concerned' [43]. The role of the realist researcher is to uncover these mechanisms activated or triggered by relevant contexts to explain an observation. Postulating which mechanisms are at play and activated under what conditions to lead to an observation requires retroductive thinking.

Pawson and Tilley [44] proposed the Context-Mechanism-Outcome analytic framework as a heuristic tool for generating theories in realist-informed studies to explain who, why, and under what conditions an observation occurs. This generative causality tool suggests that 'an action is causal only if its outcome is triggered by a mechanism acting in a context' [44]. While retroduction is considered to be the most suitable inferencing approach in realist-informed studies [45–47], inductive and deductive inferencing approaches can be applied at various levels and to different data types of such studies [45, 48]. For instance, inductive inferencing could be applied to unveil the behavior patterns (outcomes) using regression analysis and other exploratory data analysis methods. Inductive and deductive approaches are also important for identifying possible mechanisms and context conditions from qualitative data using thematic content analytic methods [45].

In a theoretically informative empirical research, evidence obtained by induction and deduction is considered as 'nuggets of information' [49] to inform retroduction. Importantly, the various tools for retroduction (abductive thinking, counterfactual thinking and studying extreme cases) are pivotal at this stage. First, information from extreme cases can be used to identify the generative mechanism(s) activated in that specific context conditions. Then counterfactual thinking can be applied to think through possible alternative mechanisms or to eliminate other possible mechanisms to establish the prevailing hypothesis.

Finally, considering the available data, the researcher is encouraged to apply abductive thinking – selecting the best possible explanation or theory to explain the observation in question. Bhaskar [41] suggests that selecting the most suitable explanation should follow the notion of judgmental rationality – having greater explanatory power – alongside the notion of immanent critique – what the world must be like – to select between rival theories. Bhaskar [41] propositions that 'a theory T_c is preferable to a theory T_d, provided that T_c can explain under its descriptions, almost all the phenomena that T_d can explain under its descriptions, plus some significant phenomena that T_d cannot explain' (p. 73). Secondly, the selected theory should be able to explain a deeper level of reality or achieve a greater order of epistemic integration – transcendental [41]. Figure 3 illustrates a critical realist informed retroduction process.

Figure 3

Critical realist informed retroductive thinking

The role of retroduction is based on the information obtained using the three tools described to form context-mechanism, context-outcome, and context-mechanism-outcome associations to allow the researcher to formulate new ideas, hypotheses, and theories. The use of the identified tools towards theorizing is not a once-off process, rather, it is iterative. The investigator employs these tools based on

the need and what can be achieved by employing each tool. In the same vein, the theory developed through retroduction is not considered a 'final' product. We agree with Kislov et al. [6] that the theory obtained through retroductive thinking is not considered ‘fixed and immutable’ but could be subject to further testing using deductive approaches.

Illustrating The Application Of Retroduction In Realist Evaluation

Description of study setting and intervention

Owing to the large number of PLHIV and accessing treatment in South Africa [50], public healthcare facilities are often congested. Congestion at the health facilities engenders poor retention in care and medication nonadherence among PLHIV [51]. The adherence club intervention, a differentiated ART delivery model aimed at enhancing self-management of ‘stable’ adult (18+ years) patients on ART was designed to improve medication adherence and retention in care [52]. The intervention delivers scheduled bi-monthly clinical screening, HIV medication refills, adherence support and health talks, and mutual support. The adherence club program was designed to shift the majority of consultations and ART collections for stable patients to ‘clubs’ organized and facilitated by facility counselors or peer educators [53].

While several epidemiological studies provide evidence of positive effects of the adherence clubs in experimental (pilot) [54–57] and implementation settings [58], to support scale-up [59], the conclusions drawn from these were based on inductive and deductive reasoning approaches. Nevertheless, inductive and deductive conclusions based on effect sizes provided limited evidence on how the intervention could be replicated in specific contexts to reproduce trial outcomes in pragmatic/real-life conditions [60]. This evidence failed to predict if the intervention would work in a given context as it offered little information on why and how the adherence clubs (as a whole or its components) work, and under which health systems conditions. To this end, we conducted a realist evaluation, a theory-driven approach to evaluation, to unearth what works, why, how and under what health systems conditions the adherence club intervention works [51].

Methods

Our realist evaluation methodology was aligned with the principles of retroduction – counterfactual thinking, abductive reasoning, and extreme case selection. First, we formulated the initial program theory of the adherence club intervention [61, 62]. The aim of this initial program theory was to understand how and why the program designers and implementers thought the intervention was going to work. Our initial program theory had two propositions. (1) Patients using the adherence club intervention were motivated, perceived the support of club members and improved their self-efficacy towards remaining in care and adhering to medication. (2) Patients remained in the adherence club care because they were being

nudged by the adherence club rules and regulations requiring patients to attend or have representation on all adherence club sessions or they would be returned to the main clinic ART care with longer waiting times [61].

The second phase of the project required testing the initial program theory. First, we selected three contrastive cases. (1) *Typical case* – the most representative of the phenomenon being explored; (2) *Deviant case* – most likely case to be negative with regard to the phenomenon under consideration and; (3) *Crucial case* – a case that is critical in understanding the phenomenon [28]. Based on the retention in care rates from monitoring reports of the adherence club program from 2014 to 2017, we classified our cases accordingly. We classified 'good' retention in care as values above 80%. The 'typical' case (81%) was exemplified by a facility that showed a steady improvement in the retention in care of patients on ART in the facility. The 'deviant' case (63.0%) illustrated a poor-performing facility in terms of retention in care, while the 'crucial' case (70%) represented a facility that started off with very good retention in care rates, but then saw a steep drop following a change in the way the ART program was run.

We conducted an in-depth case study within each of these cases using a mixed-methods approach. The quantitative arm of the study was aimed at describing the rate at which PLHIV using the adherence club intervention dropped from care. The qualitative methods, observations, and in-depth interviews were used to explore the generative mechanisms and relevant context. The qualitative and quantitative methods enabled us to delineate the combination of the intervention, context, and mechanism components to explain the outcomes of the adherence club intervention. Retroductive thinking at this level was done by configurational mapping using the intervention-context-actor-mechanism-outcome heuristic tool to formulate case-based theories. Within each case, retroductive thinking was applied to distil the relevant mechanisms (dis)activated by the prevailing context to cause the observed outcomes. The configurational mapping was done by linking each active mechanism with the observed outcomes (M-O links); then we searched relevant context(s) that triggers or deactivates the mechanism and assessed the link with the actual intervention and the involved actors (retroduction)

We started with the typical case [63], a well-performing facility as representing an ideal situation of how the intervention was expected to work. It, therefore, offered us the chance to mine the generative mechanisms at work and the moderating effect of the context condition to produce the observed behavior – good retention in care and adherence to medication [63]. While some patients adhered because they were nudged by the club rules, other were retained because they were motivated and had improved self-efficacy. Based on the typical case, we found that when grouped for targeted care (I) in the context of available resources (C+), convenient environment (C+) and guided by rules and regulations

(C+), patients feel nudged (M+), their self-efficacy is improved (M+) and they become motivated (M+) to adhere to their medication (O+) and remain in continuous care (O+) [63].

Having unearthed the principal mechanisms and the prevailing conditions that lead to good retention in care and adherence behaviors based on the typical case, we moved to the deviant case, which represented at this level, a counterfactual case, whereby the conditions under which the adherence club intervention is implemented is different from those of the typical case. While in the typical case adherence club patients met in a separate section of the health facility dedicated to ART activities, in the deviant case, adherence club patients were managed in the same area where people with other noninfectious chronic diseases were also receiving health care [48]. Consequently, the patients refused to attend regular club activities for fear of being identified by patients from the non-infectious chronic disease section and would only come to pick-up their medication at varying hours. The adherence club program became a *de facto* medication pick-up model. We found that the presence of non-HIV positive patients (C-), and not holding standard club activities (C-), frustrated (M-), demotivated (M-), and instilled negligence (M-) and perceived stigma (M-) in the patients, which led to poor retention in care (O-) and medication adherence (O-) [48].

Our application of counterfactual thinking followed Mingers [64] assertion that the interplay between positive or counteracting mechanisms determines whether events occur or not. Comparing the negative and positive cases, therefore, provided evidence for adjusting our ICAMO configurations as in some cases the negative ones enforced the construction of positive ones. This was achieved by identifying the association of the failed outcomes with 'missing mechanisms' and 'negative contexts' [65]. This allowed us to move from descriptions of the concrete to the abstract, and back to the concrete [44].

Our selection the third case, was driven by abductive thinking. We wanted to ensure that we had enough evidence on which to refine our developing program theory and at the same time it offered an alternative context for counterfactuals. To this end, we selected an average performing facility to explore what factors are at work – a crucial case [66]. The crucial case added some context conditions that modified the mechanisms introduced by the adherence club intervention. We noticed, in this case, the important role of buy-in from the facility manager and those working with the intervention. Buy-in improved the dedication of the staff working on the intervention (C+), so we confirmed that patients on ART in adherence clubs will continue to adhere to their medication (O+) and remain in care (O+) because their self-efficacy is improved (M+); they are motivated (M+) or are being nudged (M+) [66].

According to Danermark et al. [1], retroduction can be applied 'both as analyses at a very high level of abstraction and as analyses of more specific conditions for social processes.' The final application of retroduction required us to conduct a cross-case analysis involving the three selected cases – theoretical abstraction. This process required identifying certain mechanisms and context conditions that 'dominate' others and occur more frequently and thus become apparent at the level of the 'actual' in the form of partial regularities, or demi-regularities. The cross-case analysis was achieved by placing the different within-case theories in a juxtaposition allowing for the differences and similarities to become apparent [67]. We searched for the variation in the contexts accounting for the differences (if any) to generalize across cases by looking at how the important outcomes may be achieved. The negative case was used to adjust (confirm) certain links to refine the developing theory or theories [68].

In the application of retroductive thinking at this level, we synchronized the mechanisms that account for the emergence of phenomena at operating at the "real" domain, based on best-explanation obtained from the different contexts within the individual case studies [69]. We applied this process iteratively until *theoretical saturation* was reached – a point when 'further abstraction brings no significant additional theoretical rigor to the generative mechanism and when empirical evidence is strong enough to support the practical adequacy of the postulated mechanism in explaining a concrete phenomenon' [69].

Results

Figure 4 illustrates a refined program theory explicating how, why and under what health systems conditions the adherence club intervention works.

Figure 4: A model explicating how and why the adherence club intervention works

The model illustrated in Figure can be translated into the following theoretical statement:

"Grouping clinically stable patients on antiretroviral therapy **[Actors]** with available resources and buy-in from health-care workers in a convenient space **[Context]** to receive quick and uninterrupted supply of medication, health talks, counselling, immediate access to a clinician when required while guided by rules and regulations **[Intervention]**, works because their self-efficacy improves and they become motivated and nudged **[Mechanisms]** to remain in care and adhere to medication **[Outcome]**"

In addition to this, the use of extreme cases indicated two important things. (1) An "integrated" approach of managing patients with HIV and people with chronic noncommunicable diseases is a countervailing context for the successful implementation of the adherence club intervention as perceived stigma inhibited the patients on ART from attending club session. (2) Having an intervention champion is pivotal

to obtaining buy-in from other healthcare works and enhances the success of the intervention implementation. When a nurse was identified and trained to champion the intervention, she exposed the other healthcare providers to the benefits of the intervention and headed the implementation. This engendered buy-in from the care workers. This led to a U-turn in the retention of patients in the facility as this facility was originally identified as deviant case.

Discussion

Induction and deduction are often adopted in studies conducted in controlled environments or closed systems, using “rigorous” research methodologies and probabilistic-statistical forms of generalizations and prediction to generate evidence. May et al. [70] noted that an important part of implementation constitutes efforts to translate evidence obtained in closed systems into the open systems or ‘real world’ contexts. Although purported to be of sound quality, when it comes to implementation, evidence obtained from controlled experiments are usually found to be incomplete, ambiguous and contested [71] as the evidence fails to consider the complexity of the healthcare system. The complex nature of the healthcare systems – dynamic, behaving differently according to its initial conditions and having feedback loops and interrelated components [72, 73] – makes the adoption and implementation of evidence obtained from one case and generalized challenging. According to Greenhalgh et al. [8], a paradigm shift is required to improve the uptake of empirical evidence to inform the practice and proposed the adoption of research methods aimed at ‘exploring tensions, generating insights and wisdom, exposing multiple perspectives and viewing complex systems as moving targets’ (p. 3). To this end, we demonstrated and argue that evidence-informed healthcare practice could benefit more from theoretically informative empirical research applying retroduction as it provides nuanced meaning-mediated and context-dependent evidence.

Because prediction is the mainstay of the positivist tradition, induction and deduction dominate inferencing approaches. Glynos and Howarth [9] explained that predictions depend on the beliefs of subjects, therefore, such predictions depend on the stability of those beliefs. While beliefs could be addressed to an extent using probabilistic-statistical forms of calculation, another challenge with prediction is that the reflexivity of the subjects makes predictions particularly inaccurate. To this end, while arguing for the role of retroduction, Glynos and Howarth [9] suggested that ‘the contextual features including the self-interpretations of the relevant social actors, serve as conditions of possibility of behavioral patterns that are strongly bound up with the content, and therefore the meaning and significance of the hypotheses and explanations themselves.’ [p. 7]. These context elements include physical environment and various institutional settings comprising of various stakeholders and their interactions, and the demographic and epidemiological conditions [74]. Therefore, evidence should not be

simply detached or ‘externalized’ from the context of discovery [9]. Chambers and Norton [75] also argue that evidence informing implementation should capture ‘information about variations in the delivery of evidence-based interventions across multiple populations and contexts’, which are the features of evidence obtained through retroductive thinking.

In retroductive thinking, a blurred boundary between contexts of discovery and justification is maintained to provide feedback to intervention developers and implementation-relevant information to the practice communities. The application of retroduction encourages the development of theories or models that incorporate both evidence and important contextual conditions to inform practice. Bhaskar [41] in his greater explanatory power criteria insisted that a developed theory should “reflect reality”. When the evidence obtained is contextualized and reflects the reality of the phenomenon under study, the process of adopting and/or translating the evidence into practice is enhanced. In this case, the practitioner or the policymaker 'will acquire not just the abstract knowledge of "what works" but also the practical wisdom that will make them make contextual judgments about **what is likely to work** (or what might be tried out to see if it works) in **this situation for these people**, in this organization with **these constraints**.’[71] p. 5. In the example presented, the model/theory developed illustrates not only what aspects of the adherence club intervention works (or not) but the situations are well articulated. We identified a health systems condition (integrated care) as a countervailing context and an implementation-promoting approach that could enhance the successful implementation of the intervention (intervention champion).

Implementation scientists recognize that attempting to implement evidence-based practices in contexts other than those from which the original evidence was generated is complex and challenging and most often requires contextual adaptation [75, 76]. There is an understanding that such adaptations may compromise the fidelity and effectiveness of the intervention [77]. To this end, implementation scientists are advocating for strategies for adapting evidence-based practices – methods or techniques used to enhance the adoption, implementation, and sustainability of a clinical program or practice [78]. Powell et al. [79] proposed strategies such as concept mapping, group model building, conjoint analysis and intervention mapping to address the contextual needs of a given change effort [79]. We argue here that the use of retroduction to develop context-linked theoretical evidence can enhance the identification of relevant strategies to improve implementation as this evidence carries the nature of the contextual requirements to inform implementation.

Critical realism questions the usefulness of deductive or inductive reasoning in open systems such as health systems and proposes that retroductive reasoning is most appropriate [45–47]. Critical realism facilitates the understanding of clinical settings and other contextual conditions by providing insight into the interrelationship between structures and their potentials, and the actions of the various actors acting

within that space [80]. This understanding is achieved through the formation of intervention-context-actor-mechanism-outcome configurational models to explain how, why, for whom and under what conditions the interventions would work. In this way, the practitioner understands the generative mechanisms behind the impact of the intervention, what section of the population would benefit more from the intervention, and also the relevant conditions required for the generative mechanisms to be triggered. Therefore, the theoretical/explanatory nature of evidence obtained from critical realist-informed studies employing primarily retroductive thinking provide not only evidence regarding the effectiveness of an intervention but also information regarding implementation.

Conclusions

While induction and deduction are useful for predicting the outcomes of interventions, programs and policies, evidence obtained from studies informed entirely by these methods of inferencing are decontextualized. We argue that the use of retroduction in theoretically-informative empirical research provides evidence linked to the contextual features of its discovery enhancing implementation. Obtaining evidence with discovery context provides practical knowledge for implementers to make contextual judgments about what is likely to work in under what likely contextual conditions, for what section of the population. Because Critical realist-informed studies apply retroduction, they have the potential to provide context-linked evidence to increase adoption and usability.

Abbreviations

ART – Antiretroviral therapy

PLHIV – People living with HIV

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no competing interests

Funding

The article did not receive any funding from any source.

Authors' contributions

FCM designed the article, wrote the first manuscript, revised the article and approved it for publication.

Acknowledgments

Not applicable

References

[1] Danermark B, Ekstrom M, Jakobsen L, et al. *Explaining Society: Critical Realism in the Social Sciences*. First. London: Routledge Taylor & Francis, https://profs.basu.ac.ir/spakseresht/free_space/explaining society.pdf (2002, accessed 28 June 2019).

[2] Eastwood JG, Jalaludin BB, Kemp LA. Realist explanatory theory building method for social epidemiology: a protocol for a mixed method multilevel study of neighbourhood context and postnatal depression. *Springerplus* 2014; 3: 12.

[3] Mason WA, Cogua-Lopez J, Fleming CB, et al. Challenges Facing Evidence-Based Prevention: Incorporating an Abductive Theory of Method. *Eval Heal Prof* 2018; 41: 155–182.

[4] Bolton JW. Varieties of clinical reasoning. *J Eval Clin Pract* 2015; 21: 486–489.

[5] Meyer SB, Lunnay B. The application of abductive and retroductive inference for the design and analysis Theory-Driven sociological research. *Sociol Res Online*; 18. Epub ahead of print 2013. DOI: https://doi.org/10.5153/sro.2819.

[6] Kislov R, Pope C, Martin GP, et al. Harnessing the power of theorising in implementation science. *Implementation Science*; 14. Epub ahead of print 11 December 2019. DOI: 10.1186/s13012-019-0957-4.

[7] Van Belle S, van de Pas R, Marchal B. Towards an agenda for implementation science in global health: there is nothing more practical than good (social science) theories. *BMJ Glob Heal* 2017; 2: e000181.

[8] Greenhalgh T, Papoutsi C. Studying complexity in health services research: Desperately seeking an overdue paradigm shift. *BMC Medicine*; 16. Epub ahead of print 20 June 2018. DOI: 10.1186/s12916-018-1089-4.

[9] Glynos J, Howarth D. The Retroductive Cycle: The research process in poststructuralist discourse analysis 1 Jason Glynos & David Howarth. In: Marttila T (ed) *Discourse, Culture and Organization: Inquiries into Relational Structures of Power*. London: Palgrave, 2018, pp. 1–13.

[10] Amico KR, Barta W, Konkle-Parker DJ, et al. The information-motivation-behavioral skills model of ART adherence in a deep south HIV+ clinic sample. *AIDS Behav* 2009; 13: 66–75.

[11] Santillán Torres Torija C, Villagrán Vázquez G, Robles Montijo SS, et al. The Information and Motivation and Behavioral Skills Model of ART Adherence among HIV-Positive Adults in Mexico. *J Int Assoc Provid AIDS Care* 2015; 14: 335–342.

[12] Fisher JD, Fisher WA, Amico KR, et al. An information-motivation-behavioral skills model of adherence to antiretroviral therapy. *Heal Psychol* 2006; 25: 462–473.

[13] Fisher JD, Amico KR, Fisher WA, et al. The Information-Motivation-Behavioral Skills Model of Antiretroviral Adherence and Its Applications. *Curr HIV/AIDS Rep* 2008; 5: 193–203.

[14] Braun V, Clarke V. *Using thematic analysis in psychology*.

[15] Hayes BK, Heit E. Inductive reasoning 2.0. *Wiley Interdisciplinary Reviews: Cognitive Science*; 9. Epub ahead of print 1 May 2018. DOI: 10.1002/wcs.1459.

[16] Getahun B, Ameni G, Medhin G, et al. Treatment outcome of tuberculosis patients under directly observed treatment in Addis Ababa, Ethiopia. *Brazilian J Infect Dis* 2013; 17: 521–528.

[17] Eastwood JG, Kemp LA, Jalaludin BB. Realist theory construction for a mixed method multilevel study of neighbourhood context and postnatal depression. *Springerplus* 2016; 5: 1081.

[18] Willis P. Retroduction, reflexivity and leadership learning: Insights from a critical realist study of empowerment. *Manag Learn* 2019; 50: 449–464.

[19] Sæther B. Retroduction: an alternative research strategy? *Bus Strateg Environ* 1998; 7: 245–249.

[20] Lawson T. *Economics and Reality (Economics as Social Theory)*. 1997. Epub ahead of print 1997. DOI: 10.4324/9780203195390.

[21] Peirce C. *Collected papers of Charles Sanders Peirce*. Cambridge: Belknap Press of Harvard University Press, 1960.

[22] Kolcaba K. Evolution of the Mid Range Theory of Comfort for Outcomes Research. *Nurs Outlook* 2001; 49: 86–92.

[23] Epstude K, Roese NJ. The functional theory of counterfactual thinking. *Personal Soc Psychol Rev* 2008; 12: 168–192.

[24] Roese NJ. Counterfactual thinking. *Psychol Bull* 1997; 121: 133–148.

[25] Ferraro PJ. Counterfactual thinking and impact evaluation in environmental policy. *New Dir Eval* 2009; 2009: 75–84.

[26] Merton R. *Social Theory and Social Structure.* First. New York City, New York: The Free Press, 1968.

[27] Mirza NA, Akhtar-Danesh N, Noesgaard C, et al. A concept analysis of abductive reasoning. *J Adv Nurs* 2014; 70: 1980–1994.

[28] Mukumbang FC, Marchal B, Van Belle S, et al. Using the realist interview approach to maintain theoretical awareness in realist studies. *Qual Res*. Epub ahead of print 2019. DOI: 10.1177/1468794119881985.

[29] Eastwood J, Kemp L, Jalaludin B. "Being Alone and Expectations Lost": A Realist Theory of Neighborhood Context, Stress, Depression, and the Developmental Origins of Health and Disease. *SAGE Open* 2018; 8: 215824401876300.

[30] Mukumbang FC. *A realist evaluation of the antiretroviral treatment adherence clubprogramme in the metropolitan area of the Western Cape Province,South Africa*. University of the Western Cape, 2018.

[31] Dossou J-P, De Brouwere V, Van Belle S, et al. Opening the 'implementation black-box' of the user fee exemption policy for caesarean section in Benin: a realist evaluation. *Health Policy Plan*. Epub ahead of print 20 November 2019. DOI: 10.1093/heapol/czz146.

[32] Mulubwa C, Hurtig A-K, Zulu JM, et al. Can sexual health interventions make community-based health systems more responsive to adolescents? A realist informed study in rural Zambia. DOI: 10.1186/s12978-019-0847-x.

[33] Allana S, Clark A. Applying Meta-Theory to Qualitative and Mixed-Methods Research: A Discussion of Critical Realism and Heart Failure Disease Management Interventions Research. *Int J Qual Methods* 2018; 17: 1–9.

[34] Bhaskar R. Forms of Realism. *Philosophica* 1975; 15: 99–127.

[35] McEvoy P, Richards D. A critical realist rationale for using a combination of quantitative and qualitative methods. *J Res Nurs* 2006; 11: 66–78.

[36] Dickinson H. The evaluation of health and social care partnerships: an analysis of approaches and synthesis for the future. *Heal Soc Care Community* 2006; 14: 375–383.

[37] Kazi M a F, Spurling LJ. Realist Evaluation for Evidence-Based Practice. *Evaluation* 2002; 1999–2002.

[38] Clark AM, Lissel SL, Davis C. Complex Critical Realism. *Adv Nurs Sci* 2008; 31: E67–E79.

[39] Schiller CJ. Critical realism in nursing: an emerging approach. *Nurs Philos* 2016; 17: 88–102.

[40] Wynn D, Williams CK. Principles for Conducting Critical Realist Case Study Research in Information Systems. *MIS Q* 2012; 36: 787–810.

[41] Bhaskar R. *Scientific realism and human emancipation*. Routledge, 2009.

[42] Sayer RA. *Method in social science : a realist approach*. Routledge, 1992.

[43] Elder-Vass D. *Searching for realism, structure and agency in Actor Network Theory*. Blackwell Publishing Ltd © London School of Economics and Political Science. Epub ahead of print 2008. DOI: 10.1111/j.1468-4446.2008.00203.x.

[44] Pawson R, Tilley N. *Realistic evaluation*. California: Sage, 1997.

[45] Gilmore B, McAuliffe E, Power J, et al. Data Analysis and Synthesis Within a Realist Evaluation: Toward More Transparent Methodological Approaches. *Int J Qual Methods* 2019; 18: 160940691985975.

[46] Bunt S. Critical realism and grounded theory: Analysing the adoption outcomes for disabled children using the retroduction framework. *Qual Soc Work Res Pract* 2018; 17: 176–194.

[47] Oliver C. Critical Realist Grounded Theory: A New Approach for Social Work Research. *Br J Soc Work* 2012; 42: 371–387.

[48] Mukumbang FC, Marchal B, Van Belle S, et al. “Patients Are Not Following the [Adherence] Club Rules Anymore”: A Realist Case Study of the Antiretroviral Treatment Adherence Club, South Africa. *Qual Health Res* 2018; 104973231878488.

[49] Manzano A. The Craft of Interviewing in Realist Evaluation. *Evaluation* 2016; 22: 342–360.

[50] Human Sciences Research Council. *South African National HIV prevalence, Incidence, Behaviour and Communication Survey, 2017*, http://www.hsrc.ac.za/uploads/pageContent/9234/FINAL

Presentation for 17 July launch.pdf (2018, accessed 3 September 2018).

[51] Mukumbang FCFC, Van Belle S, Marchal B, et al. Realist evaluation of the antiretroviral treatment adherence club programme in selected primary healthcare facilities in the metropolitan area of Western Cape Province, South Africa: a study protocol. *BMJ Open* 2016; 6: e009977.

[52] HAST. Guidelines for ART Clubs, http://www.differentiatedcare.org/Portals/0/adam/Content/RN8-EedHTEq0MpQtRd2jDA/File/Guideline for ART Clubs March 2015.pdf (2015, accessed 12 July 2017).

[53] Médecins Sans Frontières. *ART adherence club report and toolkit.*, http://samumsf.org/wp-content/uploads/2014/11/ART-Adherence-Club-REPORT-and-TOOLKIT_OCT2014.pdf (2012, accessed 12 July 2017).

[54] Luque-fernandez MA, Cutsem G Van, Goemaere E, et al. Effectiveness of Patient Adherence Groups as a Model of Care for Stable Patients on Antiretroviral Therapy in. *Exposure*; 8. Epub ahead of print 2013. DOI: 10.1371/journal.pone.0056088.

[55] Grimsrud A, Sharp J, Kalombo C, et al. Implementation of community-based adherence clubs for stable antiretroviral therapy patients in Cape Town, South Africa. *J Int AIDS Soc* 2015; 18: 19984.

[56] Parry CD, Morojele NK, Myers BJ, et al. Efficacy of an alcohol-focused intervention for improving adherence to antiretroviral therapy (ART) and HIV treatment outcomes - a randomised controlled trial protocol. *BMC Infect Dis* 2014; 14: 500.

[57] Myer L, Iyun V, Zerbe A, et al. Differentiated models of care for postpartum women on antiretroviral therapy in Cape Town, South Africa: a cohort study. *J Int AIDS Soc* 2017; 20: 21636.

[58] Tsondai PR, Wilkinson LS, Grimsrud A, et al. High rates of retention and viral suppression in the scale-up of antiretroviral therapy adherence clubs in Cape Town, South Africa. *J Int AIDS Soc*; 20. Epub ahead of print 15 July 2017. DOI: 10.7448/IAS.20.5.21649.

[59] Grimsrud A, Barnabas R V., Ehrenkranz P, et al. Evidence for scale up: the differentiated care research agenda. *J Int AIDS Soc*; 20. Epub ahead of print 15 July 2017. DOI: 10.7448/IAS.20.5.22024.

[60] Moore GF, Audrey S, Barker M, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ* 2015; 350: h1258.

[61] Mukumbang FC, van Belle S, Marchal B, et al. Towards Developing an Initial Programme Theory: Programme Designers and Managers Assumptions on the Antiretroviral Treatment Adherence Club Programme in Primary Health Care Facilities in the Metropolitan Area of Western Cape Province, South Africa. *PLoS One* 2016; 11: e0161790.

[62] Mukumbang FC, Marchal B, Belle S Van, et al. A realist approach to eliciting the initial programme theory of the antiretroviral treatment adherence club intervention in the Western Cape Province , South

Africa. 2018; 1–16.

[63] Mukumbang FC, Wyk B Van, Belle S Van, et al. Unravelling how and why the Antiretroviral Adherence Club Intervention works (or not) in a public health facility: A realist explanatory theory-building case study. *PLoS One* 2019; 1–26.

[64] Mingers J. *Realising systems thinking : knowledge and action in management science*. Springer, 2006.

[65] Mukumbang FC, Marchal B, Belle S Van, et al. Unearthing how, why, for whom and under what health system conditions the antiretroviral treatment adherence club intervention in South Africa works: A realist theory refining approach. *BMC Health Serv Res*; 18. Epub ahead of print 2018. DOI: 10.1186/s12913-018-3150-6.

[66] Mukumbang FC, van Wyk B, Van Belle S, et al. 'At this [adherence] club, we are a family now': A realist theory-testing case study of the antiretroviral treatment adherence club, South Africa. *South Afr J HIV Med* 2019; 20: 14.

[67] McAvoy J, Butler T. A critical realist method for applied business research. *J Crit Realis* 2018; 17: 160–175.

[68] Byng R, Norman I, Redfern S. Using realistic evaluation to evaluate a practice-level intervention to improve primary health care for patients with long-term mental illness. 2005; 69–93.

[69] Wai-chung Yeung H. Critical realism and realist research in human geography: a method or a philosophy in search of a method? *Prog Hum Geogr* 1997; 21: 51–74.

[70] May CR, Johnson M, Finch T. Implementation, context and complexity. DOI: 10.1186/s13012-016-0506-3.

[71] Greenhalgh E-Book T. *How to Implement Evidence-Based Healthcare*, https://www.wiley.com/en-gb/9781119238522 (2017, accessed 21 January 2020).

[72] Lipsitz LA, Seniorlife H, Israel B. Understanding Health Care as a Complex System: The Foundation for Unintended Consequences $watermark-text $watermark-text $watermark-text. *JAMA* 2012; 308: 243–244.

[73] Kannampallil TG, Schauer GF, Cohen T, et al. Considering complexity in healthcare systems. *J Biomed Inform* 2011; 44: 943–947.

[74] Peters DH, Adam T, Alonge O, et al. Republished research: Implementation research: What it is and how to do it. *Br J Sports Med* 2014; 48: 731–736.

[75] Chambers DA, Norton WE. The Adaptome Advancing the Science of Intervention Adaptation. Epub ahead of print 2016. DOI: 10.1016/j.amepre.2016.05.011.

[76] Eccles MP, Armstrong D, Baker R, et al. Implementation Science An implementation research agenda. *Chief Med Off*. Epub ahead of print 2006. DOI: 10.1186/1748-5908-4-18.

[77] Breitenstein SM, Gross D, Garvey C, et al. Implementation Fidelity in Community-Based Interventions. DOI: 10.1002/nur.20373.

[78] Proctor EK, Powell BJ, Mcmillen JC. *Implementation strategies: recommendations for specifying and reporting*, http://www.implementationscience.com/content/8/1/139 (2013, accessed 27 January 2020).

[79] Powell BJ, Beidas RS, Lewis CC, et al. Methods to Improve the Selection and Tailoring of Implementation Strategies. *J Behav Heal Serv Res* 2017; 44: 177–194.

[80] Kontos PC, Poland BD. Implementation Science Mapping new theoretical and methodological terrain for knowledge translation: contributions from critical realism and the arts. Epub ahead of print 2009. DOI: 10.1186/1748-5908-4-1.

Figures

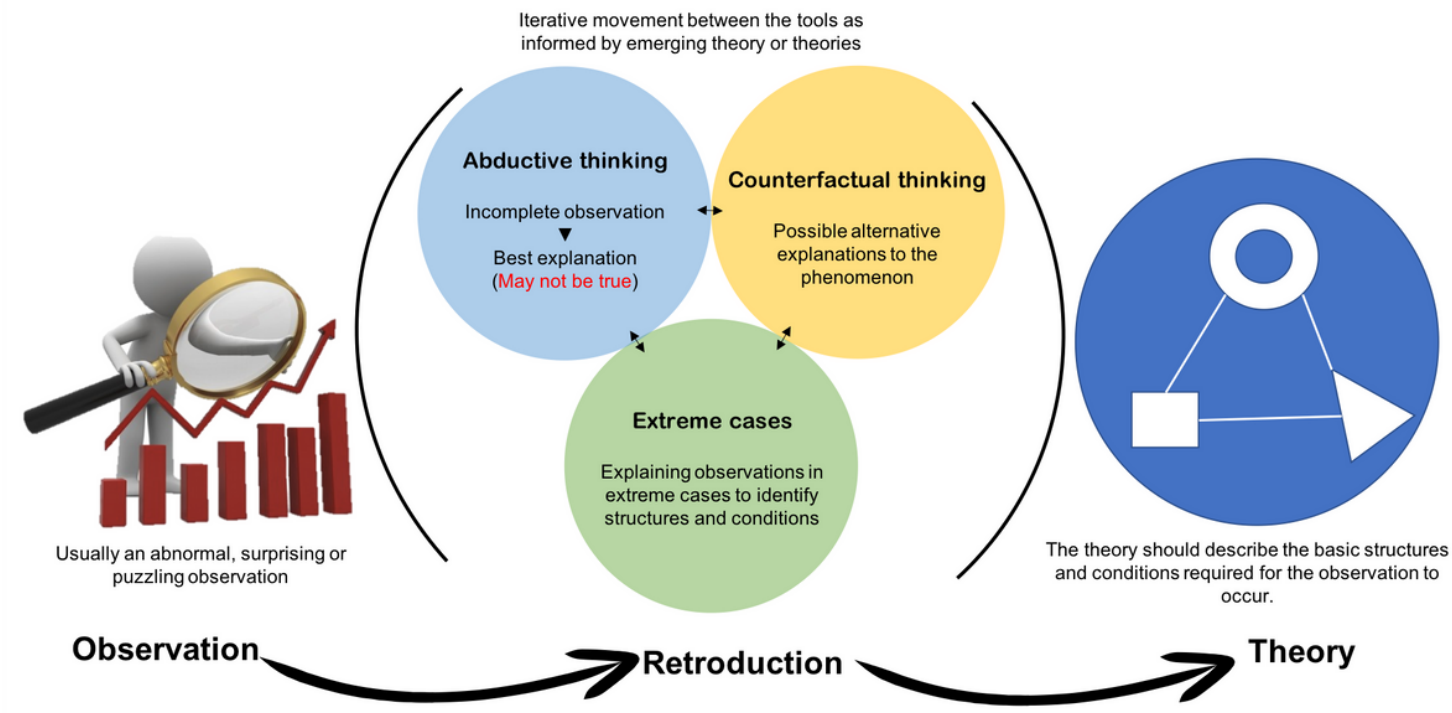

Figure 1

Retroductive process to theorizing

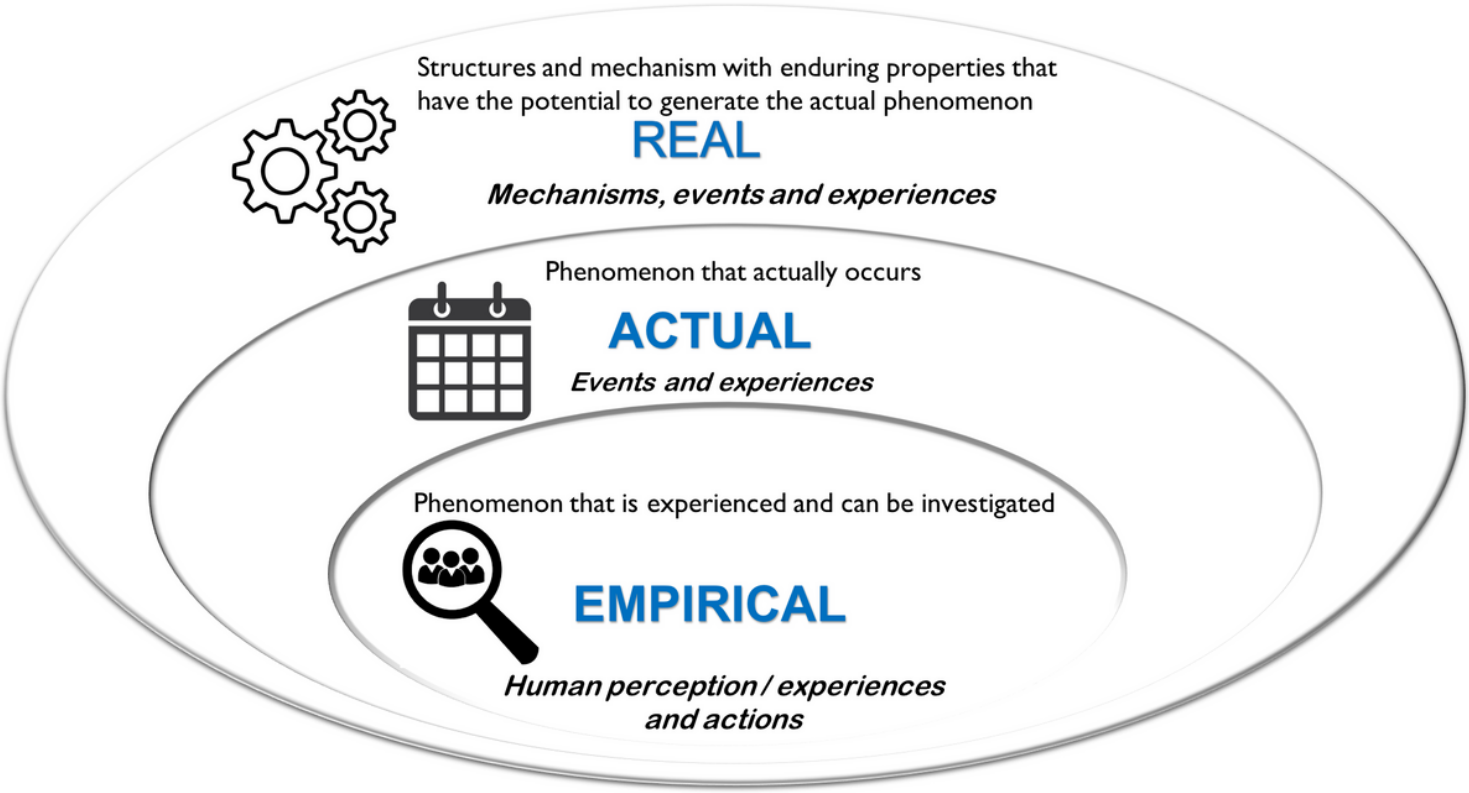

Figure 2

Stratified ontology of critical realism (Source Mukumbang et al. [26])

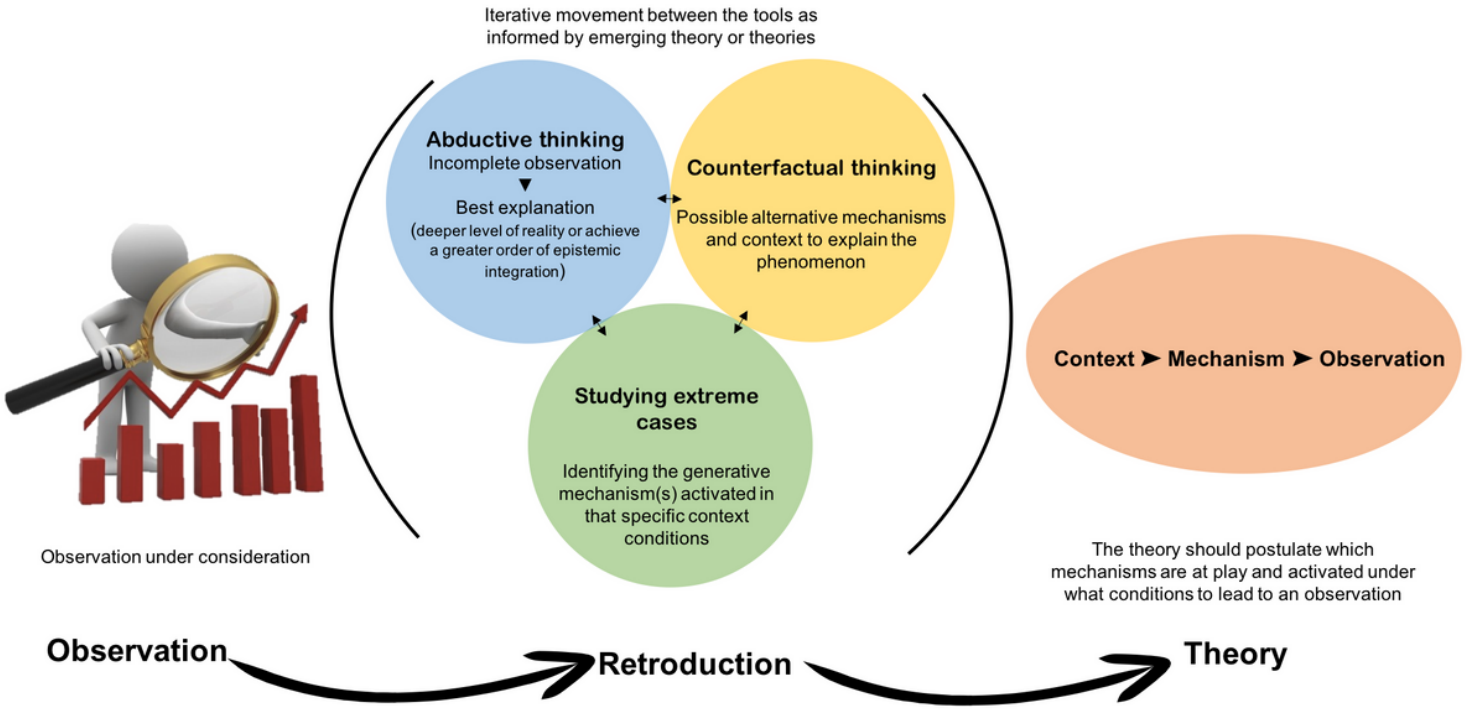

Figure 3

Critical realist informed retroductive thinking

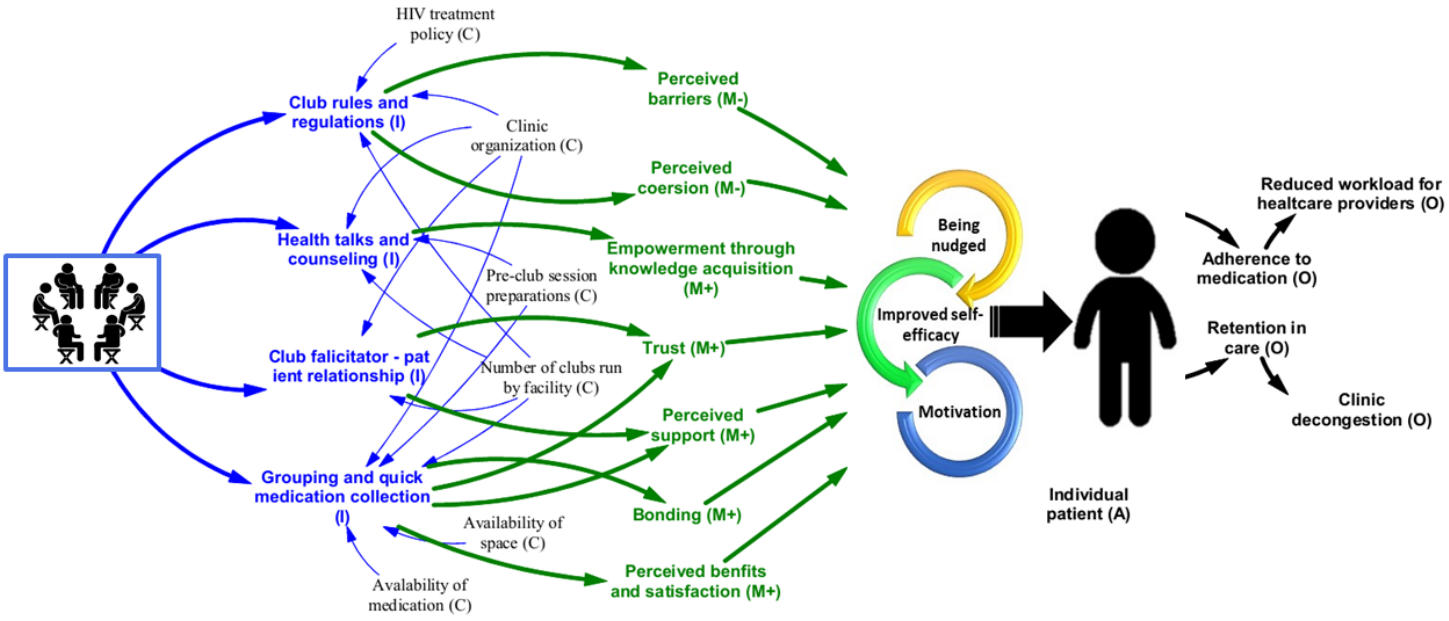

Figure 4

A model explicating how and why the adherence club intervention works