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Community Viral Load Management: Can Attractors Contribute to Developing an Improved Bio-social Response to HIV Risk-reduction?

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Abstract: *This article reports on the first twelve months of a pilot study that was designed to improve community responses to HIV/AIDS in rural South Africa. The framework was designed to enable the modification of emergent attractor landscapes. Specifically, we report on the introduction of a primary* probe*; the secondary, community initiated probes and the attractors that emerged through the process. Probes were designed to stimulate* frame *changes amongst participants that would influence social practices.* Attractors *represent the empirically visible culmination of discrete patterns that influence the dynamic landscape. Managing or modifying these patterns, thus changing the landscape, including social practices, is the principle that underpins the framework. The findings were analysed using a qualitative methodology called causal layered analysis. Six attractors emerged that contribute to reducing the aggregate community* viral load, *and three attractors emerged that detract from that ambition. The first pilot has provided insights into improving the framework and has had an impact at multiple scales suggesting that the framework is a promising tool for engaging with the bio-social aspects of the contemporary epidemic.*

Key Words: attractors; causal layered analysis; complexity science; HIV/AIDS; probes; Vision 90-90-90.

INTRODUCTION

This article presents a review of the first twelve months of one pilot in a project in the Limpopo Province of South Africa. The focus of the project is to develop a new bio-social approach to HIV prevention and risk-reduction by

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focusing on reducing the aggregate *viral load* within communities with the ambition of reducing incidence rates (the amount of people that become infected each year) and increasing prevalence rates (the total amount of people living with HIV).

The transdisciplinary initiative developed through a community-university partnership between the Waterberg Welfare Society (WWS) and the Rural Development and Innovation Hub, University of Limpopo (UL). The pilot we report on began in 2014 and is still ongoing in the Waterberg District of the Limpopo Province. Recent estimates indicate HIV prevalence rates among antenatal women in the Waterberg District to be just over 30%, with the national HIV prevalence average for women attending antenatal clinics being just over 29% (NDoH, 2013, p. 23). At a broader population level, Waterberg District is estimated to have prevalence rates between 10-12% (Shisana et al., 2014, p. 48).

Discussions prior to the pilot focused on the "intractability" (Rittel & Webber, 1973) of the challenges that WWS experience on a regular basis. These challenges mirror national priority areas identified in the most recent South African National HIV Prevalence, Incidence and Behaviour Survey, 2012 (Shisana et al., 2014) and include, *inter alia*: loss to follow-up (i.e. people that present themselves at medical centres with HIV-related concerns and then do not return), testing, adherence to medication, stigma and knowledge about HIV transmission and prevention that is attributed to increased risky sexual behaviours.

It was evident that whilst there are many examples of HIV positive people who rigorously follow recommended medical regimens and HIV negative people who practice safe-sex, there was a problematic element, comprised of diverse segments of the community, that practice patterned behaviours that sustain the levels of HIV in the distrct. This landscape was considered by the university component of the partnership to predominantly be a linear epidemiological landscape that is characterised by significant pockets of nonlinear, self-organising *rogue networks* or nodes. Throughout the article we refer to these rogue elements as networks because most examples do represent networked forms of nonlinear phenomena.

These rogue networks appear to thrive in spaces somewhere between the ordered biomedical opportunities that are now available and localised "myth and metaphor" that have been reported on in other parts of the Limpopo province (Dickinson, 2013). It was agreed that the nonlinear dynamics of the rogue networks — and developing strategies to modify those dynamics — would be the focus of the project because the nonlinear characteristics of the rogue networks contradict, thus do not fit into, the linear architecture that could "end AIDS." The expression rogue networks deliberately refers to nonlinear pockets within attractor landscapes, not descriptive high risk groups, such as sex workers or men who have sex with men (MSM).

Since the inception of the work in 2013, UNAIDS has promoted a radical global re-orientation to "end AIDS by 2030," called *Vision 90-90-90* — which is being proactively pursued by the National Department of Health

(NDoH) in South Africa (Motsoaledi, 2014). Vision 90-90-90 represents a highly ambitious agenda which aims to achieve "a 90% reduction in new HIV infections; a 90% reduction in stigma and discrimination faced by people living with HIV and a 90% reduction in AIDS-related deaths" is possible by 2020, catalysing an ultimate vision of ending AIRDS by 2030 (UNAIDS, 2014b, p. 296). This will require a radical shift from the current *response mode* to the epidemic to a *mission mode* because the "current business-as-usual mode, although it saves lives, will not be able to break the cycle of continuing new HIV infections and AIDS-related deaths and take the epidemic beyond the *tipping point* to end AIDS by 2030 (emphasis added, UNAIDS, 2014b, p. 299).

Whilst the partnership could not have foreseen the global shift, five out of eight Action Points that UNAIDS incorporate within the mission mode dovetail with the original ambition of the project. The Action Points include: (a) "Protecting human rights, embracing the human family and leaving no one behind;" (b) "Investing in communities;" (c) "Focusing on local epidemics and populations;" (d) "Expanding choices for HIV prevention and treatment" and (e) "Integrat[ing] HIV programmes with other health and development programmes" (UNAIDS, 2014b, p. 300-302). Prior to UNAIDS announcements, the partnership had also agreed that in a generalised epidemic, such as is in South Africa (SANAC, 2012), it is relevant to focus on the viral load because it is an essential mediator of the trajectory of the epidemic (Abu-Raddad et al., 2014; Loutfy et al., 2013; Rodger, Bruun, & Cambiano, 2014). This fortuitously also aligned to the new "mission" mode that UNAIDS called for.

UNAIDS also emphasise that there is an urgent need to "come up with a bio-social response and not just a medical response to end the AIDS epidemic" (UNAIDS, 2014b, p. 305). Due to the close fit between the WWS pilot and UNAIDS' call to develop new bio-social responses to the epidemic, the project is now focusing on developing rural bio-social response capacities as a contribution to achieving the global ambition envisaged by UNAIDS. Thus, the ambition of Phase One of the project was to surface the discrete dynamics of rogue networks and the ambition of Phase Two is to develop strategies to reduce the nonlinear characteristics within these rogue landscapes so that there is more alignment between them and the current biomedical campaign to "end AIDS." The overall ambition is to develop methodological tools to facilitate movement towards the tipping point UNAIDS describes above and to take the approach to scale if the findings justify it.

The university component developed an intervention that included identifying attractors within the landscape as indicators of the organising principles of the nonlinear, rogue elements of that particular HIV epidemic as a first step to achieving the partnership objective of reducing the aggregate viral load in the area.

The article is structured in the following way:

1. We introduce the generalised frames that influence our conceptualisation of the context we are working with. This includes, after Katerndahl (2010) focusing on the entire HIV landscape rather than individual

symptoms and framing the overall ambition of the project as the development of a bio-social "vortex metaphor," after (Sturmberg & Martin, 2010).

2. We then explain our conceptualisation of the rogue networks. The rogue networks originate from the pre-Vision 90-90-90 era, which we label the ABC-legacy and claim will be a major obstacle to "ending AIDS by 2030." We briefly explore the implications of this legacy and the process of transitioning the rogue networks into the new era of "ending AIDS by 2030" from the perspective of complexity before stating the more generalised perspectives that frame our current approach to the project.

3. The concepts that influence the current approach include the following: disruptive innovations (Christensen, 1997), transformative social learning, frame theory (Goffman, 1974), and developing sustainable innovations conceptualised as the process of autopoietic praxis which we argue are required for the rogue networks to transition into the Vision 90-90-90 era.

4. We then introduce the two technical tools that were used to execute the intervention. This included a change management approach that is based on complexity, which appeared in the Harvard Business Review (Snowden & Boone, 2007) and a new educational package that focuses on the biology of HIV called A-3B-4C-T (The HIV/AIDS Communication and Media Network, 2014).

5. This is then followed by the methodology, results and discussion.

The key findings include the surfacing of nine attractors that will be used to influence the next phase of the pilot. The attractors that contribute to the project ambition include: (a) shifts from "HIV as a death sentence to a chronic illness;" (b) the "origins of HIV;" (c) relating the information in the educational package to "community experiences;" (d) the "viral load;" (e) "tools and techniques" that WWS have constructed to promote the new approach and (f) "consistent messaging" about the new approach. The attractors that detract from the project ambition include: (a) a lack of "tools, techniques and time" to apply the new learning; (b) "community influences" and (c) "inconsistent messaging" within WWS and the community about the new approach.

These shifts can be associated with a new story-line that has been co-constructed by the WWS community that the rationality of the biomedical gains of recent years, represent a legitimate narrative to improve their work. The findings also prompted an opportunity to make a statement about the potential value that complexity science can add to the call to "come up with a bio-social response …. [that can contribute] to end[ing] the AIDS epidemic" (UNAIDS, 2014b, p. 305) and to prepare for the next phases of the research work.

TRANSITIONING FROM "PRE-VISON 90-90-90 LANDSCAPE" TO "ENDING AIDS BY 2030" FROM WITH COMPLEXITY SCIENCE

The overall project design is rooted in complexity science because there is a growing global consensus that health and the nonlinear dynamics associated with complexity are inextricably inter-related — despite the reality that "much work still has to be done to reach a complete understanding of complexity in health systems" (Martínez-García & Hernández-Lemus, 2013, p. 124).

Illness Representations in South Africa

Prior to the announcement of Vision 90-90-90 by the Minister of Health in 2014, the prevention landscape in South Africa was dominated by the legacy of multiple ABC campaigns and more localised illness representations.

ABC was originally designed to increase awareness of HIV in the Philippines in the early 1990s, based on the biomedical knowledge available from the 1980s (Hardee et al., 2013; WHO, 1992). The origin was small scale and represented an "innovative response, reflective of the knowledge that was available at that specific historical juncture, and was designed to have an impact on a particular epidemic in the Philippines" (Burman, Aphane, & Delobelle, 2015a, p. 16). Abstain, Be Faithful, Condomize (ABC) soon attracted global coverage due to the unprecedented support and promotion of the AIDS prevention strategy by the President's Emergency Plan for AIDS Relief (PEPFAR). This strategy has been highly controversial from an academic perspective (for an overview see pp. 16-17, Burman et al., 2015a; Lo, Lowe, & Bendavid, 2015), but simultaneously generated localised sensemaking responses by communities affected by HIV/AIDS.

In South Africa these localised sensemaking activities catalysed the emergence of themes that could have contributed to high incidence levels, such as beliefs that link HIV to the supernatural, i.e., HIV is caused by witchcraft or ancestral punishment, and HIV being associated with genocidal beliefs, i.e., whites deliberately manufacturing HIV or putting holes in condoms (Bogart et al, 2005; Nattrass, 2013; Liddell, Barrett, & Bydawell, 2005; Nattrass, 2013). It has been argued that these sensemaking activities were exacerbated by divisions within government, especially during the Mbeki administration, about both the validity that HIV was responsible for AIDS-related deaths and appropriate treatment regimens (Bogart et al., 2011).

Other themes that have been reported to contribute to reducing HIV incidence include knowledge of transmission in both Zimbabwe (Halperin et al., 2011) and Australia (Kippax, Stephenson, Parker, & Aggleton, 2013). In South Africa the themes associated with "illness representations, which ascribe meaning to and explain causes of health outcomes, vary along the dimension of perceived control over an illness; that is, the role of external entities (e.g. spiritual, supernatural) versus internal characteristics (e.g. personal effort, genetics) in controlling health events" (Bogart et al., 2011, p. 182).

Illness Representations from the Perspective of Complexity

Attractors

From the perspective of complexity the initial conditions (history) of a system matter (Koch, Eisend, & Petermann, 2014). In this instance, the global ABC slogan, combined with localised sensemaking, represents a powerful history that we described as the "legacy of the pre-Vision 90-90-90." The identity of the legacy "includes a reoccurring repertory of themes, motifs and characters" (Sivela, 2015, p. 43) associated with the ABS-legacy that may

represent metaphorical "attractors" that have discretely influenced the trajectory of the epidemic in South Africa for the last twenty years.

Attractors, in their most basic form, comprise of four generic types: point, periodic point, periodic, and strange. *Point* attractors operate in high-equilibrium conditions that "lure systems to a stable position of rest" (Pascale, Millemann, & Gioja, 2000, p. 70), such as a book being dropped on to the floor from a small height. The book, invariably lands on the floor and settles in a high equilibrium position as the kinetic energy is displaced by the pull of gravity. An example of this metaphor within the HIV landscape is the global supremacy of validated biomedical scientific methods and techniques to overcome the negative impacts of the human-virus interactions, which is now saving many thousands of lives across the globe (UNAIDS, 2014b).

Periodic point attractors operate within stable equilibrium states and demonstrate linear characteristics as the energy is gradually dissipated. Whilst the pattern is repeated, the outcome is less predictable because the energy dissipation is more gradual. An example of this metaphor within the HIV landscape is the procedure by which a biomedical strategy becomes validated by the World Health Organisation (WHO). The procedure typically begins with an informed hunch, or intuitive guess, by a scientist that initially goes through a series of controlled laboratory tests. With time, trial and error and successful outcomes a randomised control trial is undertaken. Once validated, the WHO approves, and gradually the technology is introduced to the global HIV/AIDS landscape by national health systems. The process is linear, but the outcomes are never quite the same, and once completed the process comes to an end.

Periodic attractors demonstrate more variability as iterations within the linear trajectory are influenced by minor perturbations. An example of this type of metaphor is pricing a particular medical technology. The linear trajectory remains the same: optimal delivery of the technology to patients and profit, but is influenced by production costs, economies of scale, local marketing costs and financial constraints or opportunities that require regular reviews, negotiations and alterations by the manufacturer. This process moves "systems into [bound-ed] loops of predictable but dynamic patterns" (Pascale et al., 2000, p. 70)

Strange attractors are more complex and operate close to the "edge of chaos." These attractors intersect with other systems in profound ways that create and reproduce chaotic patterns that are fractal in nature, with bounded stability. "Strange attractors are reflected in patterns of behaviour, that is, shapes in space or movements over time, which are never exactly repeated but are always similar to each other" (Stacey, 2003, p. 44). An example of this metaphor is the uptake of a biomedical technology in a particular landscape by people living with HIV. In South Africa, as many as 25% of HIV positive people are not adhering to antiretroviral medication or are being lost to follow up (Ellman, 2015), and it is common practice for some to mix traditional medications with NDoH-approved medications (Mee et al., 2014).

In this instance, the specific behaviours are unpredictable, but the behaviours operate within a bounded system of responses to an HIV positive

diagnosis. These behaviours are "close to the edge of chaos," and may alternate between both the periodic attractor and the strange attractor condition, as is evidenced by non-adherence to antiretroviral medication can lead to multiple drug resistance (HIV-MDR) at the individual level (Jiamsakul et al., 2014) and simultaneously poses a major public health threat when it intersects at scale with other forms of TB-MDR (Piot, 2015).

Both of these scenarios are recognised as distinct patterns that intersect with or are situated amongst, or nested within, the more linear scenarios of compliant patients, producing a complex HIV landscape where multiple drug resistance is a constant threat to the effectiveness of the NDoH's attempts to "end AIDS by 2030."

Self-organising Rogue Networks

Typically, the current social representation of the networks that exhibit strange and periodic attractor characteristics within the official HIV discourse is "high risk groups." We have deliberately moved beyond this descriptive signifier to the "rogue network" metaphor because of the short time scale that UNAIDS recommends if we are to "end AIDS by 2030." The rogue networks represent a component of the social epidemiological landscape underwritten by periodic and strange attractors that enables us to label the current HIV landscape as being a "complex adaptive epidemiological landscape."

From the perspective of the framework that is being developed, we assumed that the attractors that are at play are a combination of the four generic types described above. We also assumed that the characteristics of attractor-types represented a set of organising principles that could guide the intervention in unique ways without attempting to dogmatically apply physical "laws" to human interactions (Stacey, 2003). Of particular importance to the framework design is that these systems are self-organising.

Self-organisation is a "process whereby complex systems regulate their flows of information, energy, or matter" producing novel forms of unique order (Pincus & Metten, 2010, p. 354). Unique forms of localised order may become global. "Once global order emerges, this order then feeds back down to the level of the components, constraining their behavior and their cross-component feedback dynamics….[becoming] self-sustaining over time" (Pincus & Metten, 2010, p. 355).

This form of self-organising emergence poses both a threat and opportunity to achieving Vision 90-90-90. For example, within the rogue networks where strange or periodic attractors dominate, an HIV positive person on medication who binge drinks and defaults from treatment runs the risk of a combination of liver failure and multiple drug resistance. Both liver failure and the drug resistance reduce options for individual level medical responses. The drug resistance, which occurs because the virus is capable of rapid mutation (Goldberg, Siliciano, & Jacobs, 2012), generates the conditions for the evolution of new strains of HIV at multiple scales which poses an emergent public health

threat. Generally speaking, nonlinear, self-organising phenomena detract from achieving the ambition of "ending AIDS" because the foundational architecture of Vision 90-90-90 constitutes a linear design. One notable anomaly is combination antiretroviral therapy "which uses a cocktail of three drugs that work precisely because the immune response and viral dynamics are nonlinear" (Ramalingham, 2013, p. 228).

Opportunities found in the self-organising constraints of more linear forms of attractor landscapes include the normalisation of HIV amongst populations (reduced stigma), thereby increasing the social capital (support networks) that has been shown to promote levels of adherence (Campbell et al., 2011; Halperin et al., 2011). Our emphasis, however, is that many of the rogue social systems in the HIV landscape in South Africa are complex adaptive systems within which the strange and periodic attractors represent properties of the system that act like magnetic forces, constantly drawing the systems in patterned trajectories towards an equilibrium point which will jeopardise the goal of achieving Vision 90-90-90. These equilibrium conditions represent a self-organising "state or a reliable pattern of changes (e.g., periodic oscillation) toward which a dynamical system evolves over time" (Coleman, Vallacher, Nowak, & Bui-Wrzosinska, 2007, p. 1458).

The ambition is that the pilot will develop mechanisms to counter this by demonstrating that it is possible to surface and work with the attractor landscape so that the strange and periodic attractors that currently dominate our rogue networks are transformed into more manageable *point or periodic point* attractors. We believe this is necessary precondition if we are to achieve the tipping point required to "end AIDS" because the architecture of Vision 90-90-90 is implicitly designed to function with these attractors. In order to satisfy this ambition end-condition the project was framed in the following way.

FRAMING THE PILOT

Frame # 1

The first frame reflects a call by Katerndahl (2010, p. 350) for the orientation of medical diagnosis away from isolated "symptoms" towards the relational "dynamics" of the "whole person" rather than "her disease." We suggest that while this argument is coherent, the context of South Africa and HIV/AIDS does not lend itself well to such a radical step. South Africa boasts an extremely ambitious health agenda, for example see SANAC (2012), but the delivery of that agenda requires negotiating a changing and complicated population disease burden; inadequate infrastructure and a demoralised — and often over worked — human resource base (Ellman, 2015).

The current ambition of achieving Vision 90-90-90 by 2030 essentially means carpet bombing the HIV virus within South Africa with every medication that has been approved by the National Department of Health (NDOH) in a bid to keep the aggregate national viral load as low as possible which will, in theory, take us a long way to achieving the 90-90-90 vision. Attempting to achieve this goal is, in itself, a bold decision by the NDoH. Further complicating the

ambition with a national shift towards "dynamics over symptoms" would almost certainly be a step too far.

However, as we have suggested above, we suspect that while there will be significant uptake of the biomedical opportunities that the NDoH is going to provide, there will also be a number of rogue networks that will continue to resist the official, linear design. Whilst acknowledging that the NDoH is well aware of the challenges of tackling the social and structural determinants that contribute to the epidemic (SANAC, 2012), we believe that the science of complexity — especially insights into the self-organising workings of complex adaptive systems and their dynamics — provides uncharted opportunities for tackling the rogue networks within the South African HIV/AIDS landscape. It is within the arena that we suggest that unravelling and working with the discrete patterned dynamics, rather than just the symptoms, and gradually transforming them into more linear dynamics will be of maximum value.

Frame # 2

The second frame that we use to contextualise the approach is informed by the "vortex metaphor" that Sturmberg and Martin (2010, p. 527) use to emphasise the "importance of appreciating the core attractors" of health systems, also see (Sturmberg, O'Halloran, & Martin, 2012). We suggest that at the moment the NDoH is building momentum towards generating a national vortex metaphor for the future of the HIV experience as being one of reducing the impact of the epidemic using every biomedical opportunity at our disposal. This will require significant amounts of technical re-structuring, such as improved supply chain management, skills training and task shifting.

However, as commentators have warned for many years, an over-reliance on technical solutions to social, complex challenges simultaneously risks forms of complacency that could risk a rapid shift into chaos (Snowden & Boone, 2007). We therefore aim to complement the biomedical vortex with a bio-social vortex that is eventually inclusive of "patterns, structures and relationships of the multiple agents and levels within the health system" that contribute to achieving a reduced aggregate viral load in South Africa as "multiple attractors [within] nested sub-systems" intersect in the coming years (Sturmberg & Martin, 2010, p. 527).

The project has thus evolved into an ambition to develop a bio-social model that can contribute to accelerating a reduction in the aggregate community viral load, paying special attention to the rogue networks and their dynamics that currently undermine the 90-90-90 vision. It is also hoped that these insights will to contribute to developing improved insights into working with the nonlinear dynamics that influence to the treatment and care of other chronic, health-related challenges.

Working with a Complex Adaptive HIV Landscape

In response to this, the university component of the partnership designed a conceptual platform which would underpin the project design. The

platform conceptualised the HIV epidemic as being a complex adaptive epidemiological landscape in which "multilevel causes of health and their patterns of [nonlinear] feedback and interaction….influence the health of populations" (Galea, Riddle, & Kaplan, 2010, p. 104), Fig. 1.

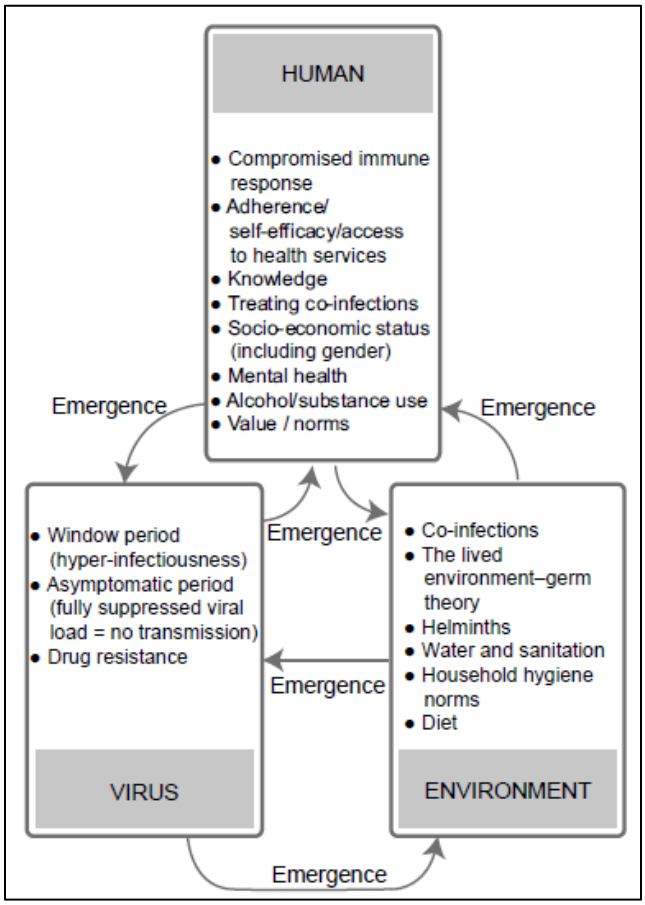

Fig. 1. A complex adaptive HIV landscape. Reprinted from Burman et al. (2015, p. 16).

Figure 1 "builds on the classic epidemiologic triangle of host, agent, and environment to focus explicitly on the role of social determinants in infectious disease transmission and progression" (Poundstone, Strathdee, & Celentano, 2004, p. 22) and has influenced the development of the methodological framework that has guided this work. The framework is

influenced by the following issues. The first emphasis is that the epidemic is a dynamic "long wave event" (Fourie & Follér, 2012, p. 254) that has been through a number of transitions (Whiteside & Strauss, 2014). The second emphasis is that the epidemic demonstrates many of the characteristics and properties of a complex adaptive system and it is therefore appropriate to respond to this complexity, rather than ignore it (Piot, Bartos, Larson, Zewdie, & Mane, 2008). The prototype framework is presented below, Fig. 2.

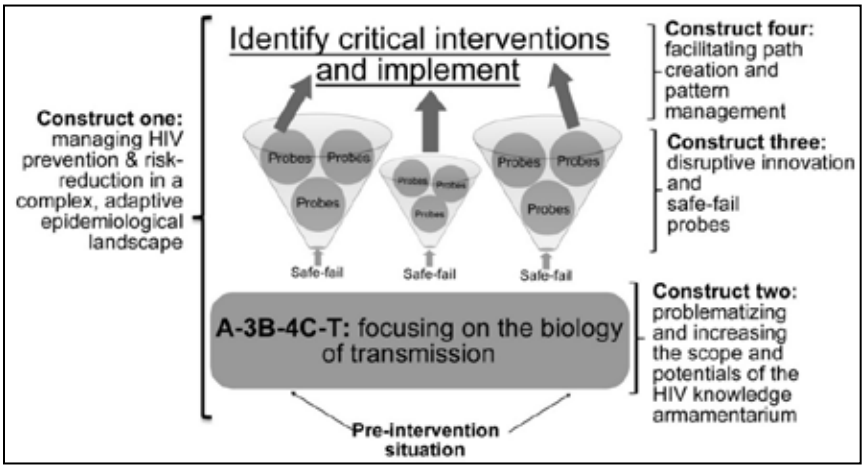

Fig. 2. The prototype framework. Reprinted from Burman, Aphane, Mtapuri, and Delobelle (2015, p. 27).

Construct one emphasises the complexity of the epidemic — including the patterned interactions that influence the characteristics of the trajectory of the epidemic across time and space. *Construct two* is the educational package, called A-3B-4C-T, which was included as the primary "probe," highlighting the relevance of the viral load to HIV prevention *and* risk-reduction. *Construct three* maintains the focus on responding to complex challenges by identifying and exploiting "disruptive innovations" that can alter the patterns that sustain the contemporary characteristics of the epidemic in particular settings. *Construct four*, after Garud, Kumaraswamy, and Karnøe (2010), was included primarily for monitoring and evaluation for the overall project. It was envisioned that the implementation process would include three inter-related phases that included Phase One: the "probe;" Phase Two: planning for safe-fail experimentation and Phase Three: implementing selected strategies at appropriate scales (Burman, Aphane, Mtapuri, & Delobelle, 2015b).

The design was influenced by the frames we have described above and we deliberately imported transdisciplinary concepts and tools to provide the infrastructure that we believed would provide a coherent scaffolding at the end

of the pilot stages which could, potentially, be taken to scale. These concepts and tools are described below.

CONCEPTS INFLUENCING THE FRAMEWORK

Disruptive Innovations

As has been argued above, the ABC legacy maintains a pervasive, embedded presence within the South African HIV landscape. Part of the project is to accelerate movement from this legacy towards the ambition of Vision 90-90-90. In order to achieve this it was believed that the overall process had to represent a paradigm shifting experience that makes sense at multiple levels amongst the community. Such experiences are often referred to as "disruptive innovations."

Disruptive innovations, which are gradually being introduced into health-related debates, are innovations that result in a radically altered context within which social practices happen (Bevan & Fairman, 2014; Jameson, 2014). Facilitating "disruptive innovations" was considered essential to the project design as a mechanism to enable people to begin to radically re-frame how they perceive — and thus respond — to the contemporary epidemiological landscape. The reason for this is that aspects of the bio-social landscape remain highly problematic, despite the biomedical armamentarium that is now available to counter HIV and thus new perspectives and approaches are required to reinforce the medical opportunities for HIV risk-reduction and prevention (UNAIDS, 2014b). Consequently, the paradigm shifting notion of a transformative innovation was imported into the conceptualisation of the project.

Transformative Learning and Frames

Transformative — or social, experiential — learning holds a visible position amongst a multitude of disciplines (Illeris, 2009; Kolb, 1984; Taylor, 2007). The key theme that these theorists share, after Goffman (1974), is that the learning process elicits shifts in frames, after Schön (1983), as people re-orientate themselves to changing their individual and collective perceptions through a process of "unlearning" as the existing world is deconstructed, prior to beginning a process of reconstructing, experimenting and shaping a new world (Rogers et al., 2013, p. 4).

It is generally agreed that transformative learning "goes beyond the individual to become situated within wider social units or communities of practice within society" (Reed et al., 2010, p. 1). There is also a consensus that the process of deconstructing, reconstructing and shaping a new world during transformative social learning is rarely a linear progression because "activities …. interrelate and overlap [because] social learning is an ongoing, cyclical and emergent process" (Wals, 2007, p. 41).

For some, this learning process is most likely to occur when the learners are dissatisfied, or are at least questioning, the current status quo: "Put simply: there is no learning without dissonance, and there is no learning with too

much dissonance" (Wals, 2007, p. 40). In order to surface indicators of transformative learning, "sequential moments" —including "orientation and exploration; deframing or deconstructing; co-creating; applying / experimenting and reviewing" that learners experience as they deconstruct the present and then reconstruct an alternative future was considered to be an appropriate heuristic (Wals, 2007, p. 41).

The purpose of introducing the focus on transformative learning and frames is that if the participants completed the training successfully they would be entitled to eight Continuing Professional Development (CPD) points, indicating that *technically* the learners had acquired new knowledge or information. However, the emphasis of the review is to evaluate the impact on the broader community knowledge-action system after the "probe" and thus the transformative social potentials of the process, rather than one isolated training event. In order to gauge the impact of the project on the broader community knowledge-action system the "deconstruction-reconstruction" process described by Wals (2007) was considered to be a viable opportunity. Not only was the impact of the learning on the broader action/knowledge system relevant, so too was the sustainability, or stickiness, of the experience was considered to be relevant. For this reason the notion of autopoietic praxis was incorporated into the design.

Sustainable Innovations and Autopoietic Praxis

For sustainable change to take root it is necessary for new attractors to emerge which "channel mental and behavioral experience into a narrow range of coherent (either positive or negative) states" that become the basis for future social practices (Coleman et al., 2007, p. 5). Self-organisation, "i.e. the emergence of [new] order without external control" (Leeuwis & Aarts, 2011, p. 26), plays a critical role in this process. However, in community, or social, systems, spaces are required to initiate and reinforce the innovation process. Leeuwis and Aarts (2011) make a compelling case that "everyday communication" mediates the transition from a probe to new social practices during innovation processes.

"Meaningful innovation is dependent on changes in discourses, representations and storylines that are mobilised by interacting social actors [as] the world is ordered and re-ordered" (Leeuwis & Aarts, 2011, p.27). This is the an embodied form of praxis in which thought and action fuse into an analytically indistinguishable process of social transformation as the constraints of yesterday are re-ordered (McNally, 2001), giving rise to a new form of constrained order and coherence (Snowden & Boone, 2007).

The analysis provided by Leeuwis and Aarts (2011) represents a descriptive account of the role of "everyday communication." We suggest that whilst "everyday communication" is a relevant indicator of change; the change is a process that responds to the modification of existing attractors and the emergence of new attractors which energises and funnels actions into a "narrow

range of coherent" social practices (Coleman et al., 2007, p. 5). Therefore, the framework design had to logically facilitate a shift in the attractor landscape, influencing social practices, prompting subsequent shifts in "everyday communication." This a non-sequential process as feedback between attractors, social practices and communication influence the evolution of an emergent system, Fig. 3.

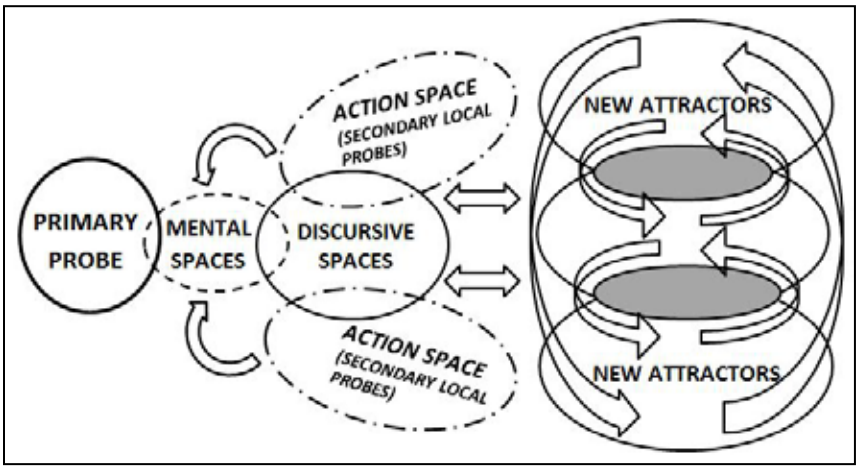

Fig. 3. The process of praxis, based on Leeuwis and Aarts (2011, p. 27).

Critical to the outcomes of the project is whether or not local energy is generated that will sustain the attempts to reduce the aggregate viral load represented by the large circular arrows, Fig. 3. Complexity scientists label this process *autopoiesis* (Fleischaker, 1992; Maturana & Varela, 1980), which represents the way in which feedback between, and within, the dynamic system generates recursive feedback loops that will influence the "evolutionary potentials" of the change process. In order to gauge the emergent autopoietic potentials during the first pilot the concept was visualised, Fig. 3, but no specific measurement tool was committed to.

TOOLS APPLIED IN THE FRAMEWORK

Identifying Patterned Attractors and Stimulating Change Processes

Identifying a pattern is difficult. However, identifying an attractor that represents the culmination of patterned interactions is possible through the interrogation of narrative data or empirical observation (Kurtz & Snowden, 2006). Management scientists influenced by complexity claim it is possible to catalyse change by introducing high energy interventions that stimulate downstream ripple effects that influences the trajectory of the patterns within that system, thus the attractor landscape across time and space. It is not a precise

art, but one that holds potentials to shape the characteristics of future landscapes. The design was influenced by a method described in the Harvard Business Review in 2007.

Kurtz and Snowden (2006) argued that facilitating change processes situated within complex adaptive systems can be achieved by introducing and experimenting with new "probes" that may alter the attractor landscape in unpredictable ways. A probe is management strategy designed to "make the patterns or potential patterns [within an attractor landscape] more visible before we take any action" (Kurtz & Snowden, 2003, p. 469). This strategy is necessary because "relying on the entrained patterns of past experience to determine our response" (Kurtz & Snowden, 2003, p. 469) in complex situations is often a "futile quest for certainty" where little exists (Wilson, Holt, & Greenhalgh, 2001, p. 688).

The probe that has to have "resonance with people" (Snowden & Boone, 2007, p. 73) is delivered with the intention of deliberately disturbing the existing equilibrium within the attractor landscape and then allowing enough time for existing, and emergent, attractors to surface. If the landscape begins to change then emergent, self-organised attractor platforms become visible containing a "*sufficiency* of the present [that can be used as a basis for action] to stimulate [the] evolution of the system" (emphasis in original, Klein, 2008; Kurtz & Snowden, 2006, p. 122). It was deemed essential that the attractor sites emerge organically in each pilot site, without the university component of the partnership interfering in the process, so that the attractors would reflect, after Wilson and Halperin (2008), the particularities of local landscapes. These new attractor sites, if they emerged, were planned to be the foundation of the next phases of the project.

This process is only possible if an end-*condition* is imagined and not a specific end-*state*. When modifying complex landscapes a precise, fully defined *a priori* future end-state cannot, and is not, expected. The best that can be done is to work with the imperfect knowledge to hand and gradually shape the past, present and future constraints to work towards a future with a predefined end-"condition." In this instance the predefined end-condition is a reduced aggregate community viral load and the primary probe that we hoped would have "resonance with people" was an educational package called A-3B-4C-T.

The Primary Probe: A-3B-4C-T

A-3B-4C-T is aligned to the NSP (SANAC, 2012) and was accredited with the South African Health Care Professions Council in 2014. A-3B-4C-T is specifically oriented to provide validated information about the virus-human-environment interactions, Fig. 1, for multiple audiences.

The A-3B-4C-T package includes nine primary strategies to reduce HIV transmission as stand-alone interventions and twenty five associated risk-reduction mechanisms that fall within the DoH guidelines (Burman et al., 2015b). The approach is presented through two educational heuristics — the

viral load and Langerhans cells and their role in transmission (De Jong & Geijtenbeek, 2009; Loutfy et al., 2013). Throughout the training the way in which the lived environment, imperfect knowledge and decision making influences viral load fluctuations is used to emphasise the challenges of managing the epidemic. It was hoped that the primary probe would stimulate downstream, innovative "secondary probes" initiated by the learners.

Overview

The pilot was designed to catalyse a sustainable "disruptive innovation" that would influence the rogue networks, with both the space for self-organisation and the autopoietic energy required to prompt a shift away from the pre-existing equilibrium state (the ABC legacy) towards an alternative condition which transforms the nonlinear attractors into more linear attractors, which Vision 90-90-90 is implicitly designed to work with. Promoting sustainable forms of change requires new attractors and as new "attractors gain momentum, they provide structure and coherence" (Snowden & Boone, 2007, p. 72). Modifying existing attractors and developing new ones was considered essential because "neglect[ing] the mechanisms that continually reinstate the [pre-existing equilibrium state] are likely to be futile, resulting only in short-term changes (Coleman et al., 2007, p. 1458). The primary objective of this phase was to surface existing — and catalyse emergent — attractors so that an overview of the identity of a new attractor landscape became visible and could be used to prepare for the next phase of the pilot.

METHODOLOGY

Participants

The educational probe was introduced to a core team at WWS which included: (a) the Child Disclosure Support Department (CDSD) which is responsible for supporting children, families and care givers of children growing up with HIV (n=1); (b) the Education and Awareness Department (E&AD) which is responsible for community and school outreach, advocacy and facilitating support groups for people living with HIV/AIDS (PLWHA) (*n*=3); (c) the Treatment and Care Department (T&CD) which provides services to chronic and terminally ill patients (*n*=2); (d) the Department of Gender Based Programmes (DGBP) which is responsible for assisting teenagers to navigate the HIV landscape (*n*=4); and (e) Youth Environmental Services (YES) — which involves an HIV/AIDS awareness programme (*n*=2) that WWS has been commissioned to facilitate.

The participants represented larger teams that work with WWS and were purposefully selected by the partnership based on the following criteria: they had a minimum of one year of experience in the particular programme area that they were representing; had demonstrated leadership qualities during that period and would be available to participate in the review aspect of the initiative over the twelve month period.

Procedure

Qualitative narrative data was collected using face-to-face semi-structured, dual moderator group discussions in the language that participants felt most comfortable with (a combination of the local language, Sepedi, and English). The group discussions were undertaken two months and then ten months after the educational probe was introduced. A total of fifteen discussions took place and follow-up interviews were undertaken to clarify uncertainties that emerged.

All of the interviews were recorded then translated, transcribed and back translated twice to ensure an accurate translation. Initially, a frame analysis — using the themes identified by Wals (2007) — was undertaken using a thematic content analysis (Elo & Kyngas, 2008) followed by a qualitative research design called "causal layered analysis."

Causal Layered Analysis

Causal layered analysis (CLA) is associated with futures science (Inayatullah, 2013) and is an analytical tool that was developed to deconstruct "complex and wicked problems" (Bishop & Dzidic, 2014, p. 15). The framework enables an analysis of the issue under investigation from multiple perspectives. The levels of analysis are labelled "litany," "social/causal," worldview/discourse" and "myth/metaphor," Fig. 4.

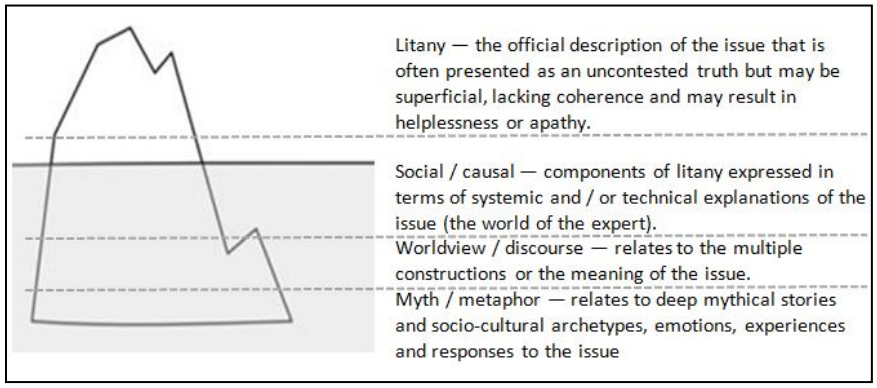

Fig. 4. The CLA iceberg metaphor, based on Bishop and Dzidic (2014, p. 17), Inayatullah (2008), and Riedy (2008).

The purpose of adopting this approach is that "underpinning our individual and collective experience is a series of worldviews, myths and social archetypes [which are] social drivers [of] social issues" (Bishop & Dzidic, 2014, p. 17). After psychologists Watzlawick, Weakland, and Fisch (1974), these worldviews, myths and social archetypes can be associated with second order change processes, whilst the layers closer to, or above, the surface can be associated with first order change. Both are relevant to change processes, with

first order change being "ameliorative," with more sustainable transformations emerging from second order change because that order "questions the underlying systems and social structures that proliferates the issue in the first place" (Bishop & Dzidic, 2014, p. 15).

Measurements

The primary objective of the first phases of the pilot was to surface and identify attractors as a precursor to Phase Two. This entailed a qualitative approach to identify the pre-existing and emergent attractors in the landscape. The secondary objective was to identify frame shifts in order to provide an indication of the effectiveness of the A-3B-4C-T probe which also required a qualitative approach. The third objective was to identify potential sites of autopoietic energy, but no attempt was made to measure this because an analytical tool could not be identified.

Analytic Strategies

The secondary objective was interrogated two months after the probe was introduced using a thematic content analysis based on the framework that was adapted from Wals (2007), Table 1. The primary objective of identifying attractors took place 10 months after the probe was introduced. In order to identify the attractors the grounded theory aspect of the Casual Layered Analysis was used. This grounded theory approach is more akin to the constructivist interpretation of Charmaz (2006) than the more widely recognised approach of Glaser and Strauss (2009). The characteristics — or identity — of the attractors were identified by cross referencing the content of the narrative associated with the attractors before refining the analysis through a thematic content analysis (Bishop & Dzidic, 2014). The analysis required coding between and within the different layers so that a rich, intersecting, and contextualised picture of both the identity of the attractor and the type of shifts that are emerging could be developed, Table 2 and 3. The third objective was attempted by cross-referencing the identified attractors with issues that are relevant to reducing the aggregate viral load, Table 4.

RESULTS

The results are presented in the following way: first an overview of the frame shifts are provided followed by the findings of the CLA and finally a comment is made about the findings of the autopoietic potentials is provided.

Short Term Impact of the Educational Probe

Prior to any implementation efforts the respondents were asked about their reactions to the educational probe, Table 1. Within two months of the training, and prior to any implementation attempts, the participants demonstrated that new ideas had emerged from the educational probe and confidence to apply the learning to some areas of their work. This indicated that the probe had influenced a process of deframing and reframing the HIV landscape facilitating

new ways for them to approach their work. This confidence was shared by all participants, with none of them reporting that the training was of no value to them. Comments such as the "cul-de-sac" comment also indicates that "dissonance" about the pre-existing situation was present (Wals, 2007, p. 41).

Table. 1. Frame Shift After the Probe, Prior to any Implementation Attempts.

Context	*Frame*	*Narrative examples (n=44)*
Prior to the training event (frustrations)	Deframing or critical deconstruction of the original construct. (*n*=10)	*I feel like I had reached a cul-de-sac in explanations. With this training, I am going to start afresh and I will enjoy it.*
		I feel like a lot of people out there are still having the half-cooked information we fed then with due to ABC.
About the A-3B-4C-T training (opening opportunity spaces)	Co-creating frames (*n=34)*	*Risk-reduction and social practices: I mean the method does not command you to do this or do that, but offers you other alternatives.*
		Risk-reduction and culture: Using A-3B-4C-T, we are dealing with people within their beliefs and cultural systems. We are guiding them on how to modify their approach. We are not telling them to change completely.
		Risk-reduction, social practices and co-infections: We can also teach them about the importance of washing hands to reduce the chances of co-infections.

Figure 5 represents the emergent attractor landscape that was identified using a grounded theory analysis of the narrative. This representation was later validated by WWS personnel during follow-up discussions. Specifically the overview identifies nine attractor sites of which five contribute to reducing the aggregate viral load; two detract from the ambition and one which is contested; i.e., it both contributes and detracts from the overall ambition. The story-line that constrains the emerging attractors that contribute to reducing the aggregate community viral load is a rational, biomedical scientific narrative, Fig. 6.

Figure 6 provides an overview of the attractor sites that that emerged after the "probe." It is also evident from the findings that the new narrative of rational biomedical science that constrains the WWS narrative is intersecting intersecting with other competing discourses — such as religion, traditional health practitioners and "HIV as a death sentence." Table 3 provides an overview of how the probe is intersecting with all of the layers that futures scientists suggest influence sustainable change.

Autopoietic potentials

The analysis also surfaced some possible links that could be the basis of a sustainable innovation because some of the impacts that contribute to

Table 2. Grounded theory analysis: the dominant attractors twelve months after the "probe."

Identified attractors after the A-3B-4C-T probe	*Influence on the ambition of the project*	*Social practice influence*
Conceptual attractors (concepts)		
HIV as a chronic condition (*n*=28) (emergent attractor)	Contributes to reducing the viral load (*n*=28)	Management of HIV (*n*=9); testing (*n*=8); testing leading to disclosure (*n*=2); disclosure (*n*=3); accepting status (*n*=2); HIV used to be a death sentence (*n*=2); messaging to community (*n*=1); HIV is more manageable than other chronic conditions (*n*=1)
The viral load (*n*=18) (emergent attractor)	Contributes to reducing the viral load (*n*=18)	False negative tests (*n*=5); Window Period (*n*=5); testing (*n*=3); under-standing serodiscordant couples (*n*=2); co-infections (*n*=1); disclo-sure (*n*=1); stigma reduction (*n*=1)
The origins of HIV (*n*=10) (emergent attractor)	Contributes to reducing the viral load (*n*=2)	Transmission (*n*=1); relating to lived experience (*n*=1)
	Unspecified — (*n*=8)	Simple to explain after A-3B-4C-T (*n*=8)
Relationship / personal experience attractors		
Relating the new narrative to prior experiences (*n*=14) (emergent attractor)	Contributes to reducing the viral load (*n*=14)	Testing (*n*= 3); serodiscordant couples (*n*= 3); disclosure (*n*= 2); Window Period (*n*= 2); miscellaneous (*n*= 2); accepting status (*n*= 1); the legacy of ABC (*n*= 1)
Community influence (*n*=20) (pre-existing attractor)	Detracts from reducing the viral load (*n*=20)	Treatment cycle (seeking & compli-ance) (*n*=6); family influence to visit traditional healer (*n*=3); VMMC (*n*=3); stigma / VMMC (*n*=2) & stigma / children (*n*=1); communication between care-givers & children à non-compli-ance (*n*=3); care givers of children stopping ARV medication (*n*=1); religion (*n*=1)
Technical attractors (tools & techniques)		
Tools, techniques and time (*n*=41) (emergent attractor)	Contributes to reducing the viral load (*n*=18)	Empowerment of WWS using the A-3B-4C-T manual (*n*=8); adapting existing tools and techniques to fit the A-3B-4C-T information (*n*=6); empowering the community using the A-3B-4C-T manual (*n*=4)
	Detracts from reducing the viral load (*n*=23)	Adult materials needed (*n*=11) – including demonstration materials for VMMC, female condom & issues

		relating to disclosure; time to explain new information (*n*=8); child material needed (*n*=4)
Conflicting messaging (*n*=16) (emergent attractor)	Contributes to reducing the viral load (*n*=2)	WWS personnel consolidate messaging (*n*=2)
	Detracts from reducing the viral load (*n*= 16)	Clash between (NDoH) information and WWS information (*n*=14); clash between information children receive in public spaces and from WWS (*n*=2)
The emergent constraints (boundaries) underpinning the new WWS narrative: rational biomedical science		
Rationality (biomedical science as a legitimising narrative) (emergent attractor)	Indicators of a new constraint (n=62)	Accepting status (*n*=1); adherence (*n*=1); chronic (*n*=5); clarifying confusions (*n*=8); dissemination of different messages (*n*=4); couples testing, testing & the Window period — including false negative test results (*n*=10); origins (*n*=2); PMTCT (*n*=2); serodiscordant couples (*n*=3); support materials (*n*=9); transmission routes (*n*=4); the viral load (*n*=6) & VMMC (*n*=7).

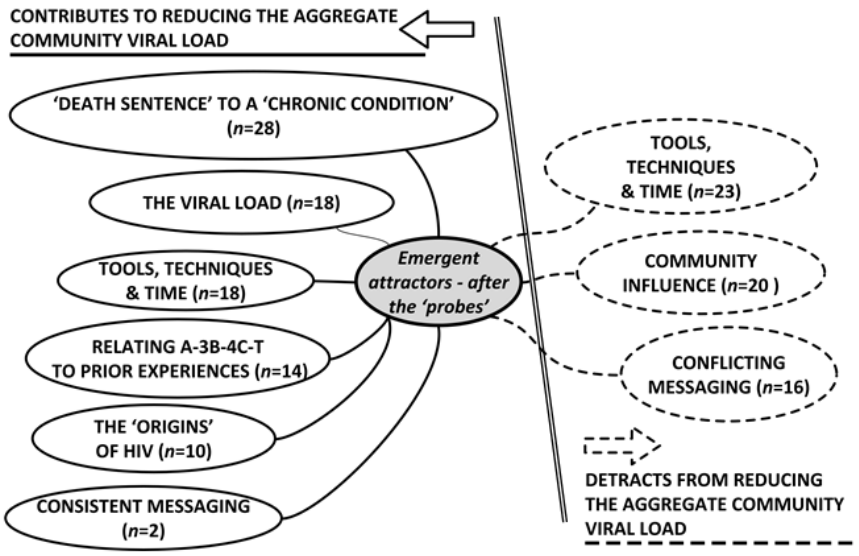

Fig. 5. Attractors as a basis for future action.

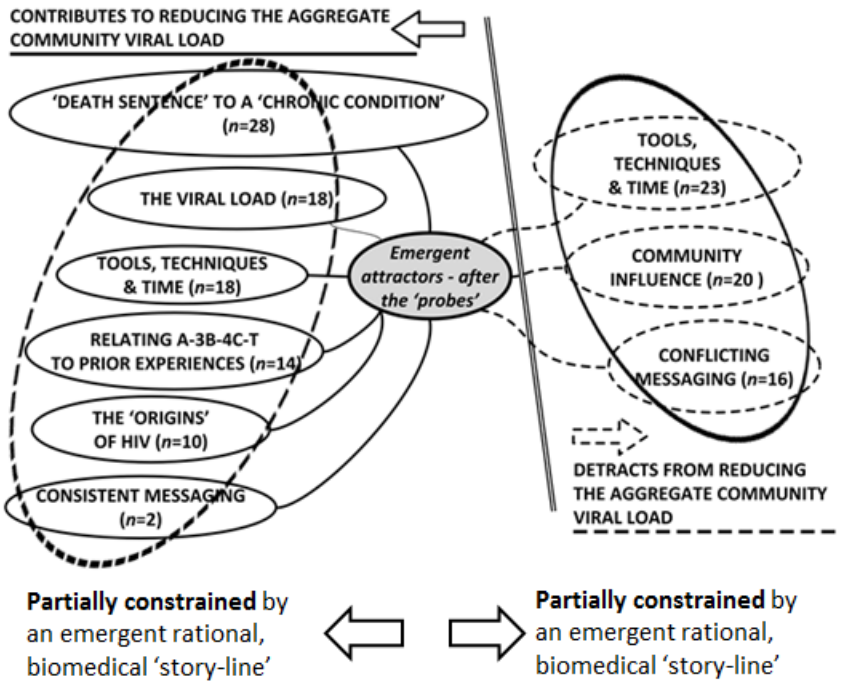

Fig. 6. The emergent attractor sites that the A-3B-4C-T probe elicited amongst WWS community.

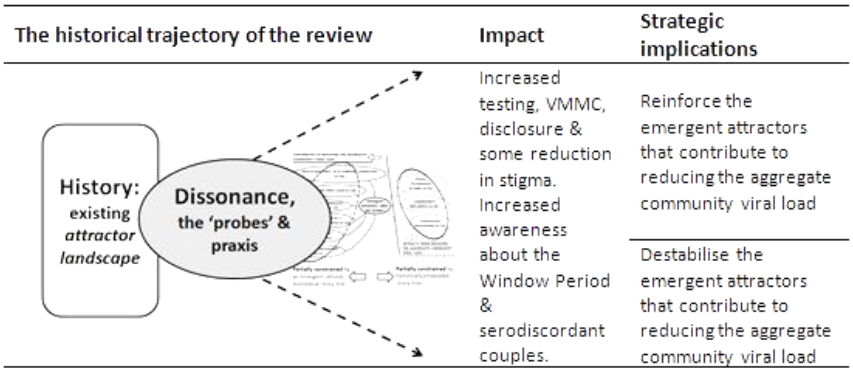

Fig. 7. Overview of the findings.

Table 3. Thematic Content Analysis for the CLA Themes.

CLA layers	*From*	*To*	*To (constraints)*	*Comment*
Litany	A "response mode"	A mission mode	Small scale reach of the project	UNAIDS" argued shift if Vision 90-90-90 is to be achieved
Social causal	Viral load poorly understood	The viral load is now under-stood & can be used as a dissemination tool	Tools, techniques & time to disseminate at scale	WWS personnel identify requirements to improve dissemination
			Consistent messaging	
Worldview	HIV as a death sentence	HIV as a chronic condition	Influence of the community	History is being "re-made," but the new narrative is contested
	The origins of HIV are unknown — or speculated about	Science explains the origins of HIV		
Overlapping boundary — between "worldview" & "myth / metaphor	Prior explanations of death	Relating the new narrative to prior experiences — creating new understandings and "relief"		
Myth / metaphor	HIV not constrained by a medical narrative	HIV constrained by a medical narrative		

reducing the aggregate community viral load are reinforced through a combination of attractors, Table 4.

DISCUSSION

Overview

We have provided three analyses of the findings. The first analysis incorporated a "frame analysis" and the second included the CLA that surfaced the reported changes to the attractor landscape and the impact that the probes have had over the twelve month period with regard to reducing the aggregate community viral load. We also provided a speculative overview of the autopoietic potentials contain within the new landscape to reduce the aggregate viral load in the longer term. Figure 7 provides an overview of the CLA findings from both a practical and strategic perspective.

Table 4. Autopoietic potentials twelve months after the probe.

Surface descriptor / characteristic	*Attractors*				
	Death sentence à chronic	*Viral load*	*Origins*	*Relating to prior experiences*	*Tools & techniques*
Encourages testing (*n*=11); including Window Period (*n*=18)	ü	ü		ü	
Encourages disclosure (*n*=7)	ü	ü		ü	
Accepting status (*n*=3)	ü			ü	
Understanding serodiscordant couples (*n*=5)		ü		ü	
Messaging to community (*n*=11)	ü				ü

The practical impacts include actions and awareness that can contribute to reducing the aggregate community viral load and the strategic impact — identification of the emergent attractors — represents a foundation for the next phases of the pilot.

Data Collection and Analysis

The use of a qualitative methodology at this stage in the pilot was appropriate because attempting to use quantitative evidence could have risked a scenario "where practices, characteristics and attributes are abstracted from context and fixed [prematurely] into place as variables" (Adam, 2011, p. 4). Also, in the early phases of the project design it is was agreed that the timescale was too short to expect any significant quantitative evidence of the efficacy of the "health innovation" impact to emerge (Chaudoir, Dugan, & Barr, 2013).

The "frame analysis" did not add any strategic value to the process and will not be repeated. The "causal layered analysis" technique was found to be a versatile tool for surfacing multiple perspectives of the issues that were influencing the WWS pilot landscape. Whilst the tool was effective, the first attempt at the data collection process using CLA was clumsy, hence unnecessarily time consuming. In future the data collection will be adapted and applied in more concise ways. For example, see Bishop and Dzidic (2014) and Conway, 2012).

Twelve Month Impact at the WWS Pilot Site

Transformative Learning at WWS

The frame analysis demonstrates that "transformative learning" has occurred within WWS and that the educational probe has been imported into their work — hence to the community that have interacted with. This suggests

that WWS personnel are "framing" the HIV landscape differently and are consequently able to ask — and respond to — different questions about the landscape. It is also clear that there was "dissonance" amongst the learners prior to the probe being introduced (Wals, 2007). However, the analysis is — to a certain extent — purely academic, descriptive and restrictive because if the dynamics of the system have altered such that a qualitatively new attractor landscape emerges then, implicitly, there must have been some frame shifts and some transformative learning. It is a restrictive analysis because, as we have argued above, Fig. 3, it is the process, driven by feedback between learning, communication, altered social practices and a shifting landscape that generates change — not learning, *per se*.

The Probes at WWS

The influence of the primary probe, A-3B-4C-T, has been extended into the local community by WWS personnel as "secondary probes." WWS have reported that they have seen increased testing, disclosure, voluntary male medical circumcision and a reduction in stigma. They have also reported that there is more clarity amongst community members about the way in which the viral load helps to explain serodiscordant couples and how the Window Period explains false negative test results. All of these issues are relevant to reducing the aggregate community viral load and the findings indicate that change is happening at both First and Second Order levels, Table 3, suggesting a robust sustainability factor. The emergent discourse that constrains their new approach reflects trust or a belief that well researched biomedical science is a more legitimate basis for managing the HIV landscape than alternative story-lines.

However, frustrations remain which relate to competing, community based story-lines that intersect and destabilise the impact of the biomedical focus that now dominates the WWS personnel's work. The other frustration relates to conflicting story-lines between the DoH and WWS and gaps within the WWS toolkits to disseminate the new biomedical risk-reduction and prevention approach.

The Attractor Landscape at WWS

The attractors that were identified that contribute to the end-condition of reducing the aggregate community viral load after the probe included: "HIV as a death sentence to a chronic condition;" the "viral load;" the "origins of HIV;" "relating new information to personal experience;" "consistent messaging" and the attractors that detract from the ambition include "tools, techniques and time" by WWS personnel, "counter-influences within the community" and "consistent messaging." Feedback from a community meeting in May, 2015, confirmed all of the attractors were "emergent" — with the exception of the "counter-influence" within the community. Feedback also confirmed that that the identified attractors had resonance with WWS personnel

and were focus areas they can imagine working with in the future. Specifically, they suggested that working with the attractors was novel because focusing exclusively on one area — such as testing or disclosure — had been the norm in the past.

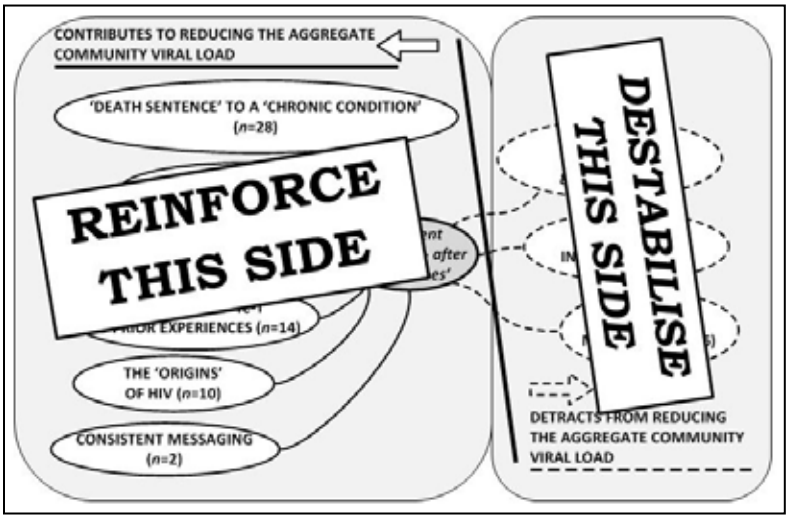

Fig. 8. Working with attractors.

Future Directions for the WWS Pilot Site

The partnership has agreed that there are two future directions that will be pursued. The first is to attempt to replicate the approach without the assistance of the consultants who delivered the primary probe and to streamline the process so that it is more user-friendly and delivered in local languages. The second is to reinforce the attractors that contribute to reducing the aggregate community viral load and to destabilise the attractors that increase the aggregate community viral load using a safe-fail, pattern management strategy, Fig. 8. Both will be monitored and evaluated using a mixed method approach.

Figure 8 represents the planned modification of the attractors. The purpose of this approach is to move the pilot closer to the ambition — or end-condition — of reducing the aggregate viral load using "safe-fail" experimentation techniques (Burman et al., 2015b). The process of reinforcement and destabilisation represents building on the "sufficiency of the present" and then "stimulating the evolution [of] the system" (Kurtz & Snowden, 2006, p. 122). This reflects a management approach in which the leaders of a complex project do not impose "a course of action, [but] patiently allow the path forward to reveal itself. *They need to probe first, then sense, and then respond*" (emphasis added, Snowden & Boone, 2007, p. 72); also see Ahern, Leavy, and Byrne (2014).

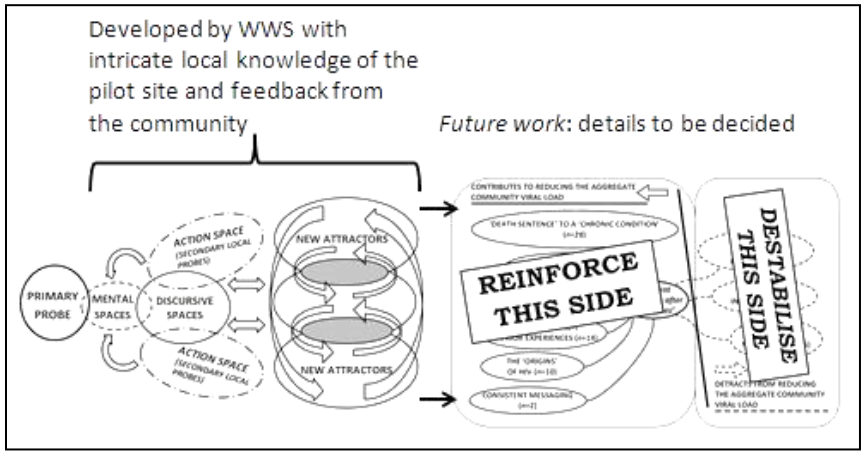

Fig. 9. Home-grown emergence. *Source:* authors' contribution.

Implications for the Development of the Prototype Framework into a Scalable Model

The primary probe — A-3B-4C-T — has influenced the local landscape in multiple, ways. The secondary, WWS initiated, probes are reported to have had impacts that contribute to achieving the end-condition of reducing the aggregate community viral load. The process was self-organising and reflects an approach that enables people in local communities to respond to their epidemic because after the introduction of the primary probe there was no external interference (UNAIDS, 2014b; Wilson & Halperin, 2008), Fig. 9.

Figure 9 represents that an overview of the first phases of the project. It is too early to say whether the framework holds the potential to be applied at scale. However, the pilot has enabled a number of methodological tools and techniques to be adapted to the HIV/AIDS landscape, with the CLA being the most notable. The implications of these tools and techniques will be synthesised when the data collection and analysis has been completed at the other pilot sites. One issue is clear: the notion of a "disruptive innovation" cannot be contained as a standalone "construct," Fig. 2, because it is an ongoing process that underpins the entire framework.

The Role of Facilitators in this Process

This framework requires that the role of the facilitator is to "*change the potential for change*" (emphasis in original, Leeuwis & Aarts, 2011, p. 29) by modifying attractor landscapes that facilitate opportunities that potentially enable the emergence of new social practices. The negotiated process that determines the end-condition is unknown, but an overarching ambition is pre-determined. This type of re-orientation of the role of the facilitator will require

discussions with local change agents so that they modify their existing approaches to fit the new role in the other pilot sites.

Developing a Bio-social Response to the Epidemic

According to UNAIDS (2014b), if the ambition of "ending AIDS" is to be achieved there needs to be a global transition from a "response mode" to a mission mode that entails a rejection of what is currently considered to be "business as usual" that is inclusive of a "new bio-social response" to the epidemic in order to build momentum that could coalesce into a tipping point that can usher in a qualitatively unique era in the history of the HIV/AIDS epidemic. The current focus of this effort in South Africa is to improve the technical delivery of every biomedical opportunity, encourage uptake of medication and to focus extensively on "high risk groups" such as young women, sex workers and men who have sex with men, whilst simultaneously reducing stigma across the board.

However, there is no conceptual framework to surface and work with the patterned, nonlinear dynamics amongst the general population. We suggest that this technical response is not a "mission mode," but rather an accelerated "response mode" because no attempts are being made to develop and implement a qualitatively unique mission mode that focuses on the equilibrium conditions that sustains the current, *generalised* epidemic in South Africa. Without focusing on the equilibrium conditions we reiterate the observation by Coleman et al. (2007, p. 1458) that "neglect[ing] the mechanisms that continually reinstate the [pre-existing equilibrium state] are likely to be futile, resulting only in short-term changes."

At the moment the equilibrium conditions represent a profound risk that Vision 90-90-90 cannot be achieved. Specifically, of the 6 million or so people known to be living with HIV in South Africa, just over 2 million are now accessing antiretroviral medication (Shisana et al., 2014, p. xxviii). Estimates suggest that approximately 25% could be non-complaint or being lost to follow up. That represents about half a million people who are alternating between nonlinear and linear attractors, fuelling the risk of, for example, multiple drug resistance.

If, as Vision 90-90-90 calls for, we extrapolate that out to 90% of HIV positive people accessing medication then we are presented with about 2 million people alternating between nonlinear and linear attractor conditions. Without addressing the discrete dynamics that sustain the movement from strange to point attractors within this population, it is possible that we will experience some very dramatic and potentially detrimental forms of emergence in the next five to fifteen years.

Likewise, the same report indicates that 469,000 people became infected with HIV in 2012 and that knowledge about HIV transmission was reported to be low amongst the majority of the population; "26.8% of South Africans had accurate knowledge about the sexual transmission and prevention

of HIV" (Shisana et al., 2014, p. xxxviii). By combining this with the reported reduction in condom use at last sex between 2008-2012, compared with the previous four years (Shisana et al., 2014, p. xxxiv), it is clear that at the prevention end of the HIV spectrum there is a rogue network that once again negotiates HIV by using linear and nonlinear mechanisms.

Whilst we applaud and support the efforts and resources that the NDoH is providing to achieve the "end of AIDS," we suggest that one major omission in their armamentarium is a focus on identifying and working with the discrete, dynamic, social properties of the epidemic. We not believe it is possible to make a definitive statement about the characteristics of a bio-social response other than to suggest that a bio-social "vortex," in the genre of Sturmberg and Martin (2010), that compliments the biomedical "vortex" that is now being constructed by the NDoH is required. The reason for this is that ignoring the dynamic properties of the social, epidemiological landscape risks an enabling environment that could facilitate the virus "spring[ing] back even stronger" (UNAIDS, 2014a, p. ii).

We also suggest that alongside the construction of the bio-social vortex, another aspect of the required "bio-social response" should involve continual, critical and analytical interrogation of the emergent landscape for nonlinear bio-social opportunities — in the genre of the biomedical antiretroviral "drug cocktail" opportunity (see above, Ramalingham, 2013) — rather than exclusively rely on the conversion of nonlinear landscapes to linear landscapes so that they evolve into a better fit with the architecture of Vision 90-90-90.

Limitations

There are several limitations. The first is that the interviews were restricted to WWS personnel and so all of the findings that refer to the community are based on WWS perceptions of the community responses to the influence to the "probes." The second is that from the outset the intention was to evaluate the framework from an institutional perspective at WWS. This site was the first pilot and it was unknown what the impact of the primary probe would be — so there was logic to not over-stretch the partnership. Now that it is clear that the primary probe has catalysed a diverse response, there is a need to undertake a new pilot with one programme to better understand the process of adaptation and improve the overall monitoring and evaluation of that process. It is planned that this will begin with the outreach department called "Education and Awareness" in 2015.

The third limitation is that no attempts have been made to measure the impact in a quantitative manner. This will be rectified in Phase Two. The fourth is that Table 4, representing potential sites of autopoietic potentials, is more speculative than empirical but remains relevant for our learning because without some form of energising force the shift from the current landscape to a new one is unlikely to be sustainable. During Phase Two this theme will remain a central focus of the enquiry.

The final limitation is that whilst Fig. 9 provides a representation of the local emergence that has dominated the work to date, the weakness within the framework is identifying emergent "attractors" because this relied upon a top-down "expert" to undertake a grounded theory analysis of the narrative data. Despite the partnership agreeing that the attractors do mirror the experiences of WWS personnel, it opens the framework up to external bias which needs to be interrogated in more detail.

Another weakness is that the attractor findings are very localised but this could be countered in the future if software such as the SenseMaker® Collector™ tool — or similar software — is applied so that national or regional landscapes can be mapped (Casella, Magara, Kumasi, Guijt, & van Soest, 2014; GlobalGiving, 2014) so that economies of scale can be achieved. Whilst acknowledging that these limitations do reduce the overall impact of the findings we suggest they are as much "lessons learnt" as they are "limitations."

FUTURE RESEARCH

Immediate Practical Directions

The project design is based upon the assumption that the architecture of the HIV/AIDS epidemic is inherently complex. The emphasis of the prototype framework has been to identify patterns that converge into significant attractors after a probe is parachuted into a community as a mechanism to stimulate new ways of framing the local epidemiological landscape. Future modifications of the attractor landscape are intended to gradually shape future social practices in indeterminate ways — as long as the project end-condition reflects a reduced aggregate community viral load. This will require reducing the number and concentration of nonlinear strange and periodic attractors and increasing the presence of linear attractors.

The first phases of one pilot site have been reported on. The prototype framework — which requires some changes — has stimulated movement towards the end-condition of reducing the aggregate viral load, which included reported increases in voluntary male medical circumcision, disclosure, testing and a reduction in stigma but challenges remain. The next phases include modification of the emergent attractors in a bid to accelerate the process. The overall findings are generally promising and further work at different pilots sites in the Limpopo Province will be reported on in due course.

Longer Term, Strategic Directions: Reducing Rogue Networks

From a purely biomedical perspective, the HIV landscape will remain complex because of the ability of the virus to mutate and the uncertainties that will emerge as millions of people adhere to antiretroviral medication, thus live longer lives and the virus-medication dynamics interact with other chronic conditions (Deeks, Lewin, & Havlir, 2013). From a bio-social perspective, with increasing numbers of people accessing lifesaving medication a new threat to achieving the 2030 vision of "ending AIDS" is emerging. The threat hinges

around consistent adherence to appropriate medication and developing effective prevention strategies that are aligned to the architecture of Vision 90-90-90. With something in the region of 25% of HIV positive people in South Africa being reported to default, or being lost to follow up, (Ellman, 2015), there are both individual level risks and a public health risk because within the rogue network environment the virus could mutate, thus presenting a new dynamic within the epidemiological landscape. Combining this scenario with "increased risky sexual behaviour" (Shisana et al., 2014, p. xiii) that could undermine prevention strategies presents a landscape within which a new bio-social response is required.

To date, both prevention and treatment strategies have been dominated by linear responses, which has effectively influenced the bulk of the affected population. However, from the prevention perspective alone, it is estimated that over one billion dollars was spent promoting the ABC agenda worldwide with variable impacts (Lo et al., 2015). Continuing with linear messaging, or targeting high risks groups, as the key mechanism to destabilise the rogue networks that represent one of the dominant threats that UNAIDS warn could enable the virus to "spring back even stronger" (UNAIDS, 2014a, p. ii) is an anachronistic response. Complimenting these responses with interventions that target the nonlinear dynamics associated with rogue networks at scale holds much promise for contributing to the tipping point that UNAIDS claims is required to "end AIDS."

However, an exclusive focus on modifying nonlinear attractor landscapes into linear landscapes that will — theoretically — be a better fit with the architecture of Vision 90-90-90, hence contribute to the ambition of "ending AIDS," will, logically, reach an inevitable glass ceiling of impact. Future research should therefore focus on identifying, critically understanding and responding to opportunities that can be reinforced within the dynamics associated with the nonlinear rogue networks that organically, at historical junctures, contribute to "ending AIDS" in much the same way that the intersection of the triple antiretroviral cocktail and the "viral dynamics" have done (Ramalingham, 2013). It is a possibility that insights from the self-organising decline of HIV/AIDS prevalence in Zimbabwe (Halperin et al., 2011) and the emergent negotiation of the HIV landscape by gay communities in Australia (Kippax et al., 2013) could inform that process.

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