

Implementation research design: integrating participatory action research into randomized controlled trials

Luci K Leykum*^{1,2}, Jacqueline A Pugh^{1,2}, Holly J Lanham⁴, Joel Harmon³ and Reuben R McDaniel Jr⁴

Address: ¹VERDICT, a VA HSR&D REAP at the South Texas Veterans Health Care System, San Antonio, Texas, USA, ²Department of Medicine, School of Medicine, University of Texas Health Science Center at San Antonio, San Antonio, Texas, USA, ³School of Business, Fairleigh Dickinson University, Madison, New Jersey, USA and ⁴Department of Information, Risk and Operations Management, McCombs School of Business, The University of Texas at Austin, Austin, Texas, USA

Email: Luci K Leykum* - Leykum@uthscsa.edu; Jacqueline A Pugh - jacque.pugh@gmail.com; Holly J Lanham - Holly.Lanham@phd.mcombs.utexas.edu; Joel Harmon - harmon@fd.edu; Reuben R McDaniel - reuben.mcdaniel@mcombs.utexas.edu

* Corresponding author

Published: 23 October 2009

Received: 10 July 2007

Implementation Science 2009, 4:69 doi:10.1186/1748-5908-4-69

Accepted: 23 October 2009

This article is available from: <http://www.implementationscience.com/content/4/1/69>

© 2009 Leykum et al; licensee BioMed Central Ltd.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

Background: A gap continues to exist between what is known to be effective and what is actually delivered in the usual course of medical care. The goal of implementation research is to reduce this gap. However, a tension exists between the need to obtain generalizable knowledge through implementation trials, and the inherent differences between healthcare organizations that make standard interventional approaches less likely to succeed. The purpose of this paper is to explore the integration of participatory action research and randomized controlled trial (RCT) study designs to suggest a new approach for studying interventions in healthcare settings.

Discussion: We summarize key elements of participatory action research, with particular attention to its collaborative, reflective approach. Elements of participatory action research and RCT study designs are discussed and contrasted, with a complex adaptive systems approach used to frame their integration.

Summary: The integration of participatory action research and RCT design results in a new approach that reflects not only the complex nature of healthcare organizations, but also the need to obtain generalizable knowledge regarding the implementation process.

Background

A gap exists between what is known to be effective and what is actually delivered in the course of usual medical care in international health systems [1-5]. The aim of implementation research is to reduce this gap through identifying methods to improve clinical practice in a generalizable way. Implementation research tries to understand how an intervention designed to improve clinical

practice and tested in a limited, controlled setting can be implemented across a wide range of settings. These implementation research efforts have ranged from interventions focusing on individual provider behavior, to those with a more general educational focus, to those designed to address specific barriers to change, but these efforts share in common only small to modest effects on outcomes [6-10].

Interventions that are multi-pronged in approach, or that target organizations rather than individuals, may be more likely to be successful [11-13]. However, these may also be more difficult to translate from one institution or setting to another because of inherent differences between institutions. These differences arise because healthcare organizations are not static, but are constantly adapting and evolving in response to changes in their local environments, making one-size-fits-all interventions that attempt to reduce local variation less likely to be successful.

This leads to a profound dilemma in implementation research: how do we design interventional trials that are generalizable, but also have enough flexibility to be meaningful and more likely to be successful locally? To put this another way, how can we marry what many consider to be the ideal of the randomized controlled trial (RCT) with methods that address the difficulty of retaining interventional fidelity across institutions, and also address the more individualized, institutional needs of institutions when it comes to actually making an intervention work on a local level? The goal of this paper is to explore the integration of participatory action research (PAR) with a RCT study design as a mechanism for informing and improving our ability to translate research findings into general practice.

Why there is a need to consider different research methods in healthcare organizations

A growing literature suggests that healthcare organizations are complex adaptive systems (CAS) [13-19]. CAS are comprised of individuals who learn, inter-relate, and self-organize to complete tasks. They also co-evolve with their environment, responding to external forces in ways that in turn reshape their external environment. Most importantly, CAS are characterized by non-linear interactions that may lead to outputs, or 'emergent properties,' that are not entirely predictable.

Conceptualizing healthcare organizations as CAS has important implications for how we think about intervening in such systems, as the CAS framework reinforces the idea that each system is unique, and that interventions cannot easily be moved from one organization to the next with predictable results [13,17,20,21]. The CAS framework goes further, however, by suggesting that it is only through leveraging each system's pattern of interconnections between individuals that interventions will be optimally effective. Thus, to have the biggest impact, it is necessary to not only take into account differences between systems, but to exploit these in a way that will lead to maximal results. The implication is that the local participants will have the greatest ability to accomplish this.

The idea of performing a RCT in CAS requires us to rethink several key points about RCTs. First, the notion that a single intervention can be applied in a standardized way is not applicable. Therefore, we need to pay attention to what elements of an intervention could or should be common to all sites, and what can be varied locally. Second, the CAS framework should lead us to rethink the idea of monitoring fixed 'endpoints' at certain pre-specified points in time. Instead, we must pay attention to the implementation of an intervention throughout time, to how the intervention impacts the interdependencies within the system, and to the potentially unpredictable impacts of interventions. This requires a different level of monitoring, one that can best be done by local participants. Finally, the application of CAS to clinical systems encourages the idea that the intervention itself will evolve over time as the organization in which it is implemented changes. This may make the intervention more or less effective over time.

Thus, reconceptualizing clinical and healthcare organizations as CAS makes new approaches to implementation research necessary. A way of not only accounting for but taking advantage of local differences in healthcare systems is needed, but needs to be balanced by a research design framework that allows for some level of generalizability. The CAS nature of healthcare systems may make the PAR approach a particularly appropriate one for use in healthcare. PAR recognizes the importance of relationships, feedback loops, and the ability of participants to self-organize within a dynamic system -- three hallmarks of CAS.

Participatory action research defined

PAR is a technique derived over the last 40 years from the sociological, organizational, educational, and evaluation research literatures [22-24]. It is a design that partners the researcher and participants in a collaborative effort to address issues in specific systems. It is a collaborative, cyclical, reflective inquiry design that focuses on problem solving, improving work practices, and on understanding the effect of the research or intervention as part of the research process. It explicitly calls for making sense of the impact of change, and refining actions based on this impact. Essential elements and typical methods of action research are shown in Table 1 [22-56], derived from reviewing definitions of PAR across disciplines and qualitatively analyzing these definitions for themes and commonalities.

PAR has been influential in healthcare literature. Two systematic reviews of what may be considered PAR in healthcare settings are available. The UK National Health Service funded a systematic review of action research, published in 2001 [23]. 'Initiatives that persisted at the same loca-

Table 1: Essential elements of participatory action research

Quotes from Published Definitions	References
Names Used	
Participatory action research Qualifiers: cooperative inquiry; appreciative inquiry; community-based participatory research; action learning; action science; developmental action inquiry	[22-24,35-40,44-50]
Purpose of the Action Research	
Generation of new knowledge Qualifiers: practice-grounded, compelling enough to motivate to action; answer a question of importance to each other	[24,32,34,36,38,39,46,51,52]
Change Qualifiers: social change; improvement; improve health/well-being; take action; solution generation; planning action steps; engage in quest for information/ideas to guide future actions	[22-24,32,35-37,52,53]
Educating	[23,24,32,36,54]
Theory generation or refinement	[23,52]
Relationship building Qualifiers: strengthen relationships among group members, learn to integrate individualizing characteristics with a deeper communion with others and the world; involvement;	[23,27,38,55]
Developmental/Transformative for the individuals or organizations involved Qualifiers: a re-educative process that develops capabilities and transforms individuals/teams through experiential engagement; empowerment; reciprocal transfer of expertise	[23,24,35,51,53,54]
Methods	
Problem-focused Qualifiers: problem identification; diagnosing a problem; define a pressing problem; an agreed area of human activity; solution generation; planning action steps; engage actively in the quest for information and ideas to guide future actions	[22,23,34-39,54]
Systematic	[32,36]
Cyclical Qualifiers: emergence; adaptive cycles of action-feedback-action-feedback-action; repeated episodes of reflection and action; between meetings, members inquire into their own practice, observe, and implement new actions to help learn something new about the question; four phases of reflection and action; experimentation; learning at each step to inform the next set of decisions/actions; evaluation leads to diagnosing the situation anew based on incremental learnings	[23,34,35,37,39,51]
Reflective Qualifiers: self-reflective; members reflect together on their work; inquiring deeply into assumptions and root causes, and transferring learning at multiple levels	[23,27,38-40,52]
Collaborative Design and Evaluation Qualifiers: partnership; collective; group activity; mutualistic; inclusive; collaboration shapes and transforms methods; co-learning; participation of all relevant constituencies or stakeholders; involve all participants in all aspects of the research process; organization members participate throughout the research process from the initial design to the final presentation of results and discussion of their implications; reciprocal transfer of expertise; shared decision making power; mutual ownership of the processes and products of the research enterprise; facilitators and group participants co-author reports to present findings; participate in the research processes, which in turn are applied in ways that benefit all participants; multiple person, multiple perspective with participants as co-researchers	[22-24,32-39,49,51,52]
Context specific Qualifiers: Must be applicable to the system in which the inquiry takes place	[23,46,51,56]

Table 1: Essential elements of participatory action research (Continued)

Studying the whole or the patterns rather than the parts	[33,35,52]
Qualitative and quantitative data collection and analysis Qualifiers: mixed method designs collecting/analyzing both qualitative and quantitative data in single study; concurrent triangulation with multi-strand, multi-wave design; data collected/analyzed simultaneously/iteratively	[23,28,34,52]
Who	
Researchers Qualifiers: Professional action researchers, core research team members, researchers	[22-24,38,49]
Whoever is affected by the problem being studied Qualifiers: Requisite variety; system members; communities; those affected by the issue being studied; representatives of organizations; members of an organization or community seeking to improve their situation; group of peers	[24,32,38,39,46,49]
Fields Represented	
Health Related: Public Health, Primary Care, Patient Care, Nursing, Health Education, Health Sociology, Disability Research, Environmental Health, Injury Research, Mental Health, Reproductive Health Non-Health Related: Anthropology, Business Administration (Organizational Change/Development, Management, Human-Information System Interfaces), Sociology, Community Development, Community Psychology	

tion were found in 32 studies (54%) and, in a small number (four studies, 13%), an effect beyond their location was claimed.' In 2004, the Agency for Healthcare Research and Quality sponsored an evidence report on community-based participatory research [24]. This review found only 12 completed interventional studies, four of which were RCT's. Findings revealed modest positive health outcome findings, but the reviewers could not determine whether this benefit could be attributed to the community-based participatory research methods. Both reviews suggest the need to further understand what constitutes high-quality PAR and how best to evaluate the quality and outcomes of such research. More recently, a number of studies have been published using PAR to approach a variety of healthcare issues, including physical activity and obesity in young people [25,26], health disparities [27], hypertension and diabetes management [28], primary care delivery [29], and disaster planning [30].

PAR shares concepts with both action research and participatory research, but is not identical to these approaches.

Similarities and differences between PAR and quality improvement strategies

While the term 'PAR' is not widely used in clinical circles, many continuous quality improvement (CQI) techniques, such as Deming's total quality improvement, Six Sigma techniques, and the Institute for Healthcare Improvement's learning collaboratives, have features that are consistent with PAR. First, they call for involvement of a team of key individuals, particularly those with a fundamental knowledge of the context and need for improve-

ment, to be involved in the process. Second, they call for focusing a team around a specific problem. Third, they involve a cyclical approach with repeated cycles of incremental improvement, analogous to 'plan-do-study-act.' Finally, both PAR and CQI are meant to be transformative for the individuals involved, so that they have the skills to problem solve in new scenarios.

An important difference between PAR and CQI is that the latter typically assumes a reductionist system that can be improved by looking at specific steps in healthcare processes. PAR's emphasis on the relationships between individuals in the system, and their ability to self-organize over time, implies an inherent applicability to CAS. An additional difference between PAR and CQI approaches is that the primary goal of the latter is to do an intervention, while that of the former is also to learn something about the implementation process itself.

How PAR may be integrated with randomized controlled trials in implementation research design

We propose integrating the RCT and PAR approaches to retain the 'rigor' of the RCT with the local sensibility brought by PAR. This integration informs several elements of a combined design: the intervention, the endpoints, and the process of measurement. Table 2 summarizes key elements of PAR and RCT, and how these specific elements may be incorporated into an integrated PAR/RCT approach.

To integrate PAR into an RCT framework, we will need to move away from the proscribed interventions of the 'tra-

Table 2: Elements of PAR, RCT's, and integrated PAR/RCT

PAR	RCT	Integrated PAR/RCT	Example of PAR/RCT
Collaborative design	Externally created, standardized interventions	Key elements of intervention are locally implemented based on collaborative discussion	Use of site PIs in each unique study site as collaborators with study PIs in intervention design
Internal control	External control	Joint control	Site PIs with local or shared authority
Local applicability	Generalizeable	Use local findings to inform universal understanding	Consider local insights gleaned from the implementation process as data that will form the basis for a general understanding
Acknowledge unique local environments	Uniqueness minimized through random assignment	Incorporation of local conditions into overarching approaches	Address local barriers in intervention implementation
Reveal biases	Reduce bias	Use bias to form basis of generalizeable understanding	Allowing bias into the design may lead to a better understanding of the implementation process.
Reflective process throughout intervention	Endpoints/measurement set in advance	Time function or endpoints may vary within boundaries Reflection both within and across sites	Modify endpoints based on results Incorporate reflection periods into study design.
No comparisons, internal focus	Comparisons between arms	Comparisons based on 'content analysis' of internal understandings and lessons	Use of qualitative methods to probe themes from implementation experiences between sites

ditional' RCT in favor of locally designed interventions that meet a general goal or strategy. Elements of PAR may be important additions to intervention design in implementation research, particularly the need for local input into intervention design, and the need for sites to continue to change over the course of an intervention based on the success of the intervention. PAR may help us to focus less on the medical content of the intervention and more on the processes of group facilitation, reflection, and relationship building that may be the more generalizable components of the intervention. These activities should be made explicit elements of an intervention to allow for the incorporation of local conditions or context into the research design.

Non-healthcare literatures suggest that participation and decisional control are facilitators of organizational learning and change, overcoming barriers such as established routines and political barriers. Participation may also facilitate learning, in turn leading to increased likelihood of longer-term changes in behavior. These attributes may also facilitate the successful implementation of interventions to improve healthcare delivery. In a PAR/RCT approach, a 'joint' leadership structure with both a study and a site PI with local decision-making authority over choosing participants and intervention implementation

may create a mixture of internal and external control that leads to more effective interventions.

There may also be benefit to integrating the ability to modify the intervention plan into the research design by building reflection into the intervention. Interventions that explicitly allow participants to reflect and respond to incremental changes in the outcome variables during the course of the intervention period may allow for adaptation of the intervention in ways that may make the intervention more effective. Creating opportunities for reflection within and across sites with a focus on sharing experiences may also allow interventions to evolve in more effective directions. These adaptations and their impact are important to understand. Rather than undermining the ability to generalize from results, a greater understanding of how local contexts and biases influence interventions may actually lead to findings that improve the ability of subsequent settings to implement the intervention. An example of such a strategy may include result feedback during specific ranges of time, such as sharing the impact of an intervention on process or patient outcomes.

To integrate PAR and RCT, new approaches to defining endpoints and their measurement will be required. In

addition to the clinical endpoints that relate to the disease or population in question, endpoints chosen by local participants to help them monitor their progress should be added. Instead of pre-defined time periods at which endpoints are measured, the process of reflecting on the impact of an intervention in the clinical setting should become continuous, and the time it takes to implement an intervention may become an endpoint. This will allow for feedback that will help to strengthen the intervention, and will lead to a greater understanding of how the implementation process unfolds in each clinical setting. This understanding will be key to our ability to implement interventions successfully in other clinical settings. Thus, a greater appreciation of the process of intervention is a key lesson that must be derived from intervention studies.

An example of a PAR/RCT approach could include a multi-site study, half of which are randomized to an organizational intervention. The study team would partner with members of each intervention site to identify local barriers and create strategies to implement the intervention in a way that is deemed most effective by site participants. The intervention itself could include cyclical reflection exercises in which each site reviews results and modifies the intervention based on the results. In addition to these site-specific reflections, the intervention may also include times for all intervention sites to transfer ideas across sites. The timing of these reflective cycles and the timing of endpoint measurement could be modified based on these discussions. As part of the analysis of the results of the study, the themes of the reflections would be analyzed. An examination of any changes that might have occurred in control sites as a result of study participation would also be performed.

Why including PAR may improve our ability to design more effective interventions and improve patient outcomes

At first glance, the suggestion to integrate RCT and PAR approaches may seem contradictory -- the former attempts to implement standardized interventions in an effort to reduce bias and increase generalizability, while the latter is concerned with an individual system and its unique needs, rejecting the idea of the 'external researcher'. However, implementation research always occurs in the context of an organization, and for our efforts to become successful, new methodologies and approaches that recognize and respect each organization's unique characteristics, but still allow for a more universal understanding to be gained, must be developed. Rather than using standardized approaches to reduce bias, being explicit about differences and their impacts that will allow us to better understand the process of implementation, and it is this understanding that will lead to more successful implementation strategies. We suggest that an

approach that builds on and integrates the RCT and PAR characteristics is more likely to advance our efforts than either approach alone.

The addition of elements of PAR to interventional research studies may be a way to better meet the needs of implementation research -- to meet the needs of generalizability while respecting local conditions that are important in individual healthcare settings. Additionally, these elements are well-suited to specific aspects of healthcare systems that reflect their complexity -- the role of relationships among healthcare workers, managers, and patients in potentially unpredictable settings. Incorporating PAR principles may provide us with a deeper understanding of healthcare systems and what is needed to improve them, as well as a better theoretical understanding of interventions and why they might be more or less effective in certain contexts. The results of implementation studies utilizing a practice facilitation approach suggests support for this approach, as practice facilitation focuses on improving relationships and communication within healthcare organizations.

Additionally, the explicit inclusion of reflection and 'sense making' is an important component of the PAR methodology that is critical for understanding CAS, where unanticipated or unexpected results of interventions may occur. The process of looking critically at the impact of an intervention and adapting to this impact may lead to more effective interventions. The application of sense making to organizations outside of healthcare supports this idea.

The approach of adapting elements of PAR to RCTs may seem problematic to both the strict adherents of both PAR, and to those of RCTs. For the former, the attempt to fit an approach that is meant to focus exclusively on the needs of participants into an intervention that is on some level superimposed may seem to negate the very principles of PAR. For the latter, the incorporation of this degree of latitude into an intervention may seem to nullify the purpose of performing an RCT, and the ability to generalize from its results.

We believe that these criticisms miss an essential point of this approach -- that organizations are dynamic, and that a greater understanding of the diverse processes through which general strategies may be implemented successfully is critical to implementation research. The question is not whether a diabetes registry or a clinical reminder applied in a specific way can lead to predictably improved outcomes for diabetic patients in six months; the question is whether these approaches applied uniquely in the contexts of individual healthcare systems are more likely to change these systems in sustained ways that will lead to

improved outcomes. A key issue is whether an intervention is more or less likely to help to change the interconnections between elements of the system in a way that will lead to improved care. We can gain an understanding of whether certain types of interventions can be utilized in a manner across individual clinical systems such that outcomes are likely to improve. Instead of focusing on whether interventions are faithfully applied, we can learn from the myriad ways that participants apply interventions in their own settings, and from the degrees of change in outcomes that result.

Incorporating PAR principles may make the task of interpreting results of implementation trials more challenging, as it may be more difficult to assess true improvement in the setting of evolving interventions in organizations over time. However, they may also make interventions better suited to long-term successes by enabling us to implement more lasting organizational changes through the adaptive participation of those individuals who are most involved in the local process of care.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JAP conceived the manuscript, conducted the initial review of studies of participatory action research, and completed the first draft of the manuscript. LL performed additional literature review, contributed to the first draft of the manuscript, and completed significant revision as part of the peer-review process. HL performed additional literature review, contributed to the application of the CAS framework, and contributed to the revision of the manuscript. JH contributed to the conceptualization and first draft of the manuscript. RRM contributed to the initial development of the manuscript, the application of the CAS framework, and the revision of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The research reported here was supported by the US Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service (grants REA 05-129, IMA 04-734, and RCD 04-297). The views expressed in this article are those of the authors and do not necessarily reflect the position of policy of the Department of Veterans Affairs. The authors would like to acknowledge the assistance of Carla Pezizia in the development of this manuscript.

References

- Committee on Quality of Health Care in America: *Crossing the quality chasm: a new health care system for the 21st century* Washington, DC: National Academy Press; 2001.
- Wachter RM: **The end of the beginning: patient safety five years after 'To Err is Human'**. *Health Affairs-Web Exclusive* 2004, **W4**:534-545.
- Lenfant C: **Clinical research to clinical practice--Lost in translation?** *N Engl J Med* 2003, **349**:868-874.
- Asch SM, Kerr EA, Keesey J, Adams JL, Setodji CM, Malik S, McGlynn EA: **Who is at greatest risk for receiving poor-quality health care?** *N Engl J Med* 2006, **354**:1147-1156.
- Oxman AD: **No magic bullet: a systematic review of 102 trials of interventions to improve professional practice.** *Canadian Medical Assoc J* 1995, **153**:1423-1431.
- Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, Whitty P, Eccles MP, Matowe L, Shirran L, Wensing M, Dijkstra R, Donaldson C: **Effectiveness and efficiency of guideline dissemination and implementation strategies.** *Health Technol Assess* 2004, **8(6)**:1-72.
- Oxman AD: **No magic bullet: a systematic review of 102 trials of interventions to improve professional practice.** *Canadian Medical Assoc J* 1995, **153**:1423-1431.
- Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MA: **Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. The Cochrane Effective Practice and Organization of Care Review Group.** *BMJ* 1998, **317**:465-468.
- Solberg LI, Kottke TE, Brekke ML, Magnan S, Davidson G, Calomeni CA, Conn SA: **Failure of a continuous quality improvement intervention to increase the delivery of preventive services. A randomized trial.** *Eff Clin Pract* 2000, **3(3)**:105-115.
- Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR: **Why don't physicians follow clinical practice guidelines? A framework for improvement.** *JAMA* 1999, **282(15)**:1458-1465.
- Weingarten SR, Henning JM, Badamgarov E, Knight K, Hasselbad V, Gano A, Ofman JJ: **Interventions used in disease management programmes for patients with chronic illness - which ones work? Meta-analysis of published reports.** *BMJ* 2002, **325**:925.
- Katon W, Russo J, Von Korff M, Lin E, Simon G, Bush T, Ludman E, Walker E: **Long-term effects of a collaborative care intervention in persistently depressed primary care patients.** *J Gen Intern Med* 2002, **17(10)**:741-748.
- Stroebe CK, McDaniel RR Jr, Crabtree BF, Miller WL, Nutting PA, Stange KC: **How complexity science can inform a reflective process for improvement in primary care practices.** *Joint Commission J Qual & Patient Safety* 2005, **31(8)**:438-446.
- McDaniel RR Jr, Driebe DJ: **Complexity Science and Health Care Management.** *Advances in Health Care Management* 2001, **2**:11-36.
- Plsek PE, Greenhalgh T: **Complexity science: The challenge of complexity in health care.** *BMJ* 2001, **323(7313)**:625-628.
- Miller WL, McDaniel RR Jr, Crabtree BF, Stange KC: **Practice jazz: understanding variation in family practices using complexity science.** *J Fam Pract* 2001, **50(10)**:872-878.
- Plsek P: **Redesigning Health Care with Insights from the Science of Complex Adaptive Systems.** *Crossing the Quality Chasm: A New Health System for the 21st Century.* National Academy of Sciences 2000:309-322.
- Cilliers P: *Complexity and Postmodernism: Understanding Complex Systems* New York, NY: Routledge; 1998.
- Maguire S, McKelvey B, Mirabeau L, Oztas N: **Complexity Science and Organization Studies.** In *The Sage Handbook of Organization Studies* 2nd edition. SAGE Publications; 2006:165-214.
- Litaker D, Tomolo A, Liberatore V, Stange K, Aron D: **Using Complexity Theory to Build Interventions that Improve Health Care Delivery in Primary Care.** *J Gen Intern Med* 2006, **21(Suppl)**:30-34.
- Leykum LK, Pugh J, Lawrence V, Parchman M, Noel P, Cornell J, McDaniel RR: **Organizational interventions employing principles of complexity science have improved outcomes for patients with type II diabetes.** *Imp Sci* 2007, **2**:28.
- Whyte WF: *Participatory Action Research* Thousand Oaks, CA: Sage Publications; 1991.
- Waterman H, Tillen D, Dickson R, de Koning K: **Action research: a systematic review and guidance for acceptance.** *Health Technology Assessment* 2001, **5(23)**:1-174.
- Viswanathan M, Ammerman A, Eng E, Garlehner G, Lohr KN: *Community-based participatory research: assessing the evidence. Evidence Report/Technology Assessment No. 99* Rockville, MD: AHRQ Publication 04-E022-2; 2004.
- Khunti K, Stone MA, Bankart J, Sinfield P, Pancholi A, Walker S, Talbot D, Farooqi A, Davies MJ: **Primary prevention of type-2 diabetes**

- and heart disease: action research in secondary schools serving an ethnically diverse UK population. *J Public Health* 2008, **30(1)**:30-31.
26. DiNapoli PP, Lewis JB: **Understanding school-age obesity through participatory action research.** *Am J Maternal Child Nursing* 2008, **33(2)**:104-110.
 27. Brown DR, Hernandez A, Saint-Jean G, Evans S, Tafari I, Brewster LG, Celestin MJ, Gomez-Estefan C, Regelado F, Akal S, Nierenberg B, Kauschinger ED, Schwartz R, Page JB: **A participatory action research pilot study of urban health disparities using rapid assessment response and evaluation.** *Am J Public Health* 2008, **98(1)**:28-38.
 28. Bradley HA, Puoane T: **Prevention of hypertension and diabetes in an urban setting in South Africa: participatory action research with community health workers.** *Ethnicity & Disease* 2007, **17(1)**:49-54.
 29. Hills M, Mullett J, Carroll S: **Community-based participatory action research: transforming multidisciplinary practice in primary health care.** *Pan Am J Public Health* 2007, **21**:125-135.
 30. Gershon RR, Rubin MS, Qureshi KA, Canton AN, Matzner FJ: **Participatory action research methodology in disaster research: results from the World Trade Center evacuation study.** *Disaster Medicine and Public Health Preparedness* 2008, **2(3)**:142-149.
 31. Bloom HS: *Learning More from Social Experiments: Evolving Analytic Approaches* New York, NY: Russel Sage Foundation; 2000.
 32. Aaron KF, Stryer D: **Moving from rhetoric to evidence-based action in health care.** *J Gen Int Med* 2003, **18**:589-591.
 33. Hawkins P: **A centennial tribute to Gregory Bateson 1904-1980 and his influence on the fields of organizational development and action research.** *Action Research* 2004, **2**:1-13.
 34. Peters M, Robinson V: **The origins and status of action research.** *J Applied Behavioral Science* 1984, **20(2)**:113-124.
 35. Marsick VJ, Gephart MA: **Action research: Building the capacity for learning and change.** *Human Resource Planning* 2003, **26**:14-18.
 36. Macaulay AC, Comanda LE, Freeman WL, Gibson N, McCabe ML, Robbins CM, Twohig PL: **Participatory research maximizes community and lay involvement.** *BMJ* 1999, **319**:774-778.
 37. Elden M, Chisholm RF: **Emerging varieties of action research: Introduction to the special issue.** *Human Relations* 1993, **46**:121-142.
 38. Heron J: *Co-Operative Inquiry: Research Into the Human Condition* Thousand Oaks, CA: Sage Publications; 1996.
 39. Bray JN, Lee J, Smith LL, Yorks L: *Collaborative Inquiry in Practice: Action, Reflection, and Making Meaning* Thousand Oaks, California: Sage Publications; 2000.
 40. Kemmis S, McTaggart R: *The Action Research Planner* 3rd edition. Geelong: Deakin University; 1988.
 41. Deming WE: *Out of the crisis* Cambridge, MA: MIT Press; 1982.
 42. Chassin MR: **Is health care ready for Six Sigma quality?** *Milbank Q* 1998, **76(4)**:565-591.
 43. Pexton C: **Measuring six sigma results in the health care industry.** [<http://healthcare.isixsigma.com/library/content/c040623a.asp>].
 44. Hall JE: **Professionalizing action research--a meaningful strategy for modernizing services?** *J Nursing Mgmt* 2006, **14**:195-200.
 45. Torbert W: **The distinctive questions developmental action inquiry asks.** *Management Learning* 1999, **30**:189-206.
 46. Cooperider DL, Srivastva S: **Appreciative Inquiry in Organizational Life.** *Research in Organizational Change and Development* 1987, **1**:129-169.
 47. Reason P: **Choice and quality in action research practice.** *J Mgmt Inquiry* 2006, **15**:187-203.
 48. Viswanathan M, Ammerman AS, Lohr KM, Lux L, Sutton SM: *CBPR Reviewer Checklist* 2004 [http://www.rti.org/pubs/CBPR_rev_check.pdf].
 49. Greenwood DJ, Levin M: *Introduction to Action Research* Thousand Oaks, CA: Sage Publications; 1998.
 50. Clemensen J, Larsen SB, Kyng M, Kirkevold M: **Participatory design in health sciences: Using cooperative experimental methods in developing health services and computer technology.** *Qual Health Research* 2007, **17(1)**:122-130.
 51. Glasson JB, Chang EM, Bidewell JW: **The value of participatory action research in clinical nursing practice.** *Int J Nursing Practice* 2008, **14(1)**:34-39.
 52. Westhues A, Ochocka J, Jacobson N, Simich L, Maiter S, Janzen R, Fleras A: **Developing theory from complexity: reflections on a collaborative mixed method participatory action research study.** *Qual Health Research* 2008, **18(5)**:701-717.
 53. Corbett AM, Francis K, Chapman Y: **Feminist-informed participatory action research: a methodology of choice for examining critical nursing issues.** *Int J Nursing Practice* 2007, **13(2)**:81-88.
 54. Goto K, Tiffany J, Pelto G, Pelletier D: **Use of Q methodology to analyze divergent perspectives on participatory action research as a strategy for HIV/AIDS prevention.** *AIDS Education & Prevention* 2008, **20(4)**:301-311.
 55. Esler DM: **Participatory action research in indigenous health.** *Australian Family Physician* 2008, **37(6)**:457-459.
 56. Oscos-Sanchez MA, Lesser J, Kelly P: **Cultural competence: a critical facilitator of success in community-based participatory action research.** *Issues in Mental Health Nursing* 2008, **29(2)**:197-200.

Publish with **BioMed Central** and every scientist can read your work free of charge

"BioMed Central will be the most significant development for disseminating the results of biomedical research in our lifetime."

Sir Paul Nurse, Cancer Research UK

Your research papers will be:

- available free of charge to the entire biomedical community
- peer reviewed and published immediately upon acceptance
- cited in PubMed and archived on PubMed Central
- yours — you keep the copyright

Submit your manuscript here:
http://www.biomedcentral.com/info/publishing_adv.asp

