Anticipatory Care: An action learning project in Tasmanian communities of place and culture

A manual for community project support officers

January 2019
Anticipatory Care: An action learning project in Tasmanian communities of place and culture

Welcome

Welcome to this project and your role in it! Anticipatory care is a fairly new concept in Australia, though there is plenty of it happening. You are a central player in this project. We want to make sure you feel supported, understand the project’s aims and can negotiate your way through its sometimes-complex parts! This document is my attempt to help that happen.

What you will find here

This short document sets out some information about the Anticipatory Care project and your role in it. It is set out so that it can be printed and put into a ring binder (for example), and pages added as the project progresses. And you can add other documents or things of interest as you wish.

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The project

Four Tasmanian communities have been selected to help us understand and enhance anticipatory care. Here is a formal definition of anticipatory care:

Anticipatory care is a population approach to health care that identifies and engages people who are at risk of developing chronic conditions with the aim of preventing or slowing health deterioration.

Anticipatory care is the system of supports and services that enable a person to both look after their own health and get the help they need to be healthy and well. A GP is part of anticipatory care, and so is the community nurse, the local pharmacist, podiatrist and dentist. Importantly, health specialists are only part of anticipatory care. People can be supported to have good health if they know how to cook and the local shop stocks good quality vegetables at a reasonable price. It is more likely that people will use health services if the staff treat them respectfully, there is transport to get to the service, and the cost is affordable. Services like Food Bank, or Eating with Friends can contribute to anticipatory care, as can Driver Mentoring, and mindfulness classes at the neighbourhood house. Anticipatory care is broad and networked. It looks different in different communities.

You can watch “Duncan’s Story” about one way anticipatory care looks, here:

The project, Anticipatory Care: An action learning project in Tasmanian communities of place and culture, wants to find out how anticipatory care looks and works in the communities of Clarence, Launceston’s northern suburbs, Ulverstone, and Flinders Island. In each community, a different sort of organisation is leading the investigation.

The Tasmanian government wants to improve the health of Tasmanians and—in this project—people at risk of chronic illness. The Tasmanian Department of Health (DoH) has received funding from the Australian Government to conduct research to better understand and learn from communities about different ways anticipatory care happens and what works well and why. Between now and the end of 2019, we want to:

- Increase our knowledge and understanding of how anticipatory care occurs in different communities
- Better understand the enablers and barriers to anticipatory care experienced by communities
- Increase our knowledge and understanding about how communities and health services can work together to engage ‘at risk’ Tasmanians in primary and preventative health care, including assessment and management of their health needs.

This project will identify and support models of anticipatory care as an approach to the management and prevention of chronic conditions. It will bring community representatives together, including consumers, service providers and community leaders, to explore and better understand the key health priorities of the community. Community representatives will be involved in identifying actions for new or different approaches to anticipatory care for their community.

It is likely that the anticipatory care projects and activities will be very different in each community. This diversity will help us better understand how anticipatory care occurs or can be improved in different settings and for different communities.

The project is in three phases.

Phase 1 is observation and reflection.
Phase 2 is reflecting and planning
Phase 3 is acting and observing

This is an action learning project. Across all the phases, we will be observing how things are going, what is working and what could be made better, and adjusting our plans and ways of working as needed.

Chronic illnesses are conditions that go on for a long time (3 months or more). They usually cannot be prevented by immunisation or cured. Examples of chronic illnesses are arthritis, cardiovascular disease (heart conditions and stroke), some cancers, diabetes, obesity, and poor oral health.

Several lifestyle factors increase a person’s risk of developing a chronic illness. They include use of tobacco, alcohol or other drugs, lack of physical activity, a poor diet, and poor living conditions. Chronic illness also become more common with age. The ‘social determinants of health’ are important for a person’s likelihood of developing a chronic illness. Where and how people live and their life experiences affect health. The social determinants of health are socioeconomic status, stress, early life, social exclusion, work, unemployment, social support, addiction, food and transport. Some researchers include experiencing racial or sexual discrimination in this list.
**Action learning**

A lot of research follows the process of:

- Identify the ‘problem’ or thing of interest
- Design an intervention
- Test the intervention
- Report what has been found

Typically, the research participants are involved only in the testing part of the process (for example, they might take a medication, or do an activity). In some research, the participants are just observed.

In action learning, or action research, the participants are involved in as many parts of the process as possible. The participants—community members, project officers, university researchers, evaluators—are all learners. They take part in zeroing in on the topic of the project, work together on designing and testing the intervention or alteration, and then get involved in seeing what has been learnt or changed by the project. They also collaborate on how the project’s activities and outcomes are reported. Ideally, they will also be part of keeping the benefits of the project going into the future.

Action learning is a cycle of observation, reflection, planning and action (then observation, reflection, planning, and so on). That means that we check (observation) how things are going, think about what’s working or not working (reflection) and make adjustments (planning and acting) throughout the project.

*The action learning spiral*
The project phases

*Phase 1—Scoping and baseline data: observation and reflection*

- Mapping/data gathering on existing activities across the sites
- Identifying the current role of the lead organisation(s) in these activities
- Who is currently participating? Participant profiles, baseline health information (This will be from lead organisation data and records – e.g. who attends (no names, but gender, age, whatever else we know about them), how many sessions, what they do there)
- What health/wellbeing benefits do participants perceive the activity/s offers to them, their families, their community? (This will be from feedback that is already being gathered by the lead organisation – e.g., participant comments that are recorded, etc.)

*Phase 2—Reflecting on what we know and planning action: reflection and planning*

In Phase 2, we will reflect on what we have mapped, and start identifying potential improvements/enhancements by:

- Engaging community members in identifying what enhancements/improvements could be made that would lead to better health outcomes for participants (e.g., identifying any current barriers to participation; what additional actions could be taken to improve the activity/program)
- Improvements that could be made so that the activity better aligns with the anticipatory care framework e.g. strategies to reach those most in need.

Some of this will take place in community workshops; some will require one-to-one engagement with community members.

*Phase 3—Implementing changes and monitoring their impact: act and observe*

Phase 3 is where the projects are in place and we are seeing how they are going, and tweaking or revising our plans as needed and in consultation:

- Monitoring how the activities and the enhancements align/don’t align with the anticipatory care framework
- Ongoing data gathering—what differences are the changes making for participants, their families, their community?

Observing, reflecting, planning and acting are continuous in the project. During Phase 3, we will probably have another community workshop—to check in with the community as a whole about how things are going. We will also be working with communities to see how best to share what we are learning. At the end of Phase 3, we will report what we have learnt—to communities and to the Department of Health. These two groups will probably want quite different sorts of information.

Because this is an action learning project, it is not linear. It’s an ongoing process of continuous improvement, feedback, review and adjustment of activities. We’ll be trying things, testing if they’re working and, when we need to, trying something different.
The Project Team

This project is a collaboration between your community, the Department of Health, the University of Tasmania’s Institute for the Study of Social Change, The Australian Prevention Partnership Centre (TAPPC), and the Sax Institute. Here are some of the non-community people you will work with.

Flora Dean
Principal Project Officer
flora.dean@health.tas.gov.au
Flora is the Anticipatory Care Project Officer for the Tasmanian Department of Health. She has responsibility for managing the project overall, including contract matters and ensuring that projects are going according to plan. Flora will be work closely with all community partners, can assist with planning for next steps, and will attend local advisory group and other project meetings.

Susan Banks
Senior Research Fellow
susan.banks@utas.edu.au
Susan is the lead researcher in the UTAS team. She is overseeing the mapping of anticipatory care in each community, and working with community project officers to make sense of the how, why, what, and where of anticipatory care. Susan is the person working most closely with project officers in each community. She will provide mentoring and training about research and will be in Community of Practice meetings.

Therese Riley
Evaluation Consultant
Therese is advising the project team about evaluation of the whole project. She will be working with us and her team to run the community workshops. Therese is writing a one-page description of the systems approach to evaluation that her team will be taking. That page will be added to this manual once done.

We’ll add more people to this section as they come on board—project officers, project managers and other members of the research and evaluation teams.
Your role

In each of the four communities, there are people employed by the lead organisation. This role might have different names in different communities: Project Support Officer, Project Researcher, Wellbeing Project Officer, etc. The person in this role will:

- support whatever projects the lead organisation is championing in the Anticipatory Care project, and
- do on-the-ground research to help us understand what AC looks like in that community and what enables or prevents it (barriers).

In Phase 1, the main task is mapping and becoming familiar with the community and the project. This involves finding out all that we can about what AC looks like in the community—including (but not limited to) what role the lead organisation plays in anticipatory care. Susan has been working on this from an outsider’s perspective since the project started. In Phase 1, we also need to find out what key personnel in the organisations can tell us and gather any data the lead organisations have about their own programs. We’d like to know things like what programs exist, who attends, where they’re from, why they come along, what they say about their experiences, and so on.

Your role in Phase 1

Your role in Phase 1 is to engage with the community and be involved in data gathering. The data we want you to collect here is mostly what is called ‘secondary’ data. That is, data that was collected by someone else (e.g., data the NSCC and SPNH collect about how their programs are going). The secondary data we need for our mapping is:

- What programs and services exist (in the lead organisation/s, and more broadly in the community)—
  - This is anything that may be part of, or support a person’s access to, anticipatory care. Take this broadly. It includes any medical, dental or allied health services, as well as the means to get to them (buses, sharing transport, community transport, safe walking routes, facilities for cyclists, etc.), as well as courses, classes, meetings, clinics, information sessions, things like Food Bank, or driver mentoring, yarning circles, therapist services (i.e. physio, occupational therapy, podiatry, etc.), dentists, schools, clubs. Think broadly about things that support people to become or stay healthy (in social as well as medical ways). Susan has prepared a preliminary map of this for each community that you can build on.
- Who attends (this is for things other than medical, dental and allied health services)—
  - We do not want to know (at this stage) about individuals, but about the general picture of attendants. Are they 33% women and 67% men? Are they between the ages of 17 and 25, but mostly 22 year olds? Do they have children, partners, do they support a person with disability, or experience a disability themselves? Do the same people come repeatedly, or often miss sessions? Do they identify with a particular cultural, ethnic or religious group? Where are they from (which part of the community – geographically)?
- Who is missing—
As you scan, think about (and note down) any groups who seem to not be involved or connected. We hope to engage with the ‘missing’ or the ‘unusual suspects’ during this project.

- Why they come along (and how they got there, known)—
  - Sometimes, data is gathered about people’s reasons for attending. That is useful information.

- What they say about their experiences—
  - Any evaluation or feedback from people about their experiences in the service, or course, or session (etc.) is GOLD.

You can record this information in a spreadsheet, or table, or Word document – whatever works that will enable us to ‘see’ what anticipatory care looks like. Please use these five questions (the dot points above) to guide you. If there are other questions you think are relevant, please talk to Susan about them. Our monthly meetings with all the project officers is also a place to talk about new ideas.

In Phase 1, Susan will also be gathering ‘primary’ data by interviewing key personnel in each community (that is, the manager or head of the lead organisation and key personnel, members of the Local Advisory Group and the project support officers). Gathering any primary data requires ethical approval; Susan has approval to conduct interviews and focus groups in the project’s first ethics application.

Towards the end of Phase 1, we hope that project officers will start to gather primary data as well. To make this possible, during Phase 1 (as early as possible), Susan and the UTAS team will submit an amendment to ethics committee, adding you to the research team. Once approved, this will enable you to gather primary data.

There is one sort of primary data that you can collect from day 1: your reflections on what you know and think about anticipatory care in your community. You will need to keep a reflective diary in some form. There is a section about the reflection process at the end of this manual.

In Phase 1, we will also be observing how your community works and reflecting on how we might be able to get them involved in sharing their experiences and knowledge about anticipatory care in your community. The aim is to understand people’s sense of how the things they are involved in, or the services that exist in the community (and of course their own networks), affect their health and wellbeing. This is our first opportunity to get creative with hearing, gathering and recording the stories of anticipatory care. Your on-the-ground knowledge and experience makes you the best people to inform this. The ideas you develop here will help us decide how to work for the remainder of the project, gathering people’s stories of/experiences of anticipatory care. This includes, of course, their experiences of any specific program or activity your community might focus on during the anticipatory care project.

Once all the project officers are on board from our four communities, we will be ‘meeting’ monthly to share ideas and experiences. You can email or call Susan with questions, as needed (office hours).
Your role in Phase 2

Your role in Phase 2 is to help the project team share what we’ve learned so far, and gather responses. Mapping also continues in Phase 2.

This section of the manual will be written during Phase 1.
Your role in Phase 3

This section of the manual will be written during Phase 2.
What is the systems approach to evaluation?

A systems approach is about seeing the bigger picture. It does this by paying attention to how parts of the system interact with each other and this can explain why things are the way they are. A systems approach comes with tools and methods and a perspective called ‘systems thinking’.

Three ideas are central to systems thinking: perspectives, boundaries and interrelationships. Perspectives recognize that how we ‘see things’ is only one perspective on a problem and there are many more. Boundaries encourage us to ask who or what is included in our understanding of the problem. Who is missing and why? Interrelationships ask us to always pay attention to the connections between things. Changing these connections can create powerful system change.

### Hypothetical example

**The problem:** Local health advocates are concerned that many young mothers are bottle-feeding rather than breastfeeding their newborn babies. The World Health Organization recommends exclusive breastfeeding for the first 6 months after birth.

**Business-as-usual approach:** Taking their usual approach, the health advocates decided to give the mothers health education material and point out the benefits of breastfeeding and the downside of bottle-feeding. They believe the problem is a lack of health information. If the mothers knew the benefits of breastfeeding they would change their behaviour.

**Systems approach:** Alternatively, the health advocates could have taken a systems approach. This would encourage them to step back and consider what else might be going on. Using systems thinking the health advocates may seek multiple views or perspectives on the issue (from mothers, work places, community members, family). They could ask:

- **About boundaries**—What parts of the system are important? What are the boundaries that define them?
- **About interrelationships**—How do the parts—such as norms and beliefs about breastfeeding and motherhood, environmental conditions and so on—interact?

And they would try to understand what opportunities for change have been revealed.

In doing so, the health advocates may begin to understand the challenges young working mothers face when trying to breastfeed at home and express milk at work, with few breaks and no fridge. They may come to discover that beliefs about motherhood prevent changes to work place practices and so young working mothers stop breastfeeding. The health advocates now have a deeper understanding of the problem.

In the Box example, the systems approach has redefined the problem. It is no longer only an issue of the health literacy of mothers. They draw in multiple perspectives on the issue, extend the boundary of the problem beyond the clinical encounter and seek to understand the connections between factors affecting the issue. This revealed a systemic problem—that work places are not supportive to breastfeeding because some people believe that new mothers should be at home with their baby. That means it is

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difficult for young working mothers to breastfeed newborn babies. This insight and learning opens up a different set of opportunities to intervene to improve breastfeeding rates.

Systems thinking can help us better understand complex problems;\(^2\) where boundaries are unclear and solutions are either too simple (and often unlikely to work) or the course of action is not clear. Chronic disease prevention is a complex problem unlikely to be solved by a single solution.

**Why give systems thinking a go?**

Rates of chronic disease are on the rise. In Australia, chronic disease accounts for nine out of ten deaths.\(^3\) Diabetes is the fastest growing chronic condition in Australia. Many public health researchers, policy makers and practitioners lament the lack of progress in reducing rates of chronic disease. Some believe it’s because we are blinkered in how we understand the complexity of these problems. We tend to only focus on individual behaviour and fail to see the complexity of people’s lives that influence the decisions they make about their health.

Systems thinking offer a different way to think about problems and potential solutions. There are also some promising studies showing the benefits of taking a systems approach. In one study, the authors reviewed type 2 diabetes programs and found that those that applied complexity (or systems thinking) principles in their design such as interconnectedness, were associated with better outcomes for patients. That paper is attached.

**What does a systems approach mean for the AC project?**

The Anticipatory care projects take the local AC system (rather than an individual) as its starting point. Research is currently underway to surface local practices and identify important parts of the system such as the AC workforce or the range of programs and initiatives currently being implemented. It will surface new and missing perspectives on anticipatory care and elevate local knowledge to create a more comprehensive picture of the system. It will extend traditional “health service” boundaries to include community infrastructure such as community houses, schools and social services. A more comprehensive picture of the AC system will also surface new and unexpected opportunities to intervene to strengthen relationships, draw new players into the system, modify practices to be more inclusive and so on.

Along with systems thinking, various tools and methods will be applied to the AC project such as systems mapping. But most importantly, it is built on the premise that knowledge about the local AC system can only be created from within the local AC system and this is where the most relevant and potentially long-lasting solutions will emerge.

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Keeping a reflective diary

From your first week, we want you to keep a reflective diary. This can be on paper, in an electronic document, or even an audio or video diary; do what works for you to keep a record. The reflective diary has three main functions.

Firstly, it can help you to think about what you are bringing to the project, how you understand it, and how things are going—in the role, in the project, in the community. Reflecting can make it easier to see if you want to adjust or ask about anything. As the project goes on, you will also be able to see how your thinking changes, or what skills or ways of working you are adding to your skill set.

Secondly, when the project officers from each community get together, we will be reflecting together on what is being learned, what is changing, what is working and what is not. Project officers can share things that went well, ways of working, how they resolved difficulties, and so on.

Finally, the research team wants to understand what the experience of being a project officer is like. We will interview the project officers a few times during the project, and the diaries will be useful memory-joggers or stores of information you can share. Please complete the diary at least once a week; it can also be useful to make entries after any meeting, or data gathering, or project activity session.

For the first week in the role, please just respond to questions 1, 2, 6 and 7.

Project officers’ reflection guide

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<td>2. How am I working in ways that contribute to Anticipatory Care already?</td>
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<td>3. What are my strengths in providing or supporting Anticipatory Care in this community?</td>
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<td>Opportunities</td>
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<td>Barriers</td>
<td>5. What are emerging barriers? How can we navigate them?</td>
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<td>Learning</td>
<td>6. What major ‘ah ha’ moments did you/research team/community experience this period?</td>
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<td>Success</td>
<td>7. What would success look like right now at this stage of the project?</td>
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<td>8. What would success look like at the end of the project?</td>
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Some new sections will be added to the diary as we move into Phases 2 and 3.
Research papers of interest
Organizational interventions employing principles of complexity science have improved outcomes for patients with Type II diabetes

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Abstract

Background: Despite the development of several models of care delivery for patients with chronic illness, consistent improvements in outcomes have not been achieved. These inconsistent results may be less related to the content of the models themselves, but to their underlying conceptualization of clinical settings as linear, predictable systems. The science of complex adaptive systems (CAS) suggests that clinical settings are non-linear, and increasingly has been used as a framework for describing and understanding clinical systems. The purpose of this study is to broaden the conceptualization by examining the relationship between interventions that leverage CAS characteristics in intervention design and implementation, and effectiveness of reported outcomes for patients with Type II diabetes.

Methods: We conducted a systematic review of the literature on organizational interventions to improve care of Type II diabetes. For each study we recorded measured process and clinical outcomes of diabetic patients. Two independent reviewers gave each study a score that reflected whether organizational interventions reflected one or more characteristics of a complex adaptive system. The effectiveness of the intervention was assessed by standardizing the scoring of the results of each study as 0 (no effect), 0.5 (mixed effect), or 1.0 (effective).

Results: Out of 157 potentially eligible studies, 32 met our eligibility criteria. Most studies were felt to utilize at least one CAS characteristic in their intervention designs, and ninety-one percent were scored as either “mixed effect” or “effective.” The number of CAS characteristics present in each intervention was associated with effectiveness (p = 0.002). Two individual CAS characteristics were associated with effectiveness: interconnections between participants and co-evolution.

Conclusion: The significant association between CAS characteristics and effectiveness of reported outcomes for patients with Type II diabetes suggests that complexity science may provide an effective framework for designing and implementing interventions that lead to improved patient outcomes.
Background
Although the cost of managing patients with chronic disease is high and is predicted to rise to 60% of US healthcare dollars by 2020 [1], identification of effective ways to improve care of patients with chronic disease has been difficult. While the evidence base regarding optimal medical management of these patients has grown, our ability to implement evidence into routine clinical practice across diverse clinical settings has been limited. A recent study of chronically ill patients revealed poor provider adherence to guideline recommendations [2]. Attempts to improve outcomes through use of practice guidelines, quality improvement, or system improvement have not led to consistently positive effects on process of care measures or outcomes, and have been disappointing [3-5]. Organizational barriers, such as inadequate staff or support structure, are typically cited as a hurdle to guideline implementation [5].

To facilitate implementation, several models for delivery of care for patients with chronic disease have emerged. These include the "self-management" and "collaborative management" models, the "chronic care model," and the "disease management" approach [6-9]. Recent systematic reviews of organizational intervention studies based on the self-management, chronic care, and disease management models reveal small to moderate effects on process or outcome measures [6,10-13]. These results suggest that it may not be the content of the models, but rather, it may be that the specific way in which they are applied in organizations is critical.

One possible reason for the modest effects of organizational intervention outcomes is suggested by the recent application of complex adaptive system (CAS) theory to the organization of healthcare delivery [14-17]. A CAS is characterized by individuals who can learn, interconnect, self-organize, and co-evolve with their environment in non-linear dynamic ways [18,19]. These factors lead to patterns of relationships and interconnections in the system that influence performance of the system. Like musicians in an improvisational jazz band, individuals in a CAS learn from and react to each other and their environment, leading to constant shifts in the pattern of relationships or the interpretation of the music. The natural tendency of individuals to learn, form patterns of relationships, organize and evolve suggests that interventions that suppress these activities will lead to poorer outcomes than those that facilitate them.

CAS theory has been used to describe clinical settings, such as primary care clinics [15]. However, it also has implications for how we approach changing clinical systems [16,20], but the implementation literature is less developed than the descriptive literature. Using CAS theory as a framework to assist us in designing and implementing organizational interventions could potentially make these interventions more likely to achieve their aims.

Complexity science suggests that inconsistent outcomes may result from an implicit assumption of linear, mechanistic relationships between cause and effect in implementing organizational interventions. This linear viewpoint implies that a specific intervention should lead to consistent, reproducible results across clinical settings. In contrast, nonlinearity, self-organization, and co-evolution suggest that each clinical setting is unique, and that outcomes of interventions may be greatly affected by small situational differences [18,19]. For example, clinical reminders may be very effective in prompting providers in one setting to perform recommended care, but may not be as effective in another because of very small differences in the settings (i.e., differences in the workflow of test ordering, ease of access of recommended care, patient population served, or provider beliefs).

The goal of this study is to build on the current literature related to using CAS to observe and understand clinical settings, to begin to examine the extent to which CAS theory is useful as a tool for designing and/or implementing organizational interventions. We hypothesize that interventions that leverage the characteristics of complex adaptive systems, intentionally or not, and regardless of the particular model of chronic care delivery on which the intervention was based, will consistently lead to improved outcomes over those that do not. To test this hypothesis, we conducted a systematic review of organizational interventions for patients with Type II diabetes and examined these interventions through the lens of complexity science.

Methods
Search strategy
We defined organizational interventions as those that explicitly attempt to affect or change organizational structures or processes to implement evidence-based practice. We searched Medline from 1989 through 29 December 2005, after developing a search strategy based on four components: (1) the strategy developed by the Effective Practice and Organization of Care (EPOC) Group of the Cochrane Collaboration and updated for a recent systematic review of Medicare-funded preventive services [21,22]; (2) additional search terms for types of organizational interventions not included in the EPOC search strategy, such as total quality improvement, PDCA (Plan-Do-Study-Act), and practice redesign; (3) additional search terms used by a recent systematic review of preventive and quality improvement strategies [23]; and (4) bibliographies and Medline indexing terms of relevant
publications on organizational change and guideline implementation. To focus the search on diabetes, we added disease-specific MeSH and text word terms, ran a preliminary search, and reviewed 200 titles and abstracts (determined by saturation, until no further new terms were identified) for additional text word terms. The search terms are available in Additional File 1. We did not search the management literature, nor did we seek out unpublished data.

Inclusion and exclusion criteria
Inclusion criteria were randomized, quasi-randomized, or controlled clinical trials published in English and conducted in economically developed countries as identified by the International Monetary Fund or the Organization for Economic Cooperation and Development [24]. We excluded non-English articles because non-English studies comprise only 1% of the EPOC registry. We excluded studies reporting only the following nonclinical outcomes: patient or provider knowledge, self-efficacy satisfaction; or other attitudes and beliefs. We also excluded studies of Type 1 or gestational diabetes; patients < 18 years old or patients younger and older than 18 but not reporting results separately for adult work site health interventions: exercise rehabilitation or smoking cessation; and disease prevention or screening only.

Four investigators independently reviewed overlapping groups of differing halves of the citations’ titles and abstracts generated by the full literature search to assess agreement regarding potentially eligible publications. Raw agreement was 94%. If eligibility was uncertain after review of the title and abstract, the full article was reviewed. Eligible studies were independently reviewed and jointly abstracted in detail by teams of two investigators. Disagreements were resolved by consensus of the group of investigators.

Assessment of leveraging of characteristics of CAS
Eligible publications were independently evaluated by two rates with content expertise in complexity science to assess the extent to which the intervention utilized any of the following characteristics of a CAS: individual capability to learn, the interconnections between individuals, the ability of participants to self-organize and the tendency of participants to co-evolve. These are representative of critical elements of CAS [18,19]. The definition of each characteristic used by reviewers is shown in Table 1. Each study was given a point for each of the characteristics present in the study design. A possible lowest score of zero and highest score of four. Table 2 gives specific examples of interventions that met criteria for each score, with the characteristics they were felt to reflect. The rates were blinded to the outcomes of the studies. The kappa for these scores between reviewers was 0.78, with conflicts subsequently resolved by discussion.

Assessment of reported outcomes
Because of the heterogeneity across study outcomes, we did not use effect size as the outcome variable. The most commonly used outcome was change in hemoglobin A1c, but this was used in only 14 studies of variable duration. Four of which contained unit of allocation error, or mismatch between the unit of randomization and unit of analysis. Additionally, some studies compared change in hemoglobin A1c with baseline values, rather than with controls. To overcome this, a rating scale was used to assess the efficacy of the intervention. The outcomes of each study were assessed by two independent raters on a scale of 0 (no effect), 0.5 (mixed results), and 1 (intervention effective) based on the type (process versus outcome), number, and statistical significance of outcomes reported. The specific criteria used for each rating, along with specific examples of the reported outcomes for each rating, are shown in Table 3. Raters were blinded to study interventions, and one was different from the intervention raters. The kappa for these scores was 0.79, with conflicts resolved by discussion.

Statistical analysis
Because of the small number of studies identified, we used Fisher’s exact test to test the significance of the relationship between total number of characteristics of complex adaptive systems being leveraged by an organizational intervention and the strength of outcomes reported, as well as between each individual characteristic and the strength of outcomes. Because a mismatch between the unit of allocation and analysis may bias a study toward positive results, we divided studies into two groups based on whether a unit of analysis error was present. A second analysis using Fisher’s exact test was performed including only those studies that did not contain a unit of analysis error. Finally, a third analysis using logistic regression was performed to weight studies based on both sample size and duration of intervention. All statistical analyses were performed using Stata 8.0 (College Station, Texas).
Table 2: Examples of interventions utilizing characteristics of complex adaptive systems

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Characteristics Present</th>
<th>Score Given</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-page reminder of BP goals, put on the front of the charts of all diabetics</td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Educational materials (articles, videos) sent to physicians at defined times</td>
<td>Learning</td>
<td>1</td>
</tr>
<tr>
<td>Decision - support system generated treatment recommendations based on</td>
<td>Interconnections Co-evolution</td>
<td>2</td>
</tr>
<tr>
<td>current treatments and level of control. Patients seen monthly and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>review conducted at one visit every 1-2 years. Emphasis on education, but</td>
<td>Learning Interconnections</td>
<td>3</td>
</tr>
<tr>
<td>tailored to progress of individual patients.</td>
<td>Co-evolution</td>
<td></td>
</tr>
<tr>
<td>Usual visits replaced with group visits led by a physician and diabetes</td>
<td>Learning Interconnections</td>
<td>4</td>
</tr>
<tr>
<td>nurse educator, who were allowed to tailor the meeting frequency and content</td>
<td>Self-Organization Co-evolution</td>
<td></td>
</tr>
<tr>
<td>to the needs of the group. The goal of these visits was to improve compliance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results
The search identified 5,590 publications: 157 were potentially eligible for review of title and abstract. After full review of these published studies, 32 met our eligibility criteria [27-50]. Figure 1 details the numbers of articles eligible and ineligible at each stage. The interventions, outcomes, duration of intervention, presence of unit of allocation error, and extent to which interventions used characteristics of complex adaptive systems are summarized in Additional File 2. Half of studies reported significant improvement in most or all outcomes. Ten studies were felt to utilize self-organization: co-evolution was a component in twenty-four, learning in twenty-seven, and interconnections in thirty. Interventions that involved learning typically took the form of distribution of educational materials: interconnections were changed frequently through the addition of case managers or care coordinators. Relatively few (eight) allowed participants to self-organize.

The distribution of characteristics of complex adaptive systems utilized by a study intervention and the intervention efficacy for all studies is shown in Table 4. Only 50% of studies demonstrated effective results as reflected by a score of 1. All studies with an effectiveness score of 1 reported interventions whose CAS characteristic scores were at least 3, while the studies with lower effectiveness had lower CAS characteristic scores. The association between the number of CAS characteristics and effectiveness was statistically significant (p = 0.002). Analysis using logistic regression adjusting for sample size and duration of intervention remained significant. Nine studies had level of analysis error: most commonly because the unit of randomization was a clinic or physician, while the unit of analysis was the patient. The association between CAS characteristic scores and outcome effectiveness was also statistically significant when these nine studies were excluded (p = 0.004).

Of the four CAS characteristics assessed for each intervention, two were individually significantly associated with effectiveness. Interventions that affected interconnections in the organization or allowed participants to co-evolve were significantly associated with intervention effectiveness (p = 0.03 and 0.001, respectively). When studies with unit of analysis error were excluded, these associations remained significant (p = 0.05 and 0.003). The associations between interventions affecting participants’ ability to learn or self-organize were not statistically significant (p = 0.06 and 0.58).

Discussion
Consistent with prior literature, this systematic review found that many studies of organizational interventions

Table 3: Criteria used to classify outcomes of studies with organizational interventions

<table>
<thead>
<tr>
<th>Outcome Score</th>
<th>Criteria</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No differences between control and intervention groups, or</td>
<td>No differences in rate of medication changes between groups</td>
</tr>
<tr>
<td></td>
<td>between intervention and baseline, on process or outcome</td>
<td></td>
</tr>
<tr>
<td></td>
<td>measures</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>Trends without significance Mixed outcomes; significant</td>
<td>Significant improvement in HbA1c at 6 and 12 months</td>
</tr>
<tr>
<td></td>
<td>improvement in majority of measures; significant improvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>compared with baseline, but not with control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Significant improvements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- All outcomes of ≥ 2 endpoints</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Majority of outcomes of ≥ 2 endpoints</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Significant improvement in number of patients at A1c goal;</td>
<td>Significant improvement in number of patients at A1c goal, significant</td>
</tr>
<tr>
<td></td>
<td>significant decrease in hospitalizations and emergency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>department visits</td>
<td></td>
</tr>
</tbody>
</table>
do not improve process or outcome measures for patients with the chronic illness diabetes [3-5]. Only 50% of randomized or controlled clinical trials meeting criteria for this systematic review demonstrated significant improvement in most or all endpoints. In support of our hypothesis that implementation strategies consistent with CAS theory will be more likely to be effective, we found a significant relationship between the number of CAS characteristics utilized in an intervention and the intervention’s effectiveness in improving process or outcome measures in patients with Type II diabetes. This was true in studies conducted across a diversity of clinical settings and reported outcomes. This finding potentially widens the scope of the application of CAS theory beyond the current literature that focuses on describing clinical settings as CAS [14,15], to build upon the idea that we can use CAS to both design and implement interventions [16,20] that are more likely to lead to improved performance.

Table 4: Distribution of CAS and effectiveness of interventions

<table>
<thead>
<tr>
<th>Total CAS Score</th>
<th>Rating of Intervention</th>
<th>Total No. Studies at each CAS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total No. Studies as each Level of Effectiveness</td>
<td>3</td>
<td>12</td>
</tr>
</tbody>
</table>

p = 0.002

Specifically, the finding that interventions incorporating features of CAS were more effective suggests that a dynamic approach to the design of organizational interventions to improve patient outcomes may be helpful. Rather than designing one-size-fits-all interventions that require adherence to a rigid, pre-set course of action, allowing participants to have input and control that reflect their local environment, as well as allowing them to adapt or deviate from a set plan as results evolve, may lead to more effective change. In short, we suggest that thinking about the intervention as a participatory, adaptive process rather than a set blueprint will lead to more effective interventions. These approaches currently exist, one example includes the Institute for Healthcare Improvement’s Framework for Spread [57]. However, our finding that less than one-third of studies identified in our search allowed for self-organization suggests that their use is far from universal.

Two individual characteristics co-evolution (ability of participants to modify practices based on forces internal and external to the clinical setting) and interconnections (changing the pattern of communication between participants) had the strongest relationship with intervention effect. It is difficult to interpret the lack of a relationship between other individual characteristics and strength of outcomes, as the number of studies included in this analysis was small, particularly after those with level of analysis error were excluded. However, the significant association between the overall number of characteristics of CAS and the intervention effectiveness, in the absence of a clear association for all individual characteristics, could imply that combinations of characteristics are more effective, i.e., the interventions should consider the holistic nature of practices. The number of studies was too small to allow for this analysis.

The association between interventions that influenced the interconnections between participants and intervention effectiveness may suggest that interventions that focus on the quality and pattern of relationships between participants in a clinical setting may be superior to those that focus on trying to change the behavior of a single participant. What sets this apart from other theories of organizational change is the scope of this approach to allow consideration of multiple aspects of the clinical setting, and the nonlinearity of the relationships between them. This inherent nonlinearity implies that inputs and outputs are unlikely to be proportional, particularly across clinical settings and over time, and suggests the need for the following specific approaches: involvement of more than one type of participant in both intervention design and implementation, use of more than one method of connecting agents in an organization, and continual reassessment of the effect of an intervention coupled with a
willingness to make changes based on this reassessment. In fact, this may explain why multifaceted organizational interventions may be more effective than those with a focus on a single strategy [58].

Several other limitations besides the small sample size deserve mention. All of the studies included were related only to the chronic care of diabetic patients. Confirmation of these findings for patients with other chronic diseases is necessary. In addition, while we were able to address the potential bias inherent in studies with unit of allocation error, publication bias (e.g., positive studies being more likely to be published), or the possibility that studies with negative outcomes did not provide sufficient detail regarding interventions, could potentially impact these results. However, regarding the later potential bias, the rater consistency on characteristics ratings indicates that reported methods were sufficient to reliably assess the interventions. We did not identify studies in the management literature or seek out unpublished information or “grey literature.” Our intention was to focus on studies in the peer-reviewed medical literature as the most simple, direct, and universally accepted approach to studying whether an association between interventions with feature that reflect CAS and outcome effectiveness exists. If this association had not been found, our next step might have been to identify these additional sources.

The methodology of assigning scores retrospectively to both characteristics and outcomes is also potentially a limitation. Categorization based on a relatively small amount of data can be difficult, but we believe that the methods sections of the included studies contained enough information to give the reader at least a basic overview of all intervention components and thus a reliable assessment of utilization of CAS characteristics. It may also seem counterintuitive to apply a lens of nonlinearity to interventions conducted in the context of traditional randomized, quasi randomized, or controlled clinical trials, and in fact it is near impossible to assess nonlinearity itself in the context of the format of a published intervention study. However, we do believe that enough information was present to make a determination of whether key characteristics of CAS were present in the intervention, and our inter-rater reliability supports this. We also believe that the characteristics of learning, interconnections, self-organization and co-evolution are the key concepts that are representative of CAS and its implications [18,19]; therefore, we do not believe it likely that other CAS experts would identify important elements whose basic meaning is not encompassed in these characteristics. It is possible that because all investigators come from a single institution or “school” of complexity, that the interpretation of a different group of investigators could be different, but we believe that because we focused on the key characteristics of CAS whose definitions are relatively well-established, this is less likely to have occurred.

Finally, CAS characteristics may be inherent parts of several care delivery models; this is particularly true of learning and interconnections between individuals. However, the underlying CAS assumption of nonlinearity differentiates this perspective in a fundamental way. While these results may be regarded as preliminary, they point to the use of complexity science as a framework for thinking about clinical settings that may allow us to better understand the inconsistencies in the health care organizational literature and to better design interventions that will lead to the greatest improvement in outcomes for our patients.

Conclusion

Improved outcomes in Type II diabetes were significantly associated with organizational interventions that had characteristics of complex adaptive systems in their design. These interventions incorporating a greater number of characteristics demonstrated the greatest improvement in diabetes related outcomes. We observed a greater effect for interventions that promoted interconnections between, and co-evolution of, individuals.

These data may allow us to expand the framework of CAS from conceptualizing and studying clinical systems to encompass designing and implementing interventions that lead to improved patient outcomes. Specifically, interventions and implementation strategies that target multiple CAS characteristics may be most effective in improving health outcomes. Further research should address how best to translate the theoretical constructs of complex adaptive systems into interventions that improve the outcomes of chronically ill patients.

Competing interests

The author(s) declare that they have no competing interests.

Authors’ contributions

LKL conceived this analysis using the database conceived by VL, PN, and JP, rated studies, performed preliminary statistical analysis, and drafted the manuscript. JP participated in the design of the study and helped to draft the manuscript. VL conceived the systematic review and database, rated studies, and helped to draft the manuscript. MP rated studies and helped to draft the manuscript. PN conceived the systematic review and database and helped to draft the manuscript. IC performed statistical analysis and helped to draft the manuscript. RMtD participated in the design of the study, provided theoretical expertise, and helped to draft the manuscript.
All authors have read and approved the final manuscript.

Additional material

Additional file 1
Search strategy for organisational interventions to improve outcomes of patients with Type 1 diabetes. The search strategy is identical to studies included in systematic reviews, as described in Leivestad, et al. Organisational interventions employing principles of complexity science have improved outcomes for patients with Type 1 diabetes. Search completed December 2005. Click here for file: [http://www.trombonetmul.com/content/supplementary/1745-6262-3-28-s1.doc](http://www.trombonetmul.com/content/supplementary/1745-6262-3-28-s1.doc)

Additional file 2
Summary of included studies. Summary of eligible studies of organisational interventions on outcomes of patients with type 2 diabetes, as described in Leivestad, et al. Organisational interventions employing principles of complexity science have improved outcomes for patients with Type 2 diabetes. Search completed December 2005. Click here for file: [http://www.trombonetmul.com/content/supplementary/1745-6262-3-28-s2.doc](http://www.trombonetmul.com/content/supplementary/1745-6262-3-28-s2.doc)

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