

Conceptualization and utilization of community engagement approaches in translational research: A scoping review

Keyonna M King^{1*}, Tatiana Tchouankam¹, Heidi Keeler¹, Christian IJ Minter¹, Kenya Love¹, Maria Teel-Williams¹, Grace Y Cai² and Paul A Estabrooks¹

¹University of Nebraska Medical Center, USA

²Duke University, USA

Abstract

This scoping review examined the use of varying levels of community engagement across the translational research spectrum. We used a range of databases (e.g., PubMed/Medline, Scopus) to identify articles published between January 2008 and November 2018 (n=167) and eliminated studies that did not use any level of community-engagement (n=102). Studies were coded for translational stage-corresponding to T0 (basic science), T1 (basic science to clinical research in humans; n=6), T2 (clinical efficacy and effectiveness research, n=45), T3 (dissemination and implementation research, n=95), and T4 (population health, n=21) and degree of community engagement (outreach, n=14; consultation, n=13; involvement, n=7; collaboration, n=15; shared-leadership, n=16). The depth of community engagement, varied with higher engagement being more characteristic of studies at later stages of translational research. However, shared leadership, the most intensive form of community-engagement was found in T2-T4 studies suggesting the value of community-engagement across these translational research stages. A universal understanding of the various levels of community engagement, with the principles of the CBPR approach being the highest level of community engagement, could fill gaps in understanding how to engage the community in research. It is vital to encourage the involvement of community in translational research to expedite the translation of knowledge into practice and enable practice-based needs to inform policy.

Introduction

Fifteen years ago, Dr. Elias Zerhouni, as director of the National Institutes of Health (NIH) initiated the NIH Roadmap for Medical Research that highlighted the importance of improving systems-biology tools, enhanced interdisciplinary team research, and accelerated movement of bench discoveries to clinical care [1]. Within the Roadmap, translational research was defined as the process of moving scientific discovery along a scientific spectrum from basic science breakthroughs to clinical care. Overtime, this definition has been expanded with the recognition that the NIH was developed to serve public health; based on some criticism of the large amount of resources dedicated to biomedical research that were not resulting in similar gains in new treatment, diagnostics, and prevention [2]. Recently, Fort *et al.* [3] completed a systematic review with a goal to summarize scientific approaches to translational research, and to find a consensus in the definition of translational research. The review identified 3 primary typologies – gap definitions similar to the original definition used in the NIH Roadmap [4], multi-phasic continuum definitions [5], and blended gap/continuum definitions [6]. The continuum definition includes the movement of scientific findings from basic science discoveries (T0) to clinical research in humans (T1) to clinical efficacy and effectiveness research (T2) to dissemination and implementation research (T3), and finally to population health outcomes (T4). This definition appears to be the most frequently used definition when considering clinical and translational research networks and institutes [7]. A machine learning study examined the breadth of research across five Clinical and Translational Science Award hubs and found that 50% of publications were classified as T0, 21% as T1/T2, and 29% as T3/T4 [7].

In addition to accelerating and supporting translational research, the NIH Roadmap also focused on the need for interdisciplinary team-science with the fundamental hypothesis that blending scientific expertise around a common health issue would make an efficiently comprehensive transition from each phase of translational research to the next (and, potentially, back again) [1]. Some have argued that interdisciplinary approaches would also benefit from the engagement of community organizations and residents in the research process [8]. Recognizing the importance of community engagement has continued to gain prominence in clinical and translational sciences [9].

Eder and colleagues [10] engaged investigators from Clinical and Translational Science institutions (i.e., CTSA/CTSIs) to determine how community engagement was being defined and used within this context. They found that there was no consensus on the definition of community engagement with 39, 23, and 16 percent of institutional respondents, respectively, using defining community-engaged research primarily based on (1) a reciprocal need for researchers to become part of the

***Correspondence to:** Keyonna King, DrPH, MA, Assistant Professor, Center for Reducing Health Disparities Department of Health Promotion, College of Public Health, University of Nebraska Medical Center, USA, 5190 Sprague Plaza, Room 105, Omaha, NE 68104, USA, E-mail: Keyonna.king@unmc.edu

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community and the community to become part of the research team, (2) a collaborative process between people with common geographic location, interests, or situations, and (3) equitable involvement of research and community partners with a goal for social change and advancing health equity through combined knowledge application. The remaining respondents either used no definition or a definition similar to, but different from each of those described above (11 percent each). The authors concluded that while different definitions were used the principles used described by respondents most reflected a definition that focused on the principles of community engagement—“the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people. It often involves partnerships and coalitions that help mobilize resources and influence systems, changes relationships among partners, and serve as catalysts for changing policies, programs, and practices” [11]. However, they also concluded that the depth of engagement appeared to vary between institutional respondents and proposed that future research should examine how engagement varies based on different translational stages [10].

To address the potential variability in depth of community-engaged research, the Center for Disease Control and Prevention (CDC) method to operationalize community engagement based on a modified version of the International Association for Public Participation is useful [12] (Figure 1). This method describes levels of community engagement ranging from outreach (connections with community members and organizations to share research information) to shared leadership (involves community in all aspects of the research process from idea generation and prioritization through application and dissemination of findings). Under this umbrella, definitions for community engagement can focus on community organizations, community members, or both.

Specifically, defining community-based organization engagement (CBOE) as a dynamic partnership between community-based organizations and academic institutions reflects a method to operationalize engagement. It can also be operationalized with a focus

on community members rather than community organizations—such as a “process of working collaboratively with groups of people affiliated by geographic proximity, special interests, or similar situations concerning issues affecting their well-being” (p. 1-2) [13]. Combining an organizational and community member approach, community-based participatory research (CBPR) is an approach based on the equal partnership that builds on the strengths of the community and the research team to initiate social change and improve health [12,14].

Finally, perhaps the highest depth of community-engagement, shared-leadership, can be operationalized through approaches that integrate research and community or research and practice. Community-Partnered Participatory Research (CPPR) provides an operationalized approach to increase the use of CBPR principles. CPPR is designed to address multiple health problems with a sustained, institutionalized relationship uniting resources and expertise [15]. Similarly, integrated-research practice partnerships provide an operationalized approach to have shared agenda setting, problem prioritization, response and research design selection, and engagement throughout the testing of evidence-based interventions to determine the potential for sustained implementation [16]. A guiding principle of CPPR and integrated research-practice partnerships is shared leadership between academic researchers and community or practice stakeholders in all phases of research development, implementation, and dissemination.

Intuitively, the depth of community-engagement across the translational spectrum will likely vary—with more consultative and information sharing levels of engagement at earlier stages of translational research, and more collaborative and shared leadership levels of engagement signifying later translational stages. To date, there has been strong scientific work conducted on delineating the phases of translational research and levels of community engagement, however, despite the focus of clinical and translational networks and institutes on positively influencing community health, there has been a limited empirical investigation on determining the role, or level, of community engagement that has been used in translational research. The purpose of this article is to identify previous studies that indicated some involvement with community organizations, members, or partnerships as it relates to the five phases of translational research and

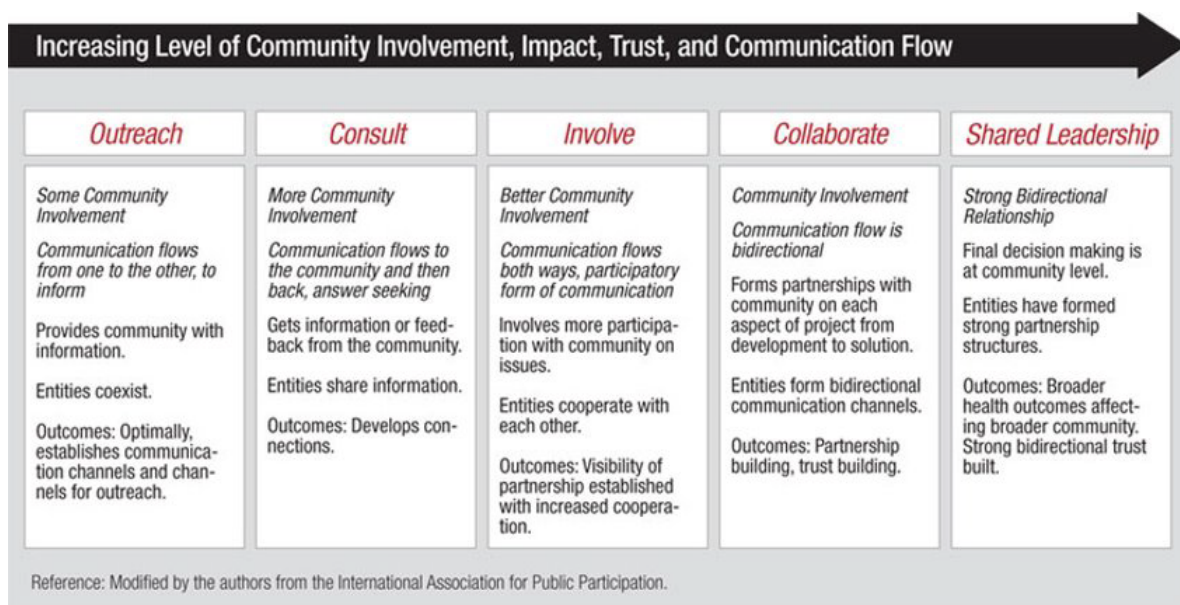


Figure 1. Community engagement continuum

provide information on, and recommendations for, appropriate levels of community-engaged research across translational science stages.

Methods

We conducted a scoping review to generate a profile in the application of community engagement in translational research. We used a scoping review approach suggested by Peters *et al.* [17] and followed the PRISMA framework of systematic reviews, which facilitates an iterative process of reviewing the literature. A scoping review is useful when mapping a new concept in a specific field of research [18].

The definition of translational research established by Fort *et al.* [3] was used to generate the eligibility criteria: “T1 involves processes that bring ideas from basic research through early testing in humans; T2 involves the establishment of effectiveness in humans and clinical guidelines; T3 primarily focuses on implementation and dissemination research, and T4 focuses on outcomes and effectiveness in populations. T0 involves research such as genome-wide association studies which wrap back around to basic research” (p. 63) [3].

The approach to categorizing community engagement used five levels of involvement across the translational spectrum: 1) outreach, 2) consultation, 3) involvement, 4) collaboration, and 5) shared leadership [12]. We used this classification in concordance with the definition of community engagement proposed by Baum, MacDougall, and Smith [11] to determine the level of community involvement across the spectrum of translational research. To be eligible, an article was required to include reference to both the translational stage and some

level of community engagement though it was possible for articles to refer to community or community-engagement and not meet the lowest standard of engagement-outreach.

Search strategy

A literature search was conducted in PubMed/MEDLINE, Cochrane Central Registry of Controlled Trials, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Scopus for articles published in English between January 2008 and November 2018. The search strategy used both subject headings and keyword terms for the two concepts of “translational research” and “community engagement.” Some of the Medical Subject Headings (MeSH) used included “translational medical research” and “community participation.” Keywords included “translational research,” “translational science,” “community-based,” and “community-engaged.” The search strategy was developed initially in PubMed/MEDLINE and adapted to conform to the additional databases. The complete search strategy is presented in Table 1. A medical librarian assisted in developing and implementing the search strategy, which included manually removing duplicate citations.

This search yielded 1,548 results after duplicates were removed. Studies were included if they met the following criteria: 1) Studies were conducted and published in the United States, 2) English only, 3) published between 2008 and 2018, and 4) matched the description of translational research at one of five phases. Eligible study designs included randomized controlled trials, experimental, quasi-experimental, qualitative, mixed-methods, observational studies (retrospective, prospective, before-after, or comparative cohorts),

Table 1. Database search strings

Database	Search string	Total of articles retrieved
PubMed		877
#1	("Translational Medical Research"[Mesh] OR "translational medical research"[tiab] OR "medical translational research"[tiab] OR "translational medical science"[tiab] OR "translational research"[tiab] OR "translational science"[tiab] OR "translational medicine"[tiab] OR "knowledge translation"[tiab] OR "translational study"[tiab] OR "translation of research"[tiab] OR translational[ti] OR translating[ti] OR translated[ti])	
#2	("Community Participation"[Mesh] OR "Community-Based Participatory Research"[Mesh] OR "community participation"[tiab] OR "community based"[tiab] OR "community engaged"[tiab] OR "community engagement"[tiab] OR "community involvement"[tiab] OR "community partnered"[tiab] OR "community action"[tiab] OR "consumer participation"[tiab] OR consumer driven[tiab] OR "consumer involvement"[tiab] OR "public participation"[tiab] OR "patient engagement"[tiab] OR patient involvement[tiab] OR participatory approach[tiab] OR participatory research[tiab] OR citizen science[tiab] OR engage*[ti] OR community[ti])	
#3	((("2008/01/01"[PDAT] : "2018/12/31"[PDAT])) AND English[lang])	
#4	#1 AND #2 AND #3	
Cochrane Central Register of Controlled Trials		79
#1	MeSH descriptor: [Translational Medical Research] explode all trees	
#2	("translational medical research" OR "medical translational research" OR "translational medical science" OR "translational research" OR "translational science" OR "translational medicine" OR "knowledge translation" OR "translational study" OR "translation of research"):ti,ab,kw	
#3	(translational OR translating OR translated):ti	
#4	#1 OR #2 OR #3	
#5	MeSH descriptor: [Community Participation] explode all trees	
#6	MeSH descriptor: [Community-Based Participatory Research] explode all trees	
#7	("community participation" OR "community based" OR "community engaged" OR "community engagement" OR "community involvement" OR "community partnered" OR "community action" OR "consumer participation" OR "consumer driven" OR "consumer involvement" OR "public participation" OR "patient engagement" OR "patient involvement" OR "participatory approach" OR "participatory research" OR "citizen science"):ti,ab,kw	
#8	(engage* OR community):ti	
#9	#5 OR #6 OR #7 OR #8	

#10	#4 AND #9	
Embase		961
#1	translational research/exp OR ("translational medical research" OR "medical translational research" OR "translational medical science" OR "translational research" OR "translational science" OR "translational medicine" OR "knowledge translation" OR "translational study" OR "translation of research"):ti,ab OR (translational OR translating OR translated):ti	
#2	'community participation/exp OR 'participatory research/exp OR ("community participation" OR "community based" OR "community engaged" OR "community engagement" OR "community involvement" OR "community partnered" OR "community action" OR "consumer participation" OR "consumer driven" OR "consumer involvement" OR "public participation" OR "patient engagement" OR "patient involvement" OR "participatory approach" OR "participatory research" OR "citizen science"):ti,ab OR (engage* OR community):ti	
#3	[english]/lim AND [2008-2018]/py	
#4	#1 AND #2 AND #3	
CINAHL		293
#1	TI ("translational medical research" OR "medical translational research" OR "translational medical science" OR "translational research" OR "translational science" OR "translational medicine" OR "knowledge translation" OR "translational study" OR "translation of research" OR translational OR translating OR translated) OR AB ("translational medical research" OR "medical translational research" OR "translational medical science" OR "translational research" OR "translational science" OR "translational medicine" OR "knowledge translation" OR "translational study" OR "translation of research")	
#2	MH "Community Role" OR TI ("community participation" OR "community based" OR "community engaged" OR "community engagement" OR "community involvement" OR "community partnered" OR "community action" OR "consumer participation" OR consumer driven OR "consumer involvement" OR "public participation" OR "patient engagement" OR "patient involvement" OR "participatory approach" OR "participatory research" OR "citizen science" OR engage* OR community) OR AB ("community participation" OR "community based" OR "community engaged" OR "community engagement" OR "community involvement" OR "community partnered" OR "community action" OR "consumer participation" OR consumer driven OR "consumer involvement" OR "public participation" OR "patient engagement" OR "patient involvement" OR "participatory approach" OR "participatory research" OR "citizen science")	
#3	#1 AND #2	
Scopus		1103
#1	TITLE-ABS-KEY ("translational medical research" OR "medical translational research" OR "translational medical science" OR "translational research" OR "translational science" OR "translational medicine" OR "knowledge translation" OR "translational study" OR "translation of research") OR TITLE(translational OR translating OR translated)	
#2	TITLE-ABS-KEY("community participation" OR "community based" OR "community engaged" OR "community engagement" OR "community involvement" OR "community partnered" OR "community action" OR "consumer participation" OR "consumer driven" OR "consumer involvement" OR "public participation" OR "patient engagement" OR "patient involvement" OR "participatory approach" OR "participatory research" OR "citizen science") OR TITLE(engage* OR community)	
#3	#1 AND #2	
Total		3313
Duplicates Removed		1765
Total after Deduplication		1548

or case studies. Systematic reviews or articles defining translational research framework and strategies, and training or workshop for translational research partnerships were excluded.

Review strategy

Figure 2 summarizes the search strategy following the PRISMA model. There were five reviewers: Two reviewers have experience conducting community-engaged research projects; one reviewer is an expert in community engagement and uses this approach to conduct research. The remaining reviewers were trained to identify articles that meet the definitions for translational research and community engagement. The five reviewers performed an elimination process, which consisted of reviewing articles by titles or abstract and selecting the studies corresponding to one of the phases of the translational spectrum and level of community engagement. The reviewers used a list of inclusion criteria to guide the review process. This included the definitions of the translational phases T0-T4 and levels of community engagement. We excluded citations when the study did not fit the inclusion criteria.

The elimination process resulted in 397 articles. From those articles, we determined inter-rater reliability by comparing the consistency of identifying potentially eligible articles across the three reviewers to identify the articles where consensus was achieved. Of the 397 articles, we selected 215 articles for a full manuscript review. Each article was read and assigned to a translational phase (T0-T4) [3]. We classified the articles into the five categories of community engagement following the definition of community engagement [12]. These categories were 1) outreach, 2) consultation, 3) involvement, 4) collaboration, and 5) shared leadership [12]. Figure 1 gives a description of each category, which guided the classification process. Articles that referred to community participation, but did not provide information on how this was operationalized were included, but coded as 'none' for level of community engagement. We excluded articles during the full review for one of the following reasons: 102 did not describe community-engagement, 29 were definitions and workshops on translational research, seven were duplicates not initially identified, four were not a peer-reviewed journal articles, three were protocol papers, two were studies done outside of the US, one was a study description from the

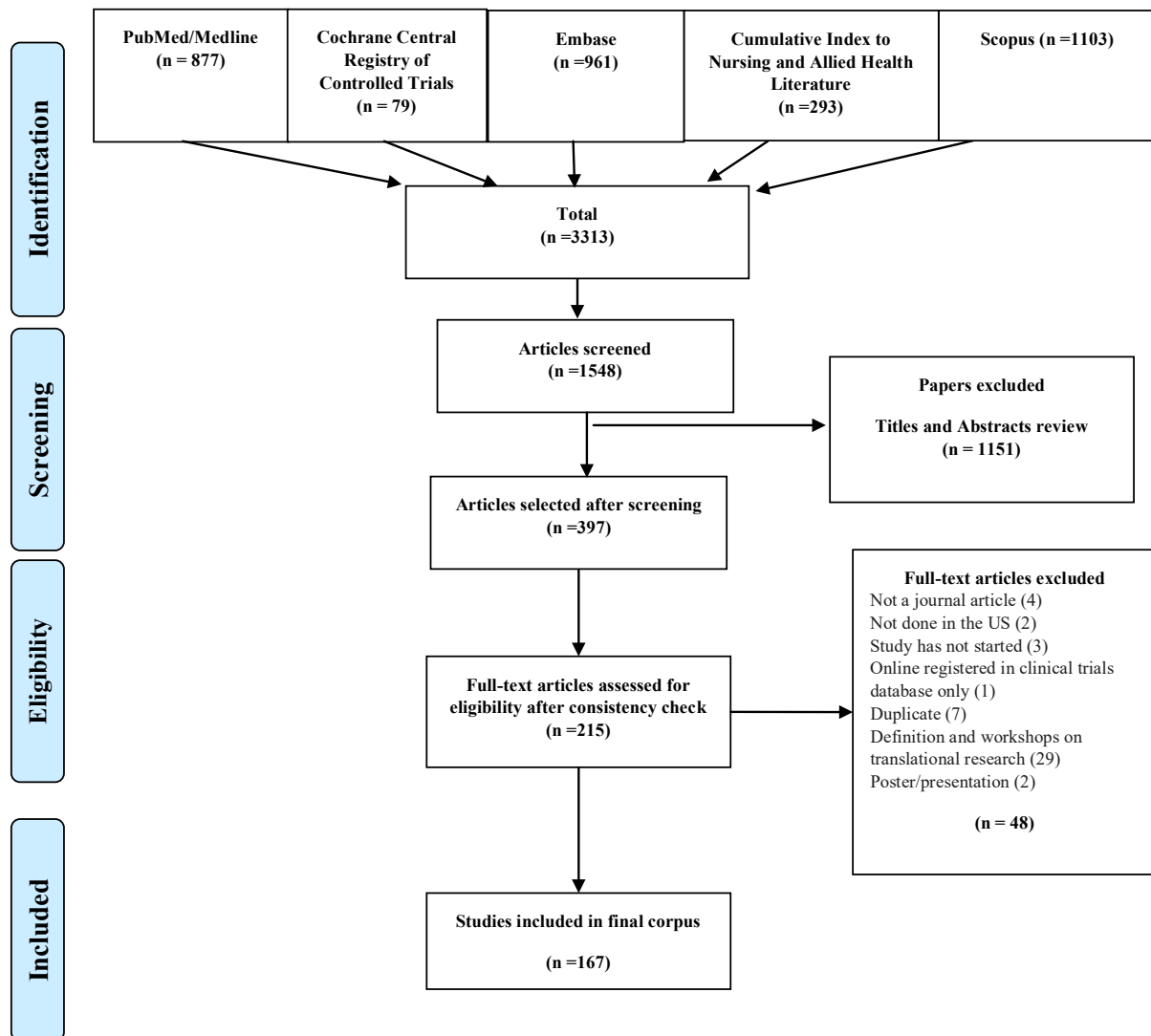


Figure 2. PRISMA model search strategy and results

Clinical Trials website with no published findings, and two were poster/oral presentations. The final number of eligible articles was 65.

Results

Of the 65 articles, none were categorized as T0 or T1 studies; 7, 43, and 15 were categorized as T2, T3, and T4 stages of translational science, respectively. Seven studies matched T2 criteria, which focused on improving clinical guidelines or analyzing the clinical efficacy of some treatments in humans. The largest number of studies ($n=43$) were categorized as T3, which involved dissemination and implementation science. T4, population health research, made up the remainder of the studies—representing 15 of the 65 articles. Table 2 provides a classification of the studies in the corresponding phases of translational research and level of community engagement.

Based on the definition used to classify the studies, 14 articles described outreach programs (first level of community engagement) implemented in a community setting. This was typically focused on engaging the community to assist with recruiting study participants [19]. The consultation level of engagement was reported in 13 studies

(second level of community engagement). In these cases, researchers typically sought community feedback about projects prior to study implementation but did not actively engage the community in the research process [20-21]. Involvement was the identified community-engagement level in seven studies (third level of community engagement). Examples include involving community organizations and members in recruitment, data collection, and assistance in program implementation [22]. Fifteen (15) studies were coded as collaborative-corresponding to the fourth level of community engagement. In these studies, there was some level of formal collaboration between the community and the researchers where the community was directly involved in finding solutions to the priority health issues [23]. Finally, shared-leadership, the fifth level of community-engagement was identified in 16 studies. In these cases, community organizations and members assisted in creating the research question, designing the intervention [24-25] and in the implementation and the dissemination of the results [25-27].

Table 3 highlights the level of community engagement by translational stage. Studies categorized at T3 represented the largest

Table 2. Classification of the studies by level of community engagement

Authors	Year	Translational Phase	Level of Community Involvement				
			Outreach	Consult	Involve	Collaborate	Shared Leadership
1. Amed, Naylor, Pinkney et al.	2015	T4					*
2. Calo, Cubillos, Breen et al.	2015	T2					*
3. Chiu, Mitchell, Fitch	2013	T4					*
4. Chung, Meldrum, Jones et al.	2014	T4					*
5. English, Merzel, Moon-Howard	2010	T3					*
6. Estabrooks, Bradshaw, Dziewaltowski et al.	2008	T4					*
7. Estabrooks, Smith-Ray, Dziewaltowski. et al.	2011	T4					*
8. Horowitz, Eckhardt, Talavera et al.	2011	T3					*
9. Lalonde, Goudreau, Hudon et al.	2014	T3					*
10. Mau, Keawe'aimoku Kaholokula, West et al.	2010	T4					*
11. Newlin, Arbauh, Sewer et al.	2011	T3					*
12. Samuel, Lightfoot, Schaal et al.	2018	T3					*
13. Sankare, Bross, Brown et al.	2015	T2					*
14. Sy, Hernandez, Tareg et al.	2017	T2					*
15. Unertl, Schaeffbauer, Campbell et al.	2016	T3					*
16. Yeary, Cornell, Prewitt et al.	2015	T3					*
17. Ackermann, Finch, Brizendine, et al.	2008	T3				*	
18. Allison, Zittleman, Ringel et al.	2014	T3				*	
19. Amundson, Butcher, Gohdes et al.	2009	T3				*	
20. Anderson, Fast, Keating et al.	2017	T3				*	
21. Brown, Harris, Harris et al.	2010	T4				*	
22. Coors, Westfall, Zittleman et al.	2018	T4				*	
23. Davis, Aromaa, McGinnis. et al.	2014	T3				*	
24. Duffy, Prince, Johnson et al.	2012	T3				*	
25. Ford, Rasmus, Allen	2012	T4				*	
26. Guest, Freedman, Alia et al.	2015	T3				*	
27. Guse, Peterson, Christiansen et al.	2015	T3				*	
28. Kobau, Dilorio, Bamps et al.	2011	T3				*	
29. Newman, Toatley, Rodgers	2018	T3				*	
30. Pedley, Case, Blackwell et al.	2018	T4				*	
31. Yeary, Mason, Turner et al.	2011	T2				*	
32. Ayoub, Geary, Londhe et al.	2018	T3			*		
33. Haider & Holt	2015	T3			*		
34. Healy, Peng, Haynes et al.	2008	T3			*		
35. Iwasaki	2016	T3			*		
36. Klooseck, Fitzsimmons, Speechley et al.	2017	T4			*		
37. Low, Baker, Jeon et al.	2013	T3			*		
38. Merriam, Tellez, Rosal et al.	2009	T3			*		
39. Bilodeau, Tremblay, Durand	2018	T2		*			
40. Colon-Otero, Albertie, Lesperance et al.	2012	T3		*			
41. Corbie-Smith, Isler, Miles et al.	2012	T3		*			
42. Garcia de Quevedo, Siminerio, L'Heveder et al.	2012	T3		*			
43. Hickman, Wiersma, Harvey	2015	T2		*			
44. O'Malley, Documet, Burke et al.	2018	T3		*			
45. Pardos de la Gandara, Raygoza Garay, Mwangi et al.	2015	T2		*			
46. Rubin, Allukian, Wang et al.	2014	T3		*			
47. Seale, Fifield, Davis-Smith et al.	2013	T3		*			
48. Shaibi, Konopken, Nagle-Williams et al.	2015	T3		*			
49. Valdez Soto, Balls-Berry, Bishop et al.	2016	T3		*			
50. Van Olphen, Ottoson, Green et al.	2009	T3		*			
51. Vona, Baweja, Santiago et al.	2018	T3		*			
52. Amed, Shea, Pinkney et al.	2016	T4	*				
53. Baptiste, Blachman, Cappella et al.	2012	T3	*				
54. Batik, Phelan, Walwick et al.	2008	T3	*				
55. Bloomquist, August, Horowitz et al.	2008	T4	*				
56. Foley, Hasson, Kendall	2018	T3	*				
57. Heck, Shakarjian, Fan et al.	2011	T3	*				
58. Jones, Lopez, Simons et al.	2013	T3	*				
59. Kaholokula, Wilson, Townsend et al.	2014	T4	*				

60.	Katula, Vitolins, Espeland et al.	2009	T4	*			
61.	Piatt, Seidel, Chen et al.	2012	T3	*			
62.	Reid, Laussen, Bhatia et al.	2018	T3	*			
63.	Rosal, White, Borg et al.	2010	T3	*			
64.	York, Shumway-Cook, Silver et al.	2011	T3	*			
65.	Zimmermann, Khare, Koch et al.	2014	T3	*			

Table 3. Number and percent of articles by categories of translational phase (T0-T4) and community engagement

Translational Phase	Community Engagement					Total
	Outreach	Consult	Involve	Collaborate	Shared leadership	
T0	-	-	-	-	-	-
T1	-	-	-	-	-	-
T2	0	3	0	1	3	7
% within translational level	(0%)	(42.9%)	(0%)	(14.3%)	(42.9%)	
% across engagement level	(0%)	(23.1%)	(0%)	(6.7%)	(18.8%)	
T3	10	10	6	10	7	43
% within translational level	(23.2%)	(23.2%)	(14.0%)	(23.2%)	(16.3%)	
% across engagement level	(71.4%)	(76.9%)	(85.7%)	(66.7%)	(43.8%)	
T4	4	0	1	4	6	15
% within translational level	(26.7%)	(0%)	(6.7%)	(26.7%)	(40%)	
% across engagement level	(28.6%)	(0%)	(14.3%)	(26.7%)	(37.5)	
Total	14	13	7	15	16	65
	(21.5%)	(20%)	(10.8%)	(23.1%)	(24.6%)	

proportion of community-engaged studies, though the level of engagement was relatively equally distributed from outreach to shared-leadership. The results also demonstrate that researchers engaged in population health research (T4) were proportionally the most likely to use the highest levels of collaboration in their work (i.e., collaboration and shared decision-making). Specifically, T4 studies represented 23 percent of those included, but 32 percent of the studies that engaged at the levels of collaboration and shared leadership. Finally, T2 studies appeared to be bi-modal in that three out of seven studies were classified collaboration and three were classified as shared-leadership.

Discussion

Our scoping review was completed to fill the gap in the literature related to the depth of community-engagement in research across the translational spectrum. We found that the majority of studies that used community-engagement were in the translational stage of dissemination and implementation science (T3) with a sizable but much smaller proportion focused on population health research questions (T4). In their review, Fort *et al.* [3] described T3 and T4 as the only phases focused on studying the movement or research-tested principles to promote population and community health and proposed this may limit the possibility to involve the community at T0, T1, and T2-our findings partially supported this hypothesis.

This should not be interpreted that our findings support that there is only a need for community-engagement in later stages of translational research or that there is no value in high community engagement for earlier stages. We found that a small number of T2 studies used shared leadership approaches even though the focus was on developing initial intervention efficacy. A good example of this is the work by Yeary and colleagues [27]. They used the CBPR approach to examine the common biological processes that cause illness in breast cancer. The community participated in the selection of the health priority, the design of the study, and the development of the study materials.

Most of the studies where the community was involved reported obtaining a wide range of positive outcomes because of the implementation of the research in a community setting [28-30]. For instance, researchers at the Rockefeller University Center for Clinical

and Translational Science (CCTS) published an article describing their collaboration with a community in New York City to analyze the nature of the community-acquired *Staphylococcus aureus* strains that causes skin and soft tissue infections [31]. In this study, the community health centers were involved in the recruitment of participants for the study although there are limited details about the extent of the collaboration.

In some studies, the researchers collaborated with the community (collaboration and shared partnership) using the CBPR approach [32-33] and provided a detail description of the partnership, the trust-building process, and how they applied the CBPR principles throughout the study. The CBPR approach was sometimes adapted in an attempt to overcome the geographical and cultural challenges of the community [34]. Ford *et al.* [34] collaborated with the indigenous youths to improve the well-being of the community and youth resiliency in Alaska; a priority identified by the community. The advisory board was only composed of community members (youths, adults, and elders) and some youth trained in research methods; there was little to no direct involvement of the researchers in the implementation and dissemination of the findings. The intention of the researchers was to build the research capacity of the youth in the community.

On the other hand, in some studies the community was not involved in determining who would participate on a community-academic advisory board despite using the CBPR approach. For instance, researchers did not include non-related health organizations on their board in a study that aimed to reduce the risk of diabetes among Latinos living in Lawrence, Massachusetts [35]. In this study, the community-engagement reported appeared to be operationalized as research participants from the community equating with community involvement. The CBPR approach is a long-term process that requires building trust over time. However, researchers often involved the community as an afterthought. In these cases, the projects were generally funded, and researchers already identified the health priority to address-then attempted to engage community in the process [29,36].

Despite our efforts to include a wide range of papers, our analysis was limited and might have excluded some articles fitting the eligibility criteria. We could only rely on the strength of our search strategy and the consistency analysis. A second limitation is the breadth and depth

of the search. We only reviewed studies from the past 10 years. A third limitation is our classification of the papers. There is a possibility of misclassification of the articles in different phases of community engagement although we implemented strategies to minimize this.

Below are key recommendations to assist researchers with engaging community at *all* translational research phases:

- Establish a practical concept of community engagement in the translational research phases (T0-T4) using the Community Engagement Continuum (See Figure 1).
- Develop trainings to guide researchers on how to engage and partner with the community in all phases of translational research.
- Publish translational research articles with a detailed description of how community is defined and engaged in the study.
- Provide mentoring opportunities for community and academic researchers to engage in community-academic partnered research.
- Offer a Translational Research Graduate Certificate Program. This provides an opportunity for graduate students to pair with researchers trained in community-engaged research during their service-learning projects [37].
- Develop and offer a Community-Academic Partnered Grant Writing Series: This gives new and previously established community-academic partnered teams an opportunity to build or maintain trust and rapport while developing a grant proposal to address a pressing need in their respective communities [38].
- Provide opportunities for the community to learn about academic research in their respective communities and beyond. It is also an opportunity for academic researchers to network with community organizations to begin the partnership development process and focus on the needs that are most pertinent to the community [39].

Our findings support the hypothesis that the majority of phases of translational research can engage community in the scientific process [39]. We also found that some overlap exists between patient-engaged research, integrated research-practice partnerships, and community systems-based approaches [14,22,24,28,40,41]. The recent reviews of translational research did not describe whether there was community involvement or engagement in the research process. This review fills the gap and provides an understanding of community engagement on a continuum within the context of translational research. A universal understanding of the various levels of community engagement, with the principles of the CBPR approach being the highest level of community engagement, could fill gaps in understanding how to engage the community in research. It is vital to encourage the involvement of community in translational research to expedite the translation of knowledge into practice and enable practice-based needs to inform policy [37].

Authorship

According to the ICMJE guidelines, all my co-authors contributed to this manuscript and approved this submission. Keyonna King, Tatiana Tchouankam, Heidi Keeler, Christian Minter, Grace Cai, and Paul Estabrooks wrote the manuscript; Keyonna King, Heidi Keeler, and Paul Estabrooks designed the research; Keyonna King, Tatiana Tchouankam, Heidi Keeler, Maria Teel, and Kenya Love performed research and analyzed the data; Christian Minter contributed analytical

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Conflicts of interest

The authors whose names are listed above certify that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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