TBM

SYSTEMATIC REVIEWS

Network analysis of RE-AIM framework: chronology of the field and the connectivity of its contributors

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Cite this as: *TBM* 2015;5:216–232
doi: 10.1007/s13142-014-0300-1

Abstract

The reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework has been widely used for translational research. We used social network analysis (SNA) to explore how innovative research frameworks, such as RE-AIM, have diffused over time in academic literature. A structured literature review was conducted on RE-AIM between 1999 and 2012. SNA indices of degree score, betweenness, centrality, and authorship ties were used to examine use of RE-AIM. Use of RE-AIM has grown since its inception and spread from a few research centers to use internationally. Investigation of co-authorship revealed many have published on RE-AIM, but a much smaller core of RE-AIM researchers have published together two or more times. SNA revealed how the RE-AIM framework has been used over time and identified areas to further expand use of the framework. SNA can be useful to understand how research frameworks diffuse over time.

Keywords

RE-AIM, Evaluation, Social network analyses, Co-authorship analyses

Implications

Practice: Social network analysis is an innovative methodology that can be used to visually demonstrate the spread of knowledge and dissemination of information in practice-based research networks.

Policy: Social network analysis, using the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework as the example, is an operative mechanism to translate effective interventions into practice and policy.

Research: Methods such as social network analysis are needed to address the gap between research-based interventions and their subsequent use in practice.

INTRODUCTION

The reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework has been used for over 14 years in health services and health behavior literature [1]. RE-AIM is intended to be used at all stages of research from planning through evaluation and reporting and across different types and stages of research [2–4]. The first publication using RE-AIM was in *American Journal of Public Health* in late 1999 [5]. The model has become popular over the last decade because it: (1) emphasizes five dimensions that together determine public health impact; (2) places equal emphasis on external and internal validity; and (3) evaluates results at both the individual and setting/contextual levels [6].

The RE-AIM framework is rooted in translational science [7, 8] because it encompasses the implementation activities across the domains of research, practice, application, and policy [9–13]. This is of significance to behavioral medicine as dissemination and adoption of evidence-based research takes on an average of 17 years from concept to translation into population-based interventions for the 14 % of the evidence that translates [14, 15]. The RE-AIM framework mediates this lag to some degree by providing a sequentially planned context for research and evaluation activities, a range of activities and outcomes with which to predict, measure, and identify feasible program sustainability processes, and promotion of flexibility in research and evaluation activities to allow for practical application in real-world settings [12]. As use of the RE-AIM framework continues to grow and be implemented (www.re-aim.org), looking in detail at RE-AIM's impact on translational science and its collaborative authorship networks will help to guide the field to identify and fill gaps, as well as advance the field of translational research.

RE-AIM as an invisible college

The growing body of literature on the RE-AIM framework among researchers and program managers is diverse in terms of topical areas, journals, academicians, and program experts, suggesting that the knowledge gained through its application is an expanding knowledge base. There is general evidence that collaboration and coordination in a particular field is responsible for some of the major scientific advancements in recent decades [16, 17], and that the quality of research is enhanced by coordination among

scholars [18]. Authors represent a system of creators of research–and influence the diversity and direction of the research by their behavior and social organization around research topics [19]. These core groups of researchers have distinct patterns of information sharing such as productivity in the literature due to collaboration [20–23] and may influence the future direction of a field of study such as research awards, programs of study, and national level strategic planning [24–27]. These scholarly collaborative strengths that contribute to scientific productivity and unify a particular research area are referred to as "invisible colleges" [16, 17]. The benefit of the invisible college is the accumulation of knowledge in a field based as much on what you know as who you know.

In this paper, we use social network analysis (SNA) to evaluate the growth and impact of RE-AIM on translational research, as it relates to behavioral medicine. We analyzed a large body of published literature on RE-AIM using the methods of SNA to assess who the key authors are, how the framework evolved, and to identify whether the RE-AIM framework is housed in particular institutions (i.e., research location, nonprofit, university). The significance of this paper is to demonstrate how a novel methodology can illustrate the spread and potential spread of knowledge, using the RE-AIM framework as an example. We look at how the connectivity among scholars implementing RE-AIM contributes to the invisible college related to health services research.

METHODS

Article selection

We conducted a systematic literature review to identify studies stating the use of the RE-AIM framework. To identify articles using RE-AIM, a literature search was conducted using six databases (Medline, Pubmed, PSYCHinfo, Ebscohost, Web of Science, and Scopus), using RE-AIM, RE-AIM framework, RE-AIM model, and RE-AIM methods as the search terms. For inclusion, articles must have been published in English, stated the use of any of the five RE-AIM dimensions, and be published from 1999 (the publication of the initial article introducing RE-AIM) to 31 December 2012. Of the 303 citations identified, 159 were excluded at various stages as they did not meet the inclusion criteria. A majority of articles excluded were due to the articles being a commentary, theoretical piece, book chapter, or having no mention of RE-AIM. One hundred and forty-four articles were included in this review.

We then created a database to organize a code book that included descriptive information for each article. Each article was coded on the following information: year published, journal name, journal impact factor, co-authorship, author affiliation/institution, author geographic location, topic area of article, and study design. Journal impact factor reflects the average number of citations to recent articles published in the journal. This measures the relative importance of a journal within its field, with journals with higher impact factors considered to be more important than those with lower ones. We used SPSS version 21 [28] to conduct descriptive analysis of each variable.

Social network analysis

In order to provide a clear understanding of the results, we provide a few key definitions for the reader in Table 1.

We used the coded information to conduct SNA to investigate who is collaborating with whom in the RE-AIM body of literature. SNA is a methodology that lends visual power to describing, exploring, and understanding structural and relational aspects of data [29–31], such as mediators and moderators of health outcomes [32–34], partnerships and collaboration in networks [35–37], and academic collaborations [38–40]. SNA helps to explain how people, organizations, and others connect to one another, revealing the structural makeup of relationships [41–44] and the dynamic relationships of dyads and groups, such as authorship groups or research topical areas, over time [45–50].

In this study, we coded relationships by co-authorship and then included attribute data such as year published and organizational affiliation to inform our research questions. We used UCINET software, version 6.0 [51] to perform the SNA. First, the data were organized by creating an edge list, whereby authors of each article are listed pairwise. Next, the data were organized into case by case matrices in which each unit of analysis, the date of article publication, is listed twice, once in the rows and once in the columns. Finally, the attributes of authors and of articles were bonded to the matrix variables. Therefore, we created two matrices, a co-authorship matrix and an article matrix (linked by year the article was published). We used each type of "network" to conduct the SNA. We began with a simple analysis of network connections between authors. As mentioned above, co-authorship is assumed to represent efforts to work across organizational settings and even across disciplines, resulting in the dissemination of knowledge and in this case, the diffusion of the RE-AIM framework. While this method is often used to identify co-citation networks where links are indicated by who cites whom in their research [52–56], we only looked at who published with whom (while using the same type of analysis). We continued our analysis to look at the connectivity among organizational affiliations of these authors to better understand the level of collaboration among affiliations.

Following these two analyses, we investigated collaboration in the literature by looking at linking ties between authors and affiliation. This additional

Table 1 | Terms and definitions related to social network analysis

Term	Definition
Node	An individual, group, or organization [59].
Connectivity	Minimum number of network members (represented as nodes) which need to be removed to disconnect the remaining nodes from each other [59].
Ties	Links between/among nodes in the network. Strong ties are associated with homophily and propinquity, while weak ties are associated with bridges [60].
Bridge	Weak ties that provide the only link between two individuals or clusters [60].
Betweenness centrality	Measure of a node's centrality in a network and is equal to the number of shortest paths from all vertices to all others that pass through that node. A node with high betweenness has great influence over what does and does not flow through the network [59].
Brokerage positions	Facilitate transactions (such as co-authorship, knowledge, or communication) between others that are lacking access to or trust in one another [60].

analysis is important because a social network analysis of "any field must also be considered from the point of view of the transmission of ideas … a thorough scientist cannot be satisfied merely with searching the literature through indexes and bibliographies [57] p. 1125" (also see Garfield [58]). This final analysis allowed us to discover how well the field is coordinated around specific topics studied in the areas of implementation science and answer the question "Who is doing what with whom and where?"

RESULTS

Descriptive information

Using the data from 144 published RE-AIM citations in the scientific health literature we identified the top five content areas as physical activity (34 articles), diabetes (22 articles), obesity (13 articles), smoking cessation (13 articles), and heart disease (8 articles). The most frequent study designs employed were evaluation (43), randomized control trials (31), systematic reviews (14), prospective cohort designs (14), and literature reviews (12). Any other design employed were less than 7 in frequency. The most frequent methodology applied by the authors was quantitative (82 %), followed by mixed methods (15 %), and followed by qualitative methods (3 %). Regarding the top geographical location of authors (each author counted for each manuscript published), 166 authors were from the state of Colorado, 79 authors were from Australia, 54 were from Oregon, and 45 from North Carolina. The top three international locations of authors were 79 authors from Australia, 44 authors from Canada, and 40 from the Netherlands. The average number of authors was 5.5 per article, with a range from 1 to 14 and median of 5. Of the 144 articles eligible for the study, there were 577 unique authors. Journals ranged from having no impact factor (0.000) to 15.880 for a 5-year impact factor, with the highest distribution of journals in the moderate to high impact factor categories (see Table 4 for complete table of impact factors of journals abstracted for study).

Network analysis

The matrix of co-authorship (Fig. 1) shows that the use of the RE-AIM framework in publications has grown over time. Starting with the first article published in 1999, there was an overall increase in use per year. From 2000 to 2006, there were a total of 37 articles published that met our criteria; from 2007 to 2012, there were a total of 107 articles published, and relative to the first year, there are many contributors by the year 2012. Looking at the ties among authors (see Fig. 2), it appears that there is a highly active and well-connected community of published authors using the RE-AIM framework, both within the USA and internationally and an equal distribution of authors from community agencies and academic (campus) institutions. However, as Fig. 3 demonstrates, there are few authors who have published two or more articles together using RE-AIM and even fewer with four or more articles (n=12, analysis not shown). Looking at all author connections tells us that there is much activity around the RE-AIM framework in the literature, however, the SNA demonstrates that to date, it has been a rather limited group of contributors.

Analyzing the results in terms of frequency of articles published demonstrates a more clustered group of contributors, with less of an international presence, and very few authors that published two or more papers jointly using RE-AIM framework. There is a core group–a hub of people–that publishes together and is bound by several primary authors. The top five authors in any author position using RE-AIM in the publication were Glasgow (43 articles, with 22 as first author), Estabrooks (16 articles, with 3 as first author), Eakin (11, with 9 as first author), Toobert (11, with 5 as first author), and Strycker (10 articles).

In Table 2, authors are listed by degree (number of connections) and number of articles. Glasgow, the hub

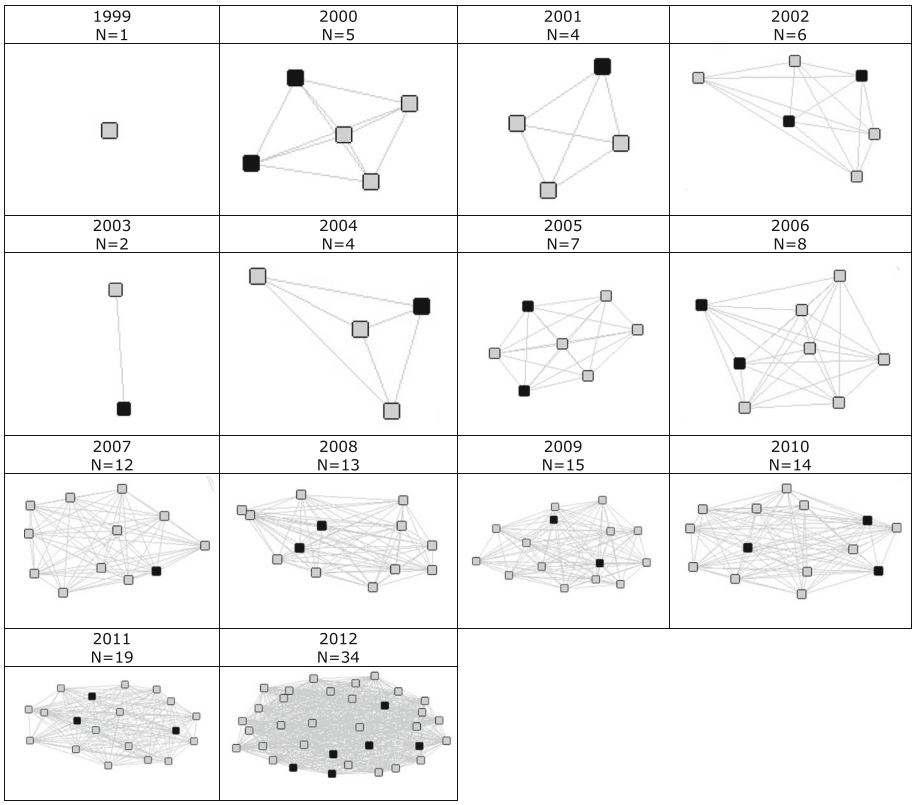

Fig 1 | Authorship matrix illustrating the use of the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework from 1999 to 2012. Note: Grey squares represent US first authors and black squares represent International first authors

of RE-AIM publications, has a degree score of 105, which is the highest (meaning he has 105 co-authors among these papers) and 43 articles. In this table, we can see that while some authors have many co-authors, they may not have as many published articles as others (i.e., Reid, De Bourdeaudhuij, and Brug), or alternatively, they may have a large number of articles but not many co-authors (i.e., Estabrooks).

Table 3 presents authors ranked by the highest betweenness centrality. Glasgow has the highest betweenness score of 19,251 indicating a strong brokerage position. Although some authors have a lower degree score, they rank high on the betweenness score, demonstrating that they bridge the more disconnected groups of authors (and subsequently link the more disparate parts of the network, adding to spread of knowledge related to RE-AIM to more diverse groups). For example, LM Klesges has published 6 articles on RE-AIM as a first author or co-author, has 13 connections, and a relatively high betweenness score of 6004 which indicates the author may have an influential position in the network by acting as a bridge between authors who may not otherwise have collaborated on RE-AIM manuscripts.

Figure 4 illustrates the variation between number of articles published, co-authors, and brokerage positions. Here, SNA allows us to see things in the data we might not see otherwise. How knowledge is disseminated throughout the networks is addressed in three different analyses. The first approach is the number of co-authors (Table 2)–indicating the "reach" of each author in terms of who they are working with (and also sharing the implementation of the RE-AIM framework). The second approach is the number of articles (Fig. 4), indicating the extent to which some authors dominate the field in terms of publications using the framework. The third approach is betweenness, showing those authors that are bridging gaps and utilizing the framework across sites and disciplines. Figure 4 shows how all the authors are connected, and the colors of the nodes show the number of articles published by each author. Finally, the size of the node shows the betweenness scores, indicating that those with larger-sized nodes are the brokers in the network. This figure demonstrates that while some authors may not have a large number of articles published, or many co-authors, they serve as important members of RE-AIM's invisible college in that they bridge diverse groups, improving the dissemination and adoption of the RE-AIM framework.

Figure 4 points out an additional characteristic, that is, those authors that have a high number of articles

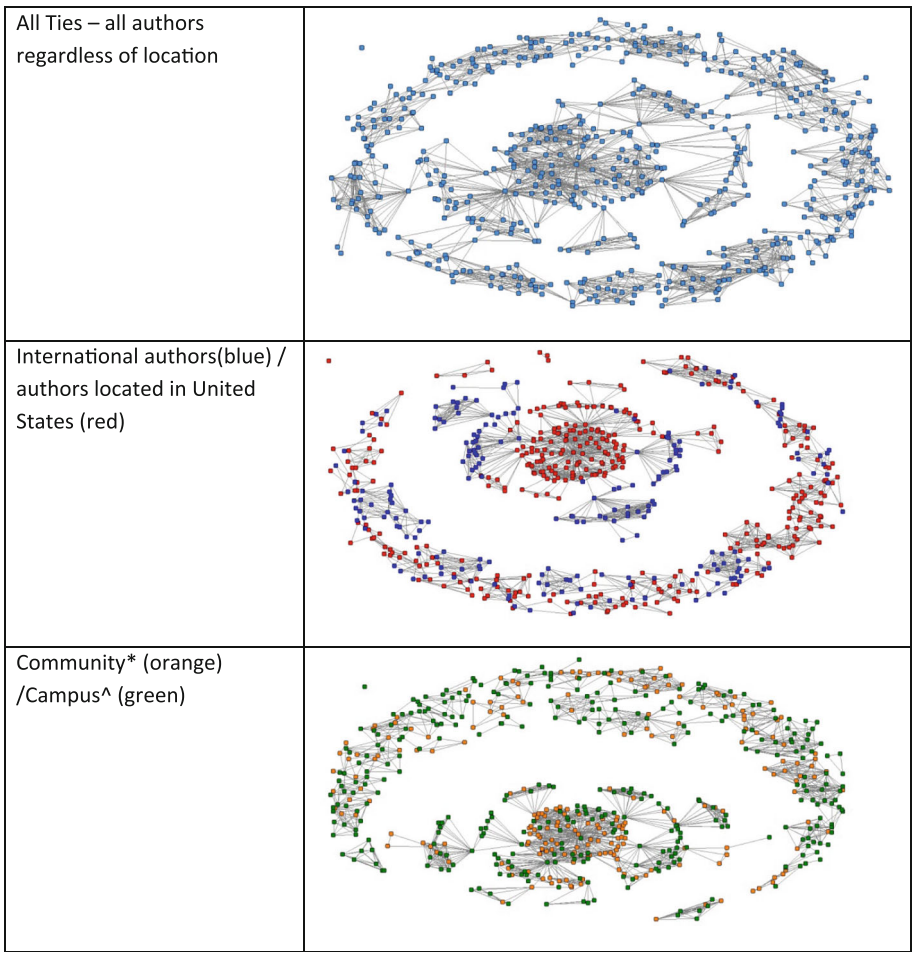

Fig 2 | Networks of authors publishing on the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework described by geography and organizational type from 1999 to 2012

published, but that may not play similar brokerage roles (based on structural positions in the network). This demonstrates that while some authors have a lot of published articles, they tend to publish in collaboration with a small circle of authors, potentially resulting in a more insular type of knowledge sharing. Conversely, Bauman, for example, has published less, but has a strong broker role in the network–connecting those who would otherwise be disconnected from the network.

DISCUSSION

The RE-AIM framework has been in use for 14 years, providing a structured and sequential approach to evaluating programs and policies. We identified 144 empirical articles published in English using RE-AIM between 1999 and 2012, reviewing the use of the RE-AIM framework in the literature, and using SNA to evaluate who is publishing with whom and the organizational affiliation types of all authors. We also investigated the relationships between authors and articles, seeing that authors who published often and with a large number of other authors were not always the bridge between diverse groups of authors. We identified authors using the RE-AIM framework as an "invisible college" and used SNA as a method to demonstrate its use over time. We found increased use of RE-AIM in the literature over time. Author geographical locations most frequently occurring were in Colorado (where one of the founders of RE-AIM, Glasgow, resided for many years), Australia, and Oregon (again, where the founder of RE-AIM originally published). The role of a prominent researcher in an invisible college can be very meaningful to the growth of the network. In this study, Glasgow is a definitive broker and initiator of research and spread of RE-AIM. Without him, the network is still rather active, although his role is clearly one of connectivity, particularly in his reach to members of the periphery. In sum, RE-AIM has a broad reach, cumulated over time.

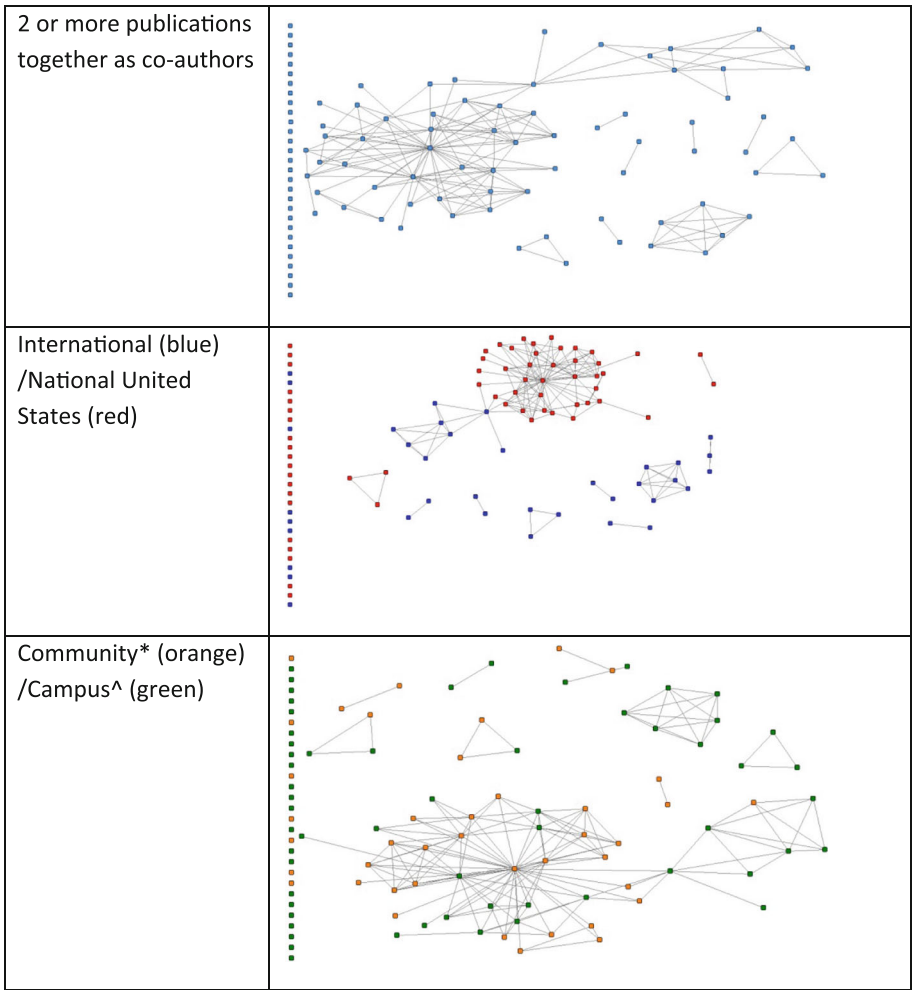

Fig 3 | Authors who have two or more publications together focused on the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework from 1999 to 2012

Interestingly, SNA revealed that at first look, there seems to be many contributors to the body of literature on RE-AIM and that knowledge is being widely disseminated across a network of scientists and practitioners. But a closer, complementary look shows a smaller, more focused cohort who have published two or more times together. Glasgow, who founded RE-AIM framework along with Vogt and Boles, is the "hub" of the network with the most publications and co-authors. While the frequency and volume of publishing is often an indicator of one's influence on a field, adding the dimension of number of co-authors and betweenness, we can see that there are other aspects of this network that can inform how RE-AIM has been disseminated, adopted, and how knowledge is spread. These analyses demonstrate the use of the RE-AIM framework as important to practice–as well as showing where the gaps are and potential opportunities lay to facilitate bridges to connect groups in use of RE-AIM concepts.

Another important point emerged from the SNA. Looking at markers of influence in isolation from one another, such as number of publications or number of co-authors, does not completely portray the network influences. These markers should be considered in conjunction with other markers such as who acts as bridges to unengaged author groups, who permeates interdisciplinary borders or who crosses topic boundaries.

Finally, the analyses revealed concerns that opportunities for expansion of the RE-AIM framework may be limited if researchers are simply using the framework once and not consistently adopting and employing it into their research and practice. In our analyses, we showed that, to date, there are relatively few authors who jointly have published on use of the RE-AIM framework other than a singular publication. Furthermore, there is a rather insular network of US authors publishing on RE-AIM for two or more times and then a periphery network of international authors.

Table 2 | Top 25 authors in terms of number of publications and number of co-authors, publishing on the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework from 1999 to 2012

Author	No. of articles	No. of connections
Glasgow	105	43
Estabrooks	57	16
Toobert	11	28
Eakin	11	27
Strycker	10	23
Bull	9	13
Dzewaltowski	8	15
Gaglio	7	23
King	7	21
Klesges	6	13
Marcus	5	14
Barrera	5	11
Ritzwoller	4	22
Finch	4	21
Nelson	4	16
Reeves	4	16
Whitesides	4	15
Levinson	4	14
Kulchak-Rahm	4	13
Nutting	4	13
Smith-Ray	4	13
McKay	4	8
Reid	3	25
De Bourdeaudhuij	3	22
Brug	3	20

Table 3 | Top 25 authors, ranked by highest centrality betweenness index, publishing on the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework from 1999 to 2012

Author	Degree index[a]	Between index[b]
Glasgow	105	19,251
Eakin	27	6994
Estabrooks	57	6304
Klesges	13	6004
De Bourdeaudhuij	22	4398
Reid	25	3844
Dzewaltowski	15	2700
Bauman	13	2508
Hampson	11	1848
Bull	13	1805
Lichtenstein	12	1453
Geller	8	1170
Smith-Ray	13	970
Mummery	7	940
Ritzwoller	22	499
Brug	20	492
Toobert	28	353
Reeves	16	311
Strycker	23	245
Caperchione	4	238
Riley	11	217
Finch	21	182
Gaglio	23	140
King	21	98
Nelson	16	87

[a] Degree=number of ties (direct links by co-authorship) an author has

[b] Betweenness=location in the network

Although these analyses provide an in-depth look at the network of RE-AIM use and authorship, there are several limitations. First, there may be a potential for underestimation of the articles using RE-AIM. In this review, we limited our inclusion to reflect only those articles that explicitly stated the use of RE-AIM, were published in English, and appeared before 2013. We know that since then, there have been at least 45 additional RE-AIM publications, and likely others in press or under review. This approach may have screened out other articles that used RE-AIM yet did not explicitly state this use. Second, we bonded the geographic location of the authors by using their most recent location. This approach was taken as only one geographic attribute was assigned to each author occurrence, and may have over or under estimated the geographic clustering of the co-author network. For example, authors who have a high number of publications may have been misclassified as international when the bulk of their RE-AIM publications were published when the author was located in the USA (e.g., Eakin). However, we think this approach of bonding author to most recent geographical location was a reasonable approach to reporting longitudinal data as a linear, cross-sectional attribute. Third, we assumed that the first author was the lead author, and this assumption varies among disciplines and study teams.

Our study addresses an important gap by investigating the use and spread of concepts of translational research through the use of RE-AIM framework; one of the most widely used frameworks for translational work and behavioral medicine, and demonstrates the utility of SNA for analyzing research publications. This approach revealed ways in which the RE-AIM framework has been used over time, but it also showed potential areas of opportunity to further expand use of the framework (e.g., linking established national RE-AIM experts with international authors; identifying emerging areas of content; institutionalizing RE-AIM use in grant reports). The first recommendation derived from this study is to create a research platform for the RE-AIM framework to assure that it is adopted and embedded as a regular practice, thus increasing its diffusion and spread in the literature.

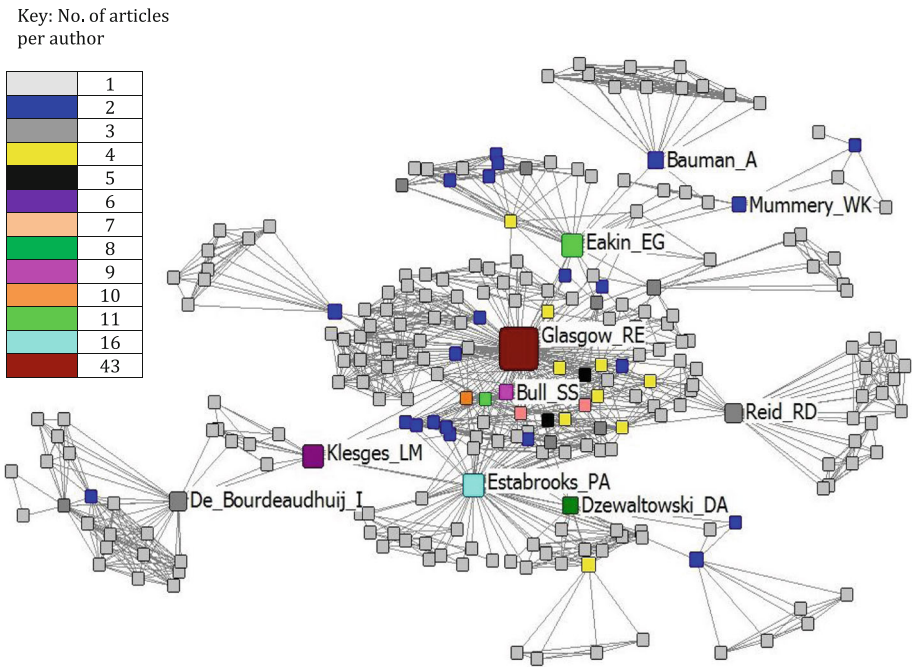

Fig 4 | Authors who have published on the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) framework highlighted by number of articles (see key) and betweenness scores (larger=higher betweenness score) from 1999 to 2012

A second recommendation is to include a core group of RE-AIM mentors to "bridge knowledge" between established interventionists and more junior researchers through use of RE-AIM in publications. Another recommendation is to stimulate diffusion of RE-AIM in the literature through its use in new areas, such as health policy or grant reporting. Finally, application of SNA to other translational or behavioral medicine theories and frameworks would be extremely helpful in determining which of our findings are replicable and generalizable versus specific to RE-AIM or this group of authors. Frameworks such as the Health Belief Model or other similar health behavior theories or models could serve as examples for examining how models and theories that articulate assumptions and hypotheses concerning strategies and targets of intervention are disseminated across scholarly literature. Additional next steps using SNA include bonding the geographic location of the research to the article, exploring the role of funding in research networks, and analyzing the effect of multiple manuscripts from a single study.

This method of using SNA has broader implications for the spread of innovation. Incorporating this broader concept into our third recommendation, as an approach to further spread an innovation, researchers can facilitate collaboration between disparate groups, groups who would not otherwise connect around the innovation, by using SNA to identify people with reach that connect subparts of the network. Each of these recommendations would serve to strengthen the invisible college for the RE-AIM framework.

We used SNA as a methodology to understand the spread of innovation, with the RE-AIM framework as our example. However, this has implications for application to other frameworks and innovations. The next step is to apply systems methodologies to capture the spread of innovations–thinking of spread of innovations as a system. In this example, we primarily focus on structural measures (counts, embeddedness), and like all networks, there are other attributes that can be incorporated. These include author (node) attributes to see how likely the innovation will be to spread. For example, qualitative interviews could be conducted with authors to find out why they used RE-AIM. Additionally, performing SNA longitudinally every five years would reveal how this network changes over time; investigating if there is growth in content or country participation in use. Finally, another approach would be to conduct an experimental design where RE-AIM is embedded into a given curriculum then observe if it is used in the literature going forward.

Acknowledgments: This was an investigator-initiated study conducted without internal or external funding. All authors, external and internal, had full access to all of the data (including datasets, statistical reports, and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards: Jo Ann Shoup, Bridget Gaglio, Danielle Varda, and Russell Glasgow declare that they have no conflict of interest. There was no human subjects' research conducted for this study.

Appendix A

Table 4 | 2012 and 5-year impact factor of journals abstracted for RE-AIM and SNA study

		Frequency	Percent	Impact factor of journal	5-year impact factor	Rating
1	Academy of emergency medicine	1	0.7	1.757	2.425	Moderate
2	Addictive behaviors	1	0.7	2.021	2.578	Moderate
3	AIDS care—psychological and social-medical aspects of AIDS/HIV	1	0.7	1.834	2.147	Moderate
4	American journal of health promotion	2	1.4	1.754	2.458	Moderate
5	American journal of managed care	2	1.4	2.117	2.738	Moderate
6	American journal of preventive medicine	11	7.6	3.945	5.249	High
7	American journal of public health	4	2.8	3.930	4.826	High
8	Annals of behavioral medicine	6	4.2	3.169	4.877	High
9	Annals of family medicine	1	0.7	4.613	5.051	High
10	Applied physiology, nutrition, and metabolism	1	0.7	2.009	2.551	Moderate
11	Arthritis care and research	1	0.7	3.731	4.777	High
12	Australasian journal on ageing	1	0.7	0.940	1.103	Moderate
13	BMC health services research	1	0.7	1.773	2.272	Moderate
14	BMC medical informatics and decision making	1	0.7	1.603	2.185	Moderate
15	BMC pediatrics	1	0.7	1.982		Moderate
16	BMC public health	7	4.9	2.076	2.623	Moderate
17	BMJ open	1	0.7	1.583	1.583	Moderate
18	British journal of sports medicine	4	2.8	3.668	3.985	High
19	British medical journal	1	0.7	17.215	15.880	High
20	Cancer detection and prevention	1	0.7	2.232	2.380	Moderate
21	Chronic illness	3	2.1	0.000		Low
22	Contemporary clinical trials	2	1.4	1.597	1.938	Moderate
23	Current respiratory medicine reviews	1	0.7	0.000		Low
24	Diabetes care	2	1.4	7.735	7.555	High
25	Diabetes spectrum	1	0.7	0.000		Low
26	Diabetes/metabolism research and reviews	1	0.7	2.968	3.163	High
27	Drug and alcohol dependence	1	0.7	3.141	3.951	High
28	Evaluation and the health professions	1	0.7	1.482	1.832	Moderate
29	Health education and behavior	4	2.8	1.682	2.663	Moderate
30	Health education journal	1	0.7	0.929	1.291	Moderate
31	Health education research	2	1.4	1.615	2.442	Moderate
32	Health promotion international	5	3.5	1.377	2.125	Moderate
33	Health promotion practice	7	4.9	0.000		Low
34	Health psychology	2	1.4	3.832	5.021	High
35	Implementation science	2	1.4	2.372	3.072	High
36	Injury prevention	2	1.4	1.755	2.016	Moderate
37	International journal of behavioral nutrition and physical activity	2	1.4	3.577	4.471	High
38	International journal of medical informatics	1	0.7	2.061	2.700	Moderate
39	Joint commission journal on quality and patient safety	1	0.7	0.000		Low
40	Journal of community health	1	0.7	1.293	1.491	Moderate
41	Journal of evaluation in clinical practice	1	0.7	1.508	1.642	Moderate
42	Journal of family practice	1	0.7	0.669	0.909	Low
43	Journal of general internal medicine	2	1.4	3.278	3.599	High
44	Journal of health care for the poor and underserved	1	0.7	1.491	1.526	Moderate
45	Journal of health communication	1	0.7	2.079	2.037	Moderate
46	Journal of medical internet research	2	1.4	3.768	4.728	High
47	Journal of occupational and environmental medicine	1	0.7	1.845	2.239	Moderate
48	Journal of physical activity and health	1	0.7	1.950		Moderate
49	Journal of psychology in Chinese societies	1	0.7	0.000		Low
50	Journal of public health dentistry	1	0.7	1.209	1.581	Moderate

Table 4 | (continued)

		Frequency	Percent	Impact factor of journal	5-year impact factor	Rating
51	Journal of safety research	1	0.7	1.379	1.970	Moderate
52	Journal of school health	1	0.7	1.495	2.014	Moderate
53	Journal of sport and exercise psychology	1	0.7	2.452	3.690	High
54	Medical care	2	1.4	3.227		High
55	Nicotine and tobacco research	2	1.4	2.477	3.134	High
56	Nutrition review	1	0.7	4.597	4.702	High
57	Obesity facts	1	0.7	1.583	2.042	Moderate
58	Obesity review	1	0.7	6.870	7.021	High
59	Patient education and counseling	6	4.2	2.372	2.933	Moderate
60	Pharmacoepidemiology and drug safety	1	0.7	2.897	2.911	Moderate
61	Pharmacotherapy	1	0.7	2.311	2.348	Moderate
62	Preventing chronic disease	4	2.8	1.585		Moderate
63	Preventive medicine	2	1.4	3.496	4.257	High
64	Public health nursing	1	0.7	0.78	1.065	Moderate
65	Public health nutrition	1	0.7	2.25	2.753	Moderate
66	Quality and safety in health care	1	0.7	2.16	3.139	High
67	Scandinavian journal of caring sciences	1	0.7	0.89	1.34	Moderate
68	The diabetes educator	3	2.1	1.936	2.649	Moderate
69	The gerontologist	1	0.7	2.283	3.106	High
70	The Permanente journal	1	0.7	0.000		Low
71	Topics in geriatric rehabilitation	1	0.7	0.227		Low
72	Translational behavioral medicine	7	4.9	0.000		Low
	Total/average	144	100	2.312	3.165	

Note: Impact factors were classified as low, 0–0.999; moderate, 1.0–2.999; high, 3.0 and above. Note: Impact factors were obtained from 2012 Journal Citation Reports Science Edition—ISI Web of Science

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