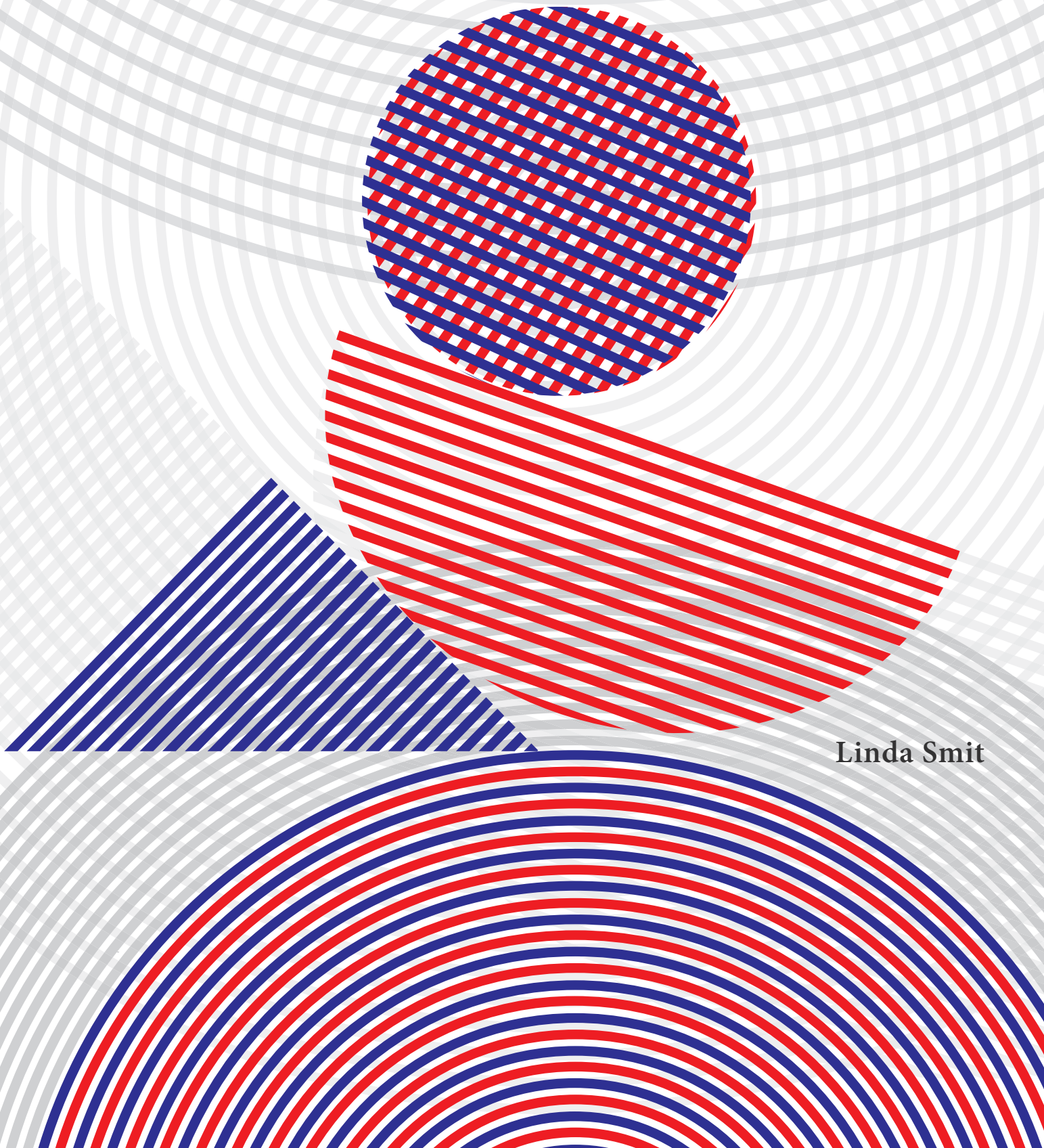


**Methodological challenges of complex proactive  
primary care programs for older people**



Linda Smit

# **Methodological challenges of complex proactive primary care programs for older people**

Linda Smit

**Methodological challenges of complex proactive primary care programs for older people**

ISBN: 978-90-831713-4-0

DOI: 10.33540/837

Cover design: Marjolein van Wijk

Printed by: Print Service Ede

©2021, Linda Smit

All rights reserved. No part of this thesis may be reproduced or transmitted in any form or by any means, without the permission of the author.

# **Methodological challenges of complex proactive primary care programs for older people**

## **Methodologische uitdagingen van complexe proactieve eerstelijns ouderenzorgprogramma's**

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht  
op gezag van de rector magnificus, prof.dr. H.R.B.M. Kummeling,  
ingevolge het besluit van het college voor promoties in het openbaar te verdedigen  
op dinsdag 14 september 2021 des middags om  
12.15 uur

door

**Aleida Catharina Smit**

geboren op 18 augustus 1989  
te Zwolle

**Promotoren:** Prof. dr. M.J. Schuurmans

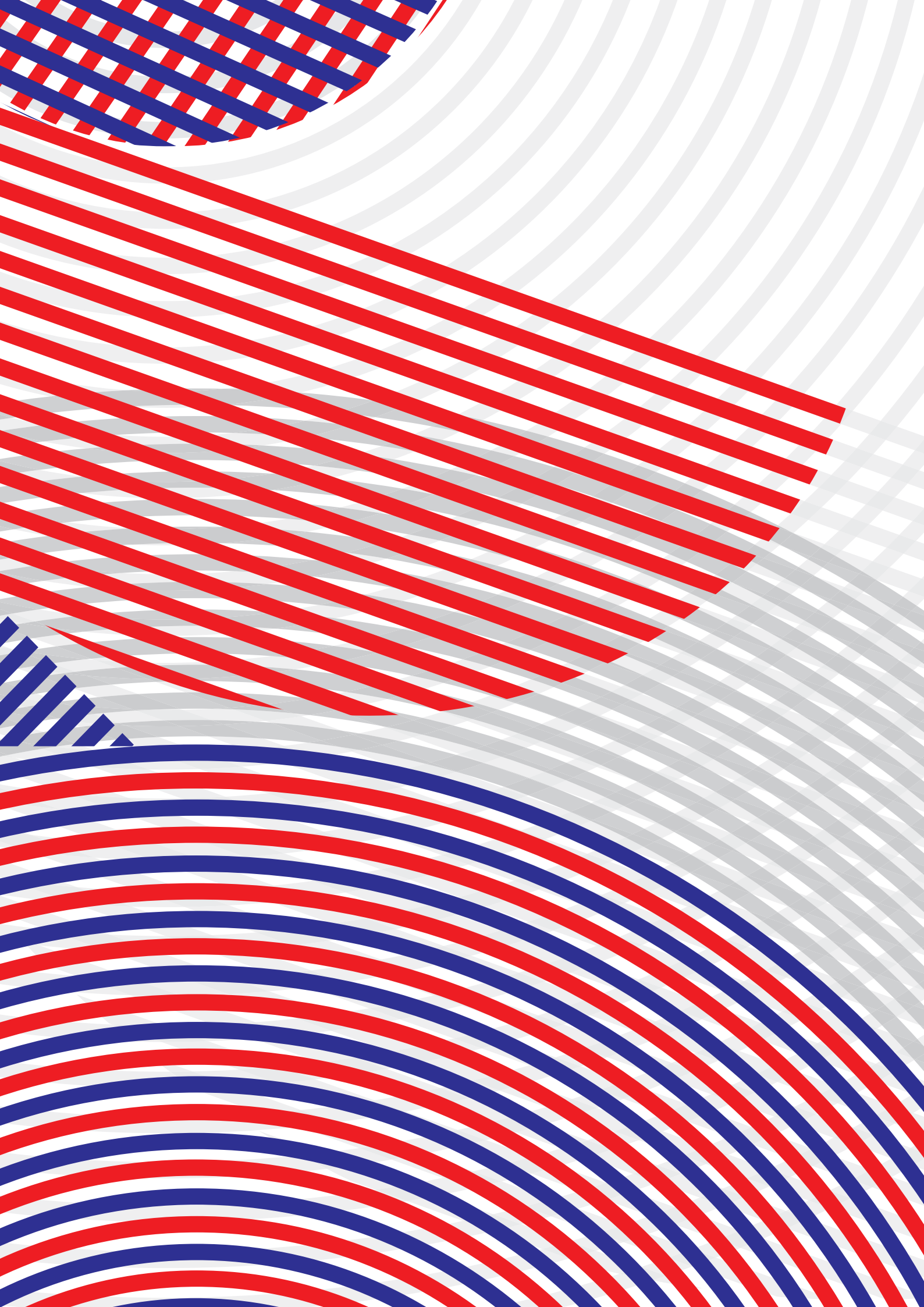
Prof. dr. N.J. de Wit

**Copromotor:** Dr. N. Bleijenberg

We gratefully acknowledge the financial support provided by the Netherlands Organization for Health Research and Development (ZonMw) (grant numbers 63300095103; 63300095110; 6330009816014) and the Master of Integrated Care Design at the University of Applied Science Utrecht for the design and printing of this thesis.

# CONTENT

<b>Chapter 1</b>	General introduction	7
<hr/>		
<i>Part 1</i>	<i>Unravelling the development and evaluation of complex proactive primary care programs for older people living at home</i>	
<hr/>		
<b>Chapter 2</b>	Unravelling complex primary care programmes to maintain independent living in older people: a systematic overview	21
<b>Chapter 3</b>	Influence of organizational context on patient outcomes regarding the effectiveness of a proactive primary care program: a longitudinal observational study	71
<b>Chapter 4</b>	Value of social network analysis for developing and evaluating complex healthcare interventions: a scoping review	93
<hr/>		
<i>Part 2</i>	<i>Improving the interprofessional collaboration between professionals involved in proactive primary care programs for older people</i>	
<hr/>		
<b>Chapter 5</b>	The methodological development of an interprofessional educational program to provide proactive integrated care for elders	149
<b>Chapter 6</b>	Implementation of an interprofessional collaboration in practice program: a feasibility study using social network analysis	179
<b>Chapter 7</b>	How context influences the effectiveness of complex primary care interventions: a discussion paper	205
	Summary	223
	Samenvatting	229
	List of publications and presentations	237
	Dankwoord	243
	Curriculum Vitae	251



# 1

## General Introduction



### Research waste

In 2014, *The Lancet* published a series of reviews demonstrating the poor design, conduct, and reporting of scientific research projects, which was labelled as research waste.<sup>1-5</sup> In 2009, it was calculated that 85% of the more than \$100 billion a year spent on medical research universally was being wasted avoidably.<sup>6</sup> This waste arises from the impurities at different stages of research, as over 50% of research is not published, over 50% has avoidable design flaws, and over 50% is unusable or incompletely reported.<sup>7</sup> Another aspect of research waste in healthcare concerns the inadequacy of knowledge translation, as much research output fails to result in changes in clinical practice.<sup>5</sup> On average, the traditional research pipeline from study to practice takes 17 years, but unfortunately, only 14% of the original research is implemented into clinical practice.<sup>8,9</sup> One of the explanations for this gap is that current intervention research, including the development, evaluation and implementation, does not fit with daily practice, which is a more complex, dynamic and less-resourced real-world setting than the experimental research environment.<sup>10-12</sup>

### Ageing population

The real world of clinical practice is continuously changing; one of the drivers being the rapidly ageing population. In Europe, the number of older people is expected to increase 35% by 2050, and the group of oldest-old (e.g. 80 years and older) is expected to even triple by 2060.<sup>13</sup> This increasing proportion of older people is caused by decreased fertility rates and the increased life expectancy.<sup>14</sup> In 2019, 19.2% of the Dutch population was aged 65 years and older, prognoses indicate further ageing of the Dutch population to 26.0% 65 years and older by the year 2060.<sup>15</sup> Within the ageing population, there is a simultaneous growth of people living with multimorbidity, defined as the coexistence of two or more chronic conditions in the same individual.<sup>16</sup> Multimorbidity is one of the key factors in the concept of frailty, which is defined as a declined physiological function and reserve, and increased susceptibility to stressors during the ageing process.<sup>17-20</sup> Frailty induces the risk of adverse outcomes, including falls, disability, institutionalization (e.g. hospitalization and nursing home admission), and mortality.<sup>20-24</sup> The prevalence of frailty in community-dwelling older people is estimated to be 11%, with a range reported in different studies (4%–59%), dependent on age group, concept and instrument used.<sup>25</sup>

Due to the rapid increase of the number of frail older people with complex care needs, health care service utilization and costs increase, urging health care systems to innovate care for older people.<sup>26</sup> Driven by the high costs, national health policies' key target is to avoid institutionalization in residential care or nursing homes.<sup>27</sup> Rather than being institutionalized, frail older people with their complex needs in multiple domains should stay in the community which stimulates autonomy and independent living.<sup>27,28</sup> General practices and primary care professionals - so-called gatekeepers - become mainly responsible for the care for these frail older people.<sup>29</sup> The delivery of care for the elderly, however, has been criticized as being fragmented as modern healthcare has led to the specialization of health care professionals.<sup>30-32</sup> To address the complex needs of frail older people in a fragmented care system, collaboration between professionals from the medical and social domain is essential.<sup>33,34</sup> Hence, the provision of high-quality integrated and effective care for the ageing population with a key focus on maintaining independence is a major challenge.<sup>35</sup>

### **Proactive primary care programs**

Preventive, integrated care is increasingly promoted in literature as the leading concept in future elderly care and key to keep frail older people functioning independently in the community.<sup>36</sup> Proactive, integrated care interventions are defined as an organizational process of coordination aiming to achieve seamless and continuous care, tailored to the patient's needs (based on a holistic view of the patient) focusing on maintaining independence and prevention of functional decline.<sup>36-38</sup> A proactive care program links the curative medical domain to areas like prevention, mental health, housing and welfare, requiring interprofessional collaboration.<sup>39,40</sup> An interprofessional collaborative care practice occurs when multiple health workers from different professional backgrounds provide comprehensive services by working with patients and their families, caregivers, and communities to deliver the highest quality of care.<sup>40</sup> To create an interprofessional collaborative practice, a partnership between a team of health and social care professionals and patients, clients, families, and communities is needed.<sup>40,41</sup>

As part of the National Program Care for Older People, in the Netherlands, nine large scaled proactive primary care programs aiming at maintaining independence of community-dwelling older people, were evaluated in controlled trials.<sup>24,42-49</sup> These programs all consisted of a nurse-led care plan and had a significant role in executing the proactive primary care programme for registered nurses or practice nurses in primary care. To date, none of these proactive primary care programs has demonstrated substantial clinically relevant improvement of daily functioning.<sup>24,42-49</sup> A systematic review of Looman et al. (2019) concluded that there is no solid

evidence that preventive, integrated care prevents functional decline.<sup>38</sup> A recently published systematic review Deschodt et al. (2020) observed that although many essential components of integrated care are present in these proactive primary care programs, there is no solid evidence that these programs impact health outcomes of the older population.<sup>50</sup> These observations trigger the question of why these so-called complex interventions fail to demonstrate outcome improvement in elderly care and if this was related to their design or inadequate implementation.

### Complex interventions

Proactive primary care programs can be defined as complex interventions since they are complex by nature, are targeted at both professionals and patients, are multi-faceted, with many interacting components.<sup>51</sup> Interventions can be conceptualized as having ‘core components,’ i.e. the essential and indispensable elements of the intervention and an ‘adaptable periphery,’ i.e. adaptable elements, structures, and systems related to the intervention and organization into which it is being implemented.<sup>52,53</sup> Hence, these multiple interacting and synergetic components are often criticized for their ‘black box’ concept. Not knowing the contents of the black box makes it difficult to understand why an intervention succeeds or fails. Undefined black boxes cannot be reported in detail which may hinder the replication of the intervention and induce research waste defined as correctable weaknesses in the design, execution or analysis of complex interventions.<sup>4,54,55</sup>

Implementing complex healthcare interventions can be difficult since implementation barriers may arise at the patient- and healthcare provider level, which is dependent on the context.<sup>56</sup> The context – that of the patient, the practice and the setting in which care is provided – affects the effectiveness of interventions and therefore co-determines the research results. Every component of an intervention, in this case, proactive primary care programs, should fit the context in which the programme is delivered.<sup>1,6</sup> For example, primary care programs include elements of integrated care for which interprofessional collaboration seems essential. If this collaboration is suboptimal, the vital working mechanism of this primary care program may be in danger. Examining context can contribute to a better understanding of the implementation<sup>52,57-60</sup> and are essential to determine the optimal implementation strategy.<sup>59</sup> Generic approaches (‘one size fits all’) may poorly fit the specific setting, which evokes resistance of individuals affected by the intervention and hamper engagement of individuals needed to accomplish successful implementation. Therefore, to limit the risk of inadequate implementation and the failure to replicate, more emphases should be given in intervention research on the implementation context.<sup>56,61</sup>

## Aim and objective of this thesis

The general aim of this thesis is to unravel and better understand the methodological challenges of complex proactive care programs for older people, the impact of the context in which they are delivered, and the importance of interprofessional collaboration to improve their implementation success.

Therefore, the objectives of this thesis are as follows:

1. To unravel the development, the evaluation and the contextual factors of complex proactive care programs for older people living at home.
2. To improve the interprofessional collaboration between professionals involved in proactive care programs for older people.

## Outline of this thesis

The first part of the thesis addresses the unravelling of the development, the evaluation and the contextual factors of complex proactive care programs. In *Chapter 2*, insights into the complex process of developing and evaluating primary care programs are presented based on a systematic overview of all written data on nine proactive primary-care programs within a controlled trial. In *Chapter 3*, the question is addressed which characteristics of general practices are associated with daily functioning and acute admissions of frail older people who received an implemented proactive primary-care program. Next, in *Chapter 4*, a scoping review is described, presenting the value of social network analysis in studies that develop or evaluate complex interventions.

The second part of the thesis focuses on improving interprofessional collaboration between professionals involved in proactive care programs for older people. In *Chapter 5*, a study described the methodological development and the final content of an interprofessional collaboration in practice program for primary care. In *Chapter 6*, a feasibility study using social network analysis is described regarding the developed interprofessional collaboration in practice program on interprofessional collaboration of health care professionals working in primary care.

*Chapter 7* consists of a critical reflection on how context influences the effectiveness of complex primary care interventions.

## REFERENCES

1. Chalmers I, Bracken MB, Djulbegovic B, et al. How to increase value and reduce waste when research priorities are set. *Lancet*. 2014;383(9912):156–65.
2. Salman RA-S, Beller E, Kagan J, et al. Increasing value and reducing waste in biomedical research regulation and management. *Lancet*. 2014;383(9912):176–85.
3. Glasziou P, Altman DG, Bossuyt P, et al. Reducing waste from incomplete or unusable reports of biomedical research. *Lancet*. 2014;383(9913):267–76.
4. Ioannidis JP, Greenland S, Hlatky MA, et al. Increasing value and reducing waste in research design, conduct, and analysis. *Lancet*. 2014;383(9912):166–75.
5. Macleod MR, Michie S, Roberts I, et al. Biomedical research: increasing value, reducing waste. *Lancet*. 2014;383(9912):101–4.
6. Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. *Lancet*. 2009;374(9683):86–9.
7. Glasziou P, Chalmers I. Paul Glasziou and Iain Chalmers: Is 85% of health research really “wasted.” *BMJ Opinion*. 2016. <https://blogs.bmj.com/bmj/2016/01/14/paul-glasziou-and-iain-chalmers-is-85-of-health-research-really-wasted>. Accessed May 3, 2021.
8. Balas EA, Boren SA. Managing clinical knowledge for health care improvement. *Yearb Med Inform*. 2000; 9(01),65-70.
9. Green LW, Ottoson JM, Garcia C, Hiatt RA. Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Annu Rev Public Health*. 2009;30:151-174.
10. Douglas NF, Burshnic VL. Implementation science: Tackling the research to practice gap in communication sciences and disorders. *Perspectives of the ASHA Special Interest Groups*. 2019;4(1):3–7.
11. Green LW, Ottoson JM, García C, Hiatt RA, Roditis ML. Diffusion theory and knowledge dissemination, utilization and integration. *Front Public Health Serv Syst Res*. 2014;3(1):3.
12. Huebschmann AG, Leavitt IM, Glasgow RE. Making health research matter: a call to increase attention to external validity. *Annu Rev Public Health*. 2019;40:45–63.
13. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Ageing 2017 - Highlights (ST/ESA/SER.A/397)*. [Updated 2017]. Available from: [https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017\\_Highlights.pdf](https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf). Accessed May 3, 2021.
14. World Health Organization. *World report on ageing and health*. Geneva: World Health Organization; 2015.
15. CBS, Centraal Bureau voor de Statistiek. *Nederland in cijfers*. [The Netherlands in numbers] [Updated 2021]. Available from:
16. <https://opendata.cbs.nl/statline/#/CBS/nl/navigatieScherm/thema?themaNr=3770>. Accessed May 3, 2021.
17. Mercer S, Furler J, Moffat K, Fischbacher-Smith D, Sancu L. *Multimorbidity: technical series on safer primary care*. Geneva: World Health Organization; 2016.

18. Vetrano DL, Palmer K, Marengoni A, et al. Frailty and multimorbidity: a systematic review and meta-analysis. *J Gerontol A*. 2019;74(5):659–66.
19. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;56(3):M146–57.
20. Hoogendijk EO, Afilalo J, Ensrud KE, et al. Frailty: implications for clinical practice and public health. *Lancet*. 2019;394(10206):1365–75.
21. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381(9868):752–62.
22. Makizako H, Shimada H, Doi T, Tsutsumimoto K, Suzuki T. Impact of physical frailty on disability in community-dwelling older adults: a prospective cohort study. *BMJ Open*. 2015;5(9).
23. Kojima G. Frailty defined by FRAIL scale as a predictor of mortality: a systematic review and meta-analysis. *J Am Med Dir Assoc*. 2018;19(6):480–3.
24. Dent E, Kowal P, Hoogendijk EO. Frailty measurement in research and clinical practice: a review. *Eur. J. Intern. Med*. 2016;31:3–10.
25. Bleijenberg N, Drubbel I, Schuurmans MJ, et al. Effectiveness of a proactive primary care program on preserving daily functioning of older people: a cluster randomized controlled trial. *J Am Geriatr Soc*. 2016;64(9):1779–88.
26. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc*. 2012;60(8):1487–92.
27. Pavolini E, Ranci C. Restructuring the welfare state: reforms in long-term care in Western European countries. *J Eur Soc Policy*. 2008;18(3):246–59.
28. Wiles JL, Leibing A, Guberman N, Reeve J, Allen RE. The meaning of “aging in place” to older people. *Gerontologist*. 2012;52(3):357–66.
29. De Groot K, De Veer A, Versteeg S, Francke A. *Het organiseren van langdurige zorg en ondersteuning voor thuiswonende patiënten: ervaringen van praktijkondersteuners in de huisartsenzorg*. [The organization of long-term care and support for community-dwelling patients: experiences from practice nurses in GP care.] Utrecht: NIVEL; 2018.
30. Boeckxstaens P, De Graaf P. Primary care and care for older persons: position paper of the European Forum for Primary Care. *Qual Prim Care*. 2011;19(6):369.
31. Enthoven AC. Integrated delivery systems: the cure for fragmentation. *Am J Manag Care*. 2009;15(12):S284.
32. Osborn R, Moulds D, Squires D, Doty MM, Anderson C. International survey of older adults finds shortcomings in access, coordination, and patient-centered care. *Health Aff*. 2014;33(12):2247–55.
33. Kromhout M, Kornalijslijper N, De Klerk M. *Veranderde zorg en ondersteuning voor mensen met een beperking* [Changed care and support for people with disabilities]. Landelijke evaluatie van de Hervorming Langdurige Zorg. Den Haag: Sociaal en Cultureel Planbureau; 2018. Available from: <https://www.scp.nl/binaries/scp/documenten/>

- publicaties/2018/06/27/veranderde-zorg-en-ondersteuning-voor-mensen-met-een-beperking/Veranderde+zorg+en+ondersteuning+voor+mensen+met+een+beperving.pdf. Accessed May 6, 2021.
34. Van Kempen JA, Robben SH, Zuidema SU, Rikkert MGO, Melis RJ, Schers HJ. Home visits for frail older people: a qualitative study on the needs and preferences of frail older people and their informal caregivers. *Br J Gen Pract.* 2012;62(601):e554–60.
  35. NZa, Nederlandse Zorgautoriteit. *Monitor Zorg voor Ouderen* [Monitoring care for older people]. Utrecht: Nederlandse Zorgautoriteit. [Updated 2018] Available from: [https://puc.overheid.nl/nza/doc/PUC\\_234967\\_22/1/](https://puc.overheid.nl/nza/doc/PUC_234967_22/1/). Accessed May 3, 2021.
  36. Rechel B, Grundy E, Robine J-M, et al. Ageing in the European union. *Lancet.* 2013;381(9874):1312–22.
  37. Beswick AD, Rees K, Dieppe P, et al. Complex interventions to improve physical function and maintain independent living in elderly people: a systematic review and meta-analysis. *Lancet.* 2008;371(9614):725–35.
  38. Markle-Reid M, Browne G, Weir R, Gafni A, Roberts J, Henderson SR. The effectiveness and efficiency of home-based nursing health promotion for older people: a review of the literature. *Med Care Res Rev.* 2006;63(5):531–69.
  39. Looman WM, Huijsman R, Fabbriotti IN. The (cost-) effectiveness of preventive, integrated care for community-dwelling frail older people: A systematic review. *Health Soc Care Community.* 2019;27(1):1–30.
  40. Ex C, Gorter K, Janssen U. *Providing integrated health and social care for older persons in the Netherlands: PROCARE Report.* Utrecht: The Verwey Jonker Institute for Research into Social Issues; 2003.
  41. World Health Organization. *Framework for action on interprofessional education and collaborative practice.* Geneva: World Health Organization; 2010.
  42. Bookey-Bassett S, Markle-Reid M, Mckey CA, Akhtar-Danesh N. Understanding interprofessional collaboration in the context of chronic disease management for older adults living in communities: a concept analysis. *J Adv Nurs.* 2017;73(1):71–84.
  43. Blom J, Den Elzen W, Van Houwelingen AH, et al. Effectiveness and cost-effectiveness of a proactive, goal-oriented, integrated care model in general practice for older people. A cluster randomised controlled trial: Integrated Systematic Care for older People—the ISCOPE study. *Age Ageing.* 2016;45(1):30–41.
  44. Metzelthin SF, Van Rossum E, De Witte LP, et al. Effectiveness of interdisciplinary primary care approach to reduce disability in community dwelling frail older people: cluster randomised controlled trial. *BMJ.* 2013;347.
  45. Looman WM, Fabbriotti IN, De Kuyper R, Huijsman R. The effects of a pro-active integrated care intervention for frail community-dwelling older people: a quasi-experimental study with the GP-practice as single entry point. *BMC Geriatr.* 2016;16(1):1–10.

46. Hoogendijk EO, Van Der Horst HE, Van De Ven PM, et al. Effectiveness of a geriatric care model for frail older adults in primary care: results from a stepped wedge cluster randomized trial. *Eur J Intern Med.* 2016;28:43–51.
47. Ruikes FG, Zuidema SU, Akkermans RP, Assendelft WJ, Schers HJ, Koopmans RT. Multicomponent program to reduce functional decline in frail elderly people: a cluster controlled trial. *J Am Board Fam Med.* 2016;29(2):209–17.
48. Stijnen M, Vrijhoef H, Jansen M, Candel M, Duimel-Peeters I. Effectiveness of a nurse-led home visitation programme on health-related quality of life and disability among potentially frail community-dwelling older people in primary care: a longitudinal, quasi-experimental study. Towards proactive care for potentially frail older people in general practice. 2015;121.
49. Suijker JJ, Van Rijn M, Buurman BM, Ter Riet G, Moll Van Charante EP, de Rooij SE. Effects of nurse-led multifactorial care to prevent disability in community-living older people: cluster randomized trial. *PloS One.* 2016;11(7):e0158714.
50. Uittenbroek RJ, Kremer HP, Spoorenberg SL, Reijneveld SA, Wynia K. Integrated care for older adults improves perceived quality of care: results of a randomized controlled trial of embrace. *J Gen Intern Med.* 2017;32(5):516–23.
51. Deschodt M, Laurent G, Cornelissen L, et al. Core components and impact of nurse-led integrated care models for home-dwelling older people: a systematic review and meta-analysis. *Int J Nurs Stud.* 2020;105:103552.
52. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ.* 2008;337.
53. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4(1):1–15.
54. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the consolidated framework for implementation research. *Implement Sci.* 2015;11(1):1–13.
55. Hawe P, Shiell A, Riley T, Gold L. Methods for exploring implementation variation and local context within a cluster randomised community intervention trial. *J Epidemiol Community Health.* 2004;58(9):788–93.
56. Oakley A, Strange V, Bonell C, Allen E, Stephenson J. Process evaluation in randomised controlled trials of complex interventions. *BMJ.* 2006;332(7538):413–6.
57. Stirman SW, Miller CJ, Toder K, Calloway A. Development of a framework and coding system for modifications and adaptations of evidence-based interventions. *Implement Sci.* 2013;8(1):1–12.
58. Van Meijel B, Gamel C, Van Swieten-Duijfjes B, Grypdonck M. The development of evidence-based nursing interventions: methodological considerations. *J Adv Nurs.* 2004;48(1):84–92.



## Chapter 1

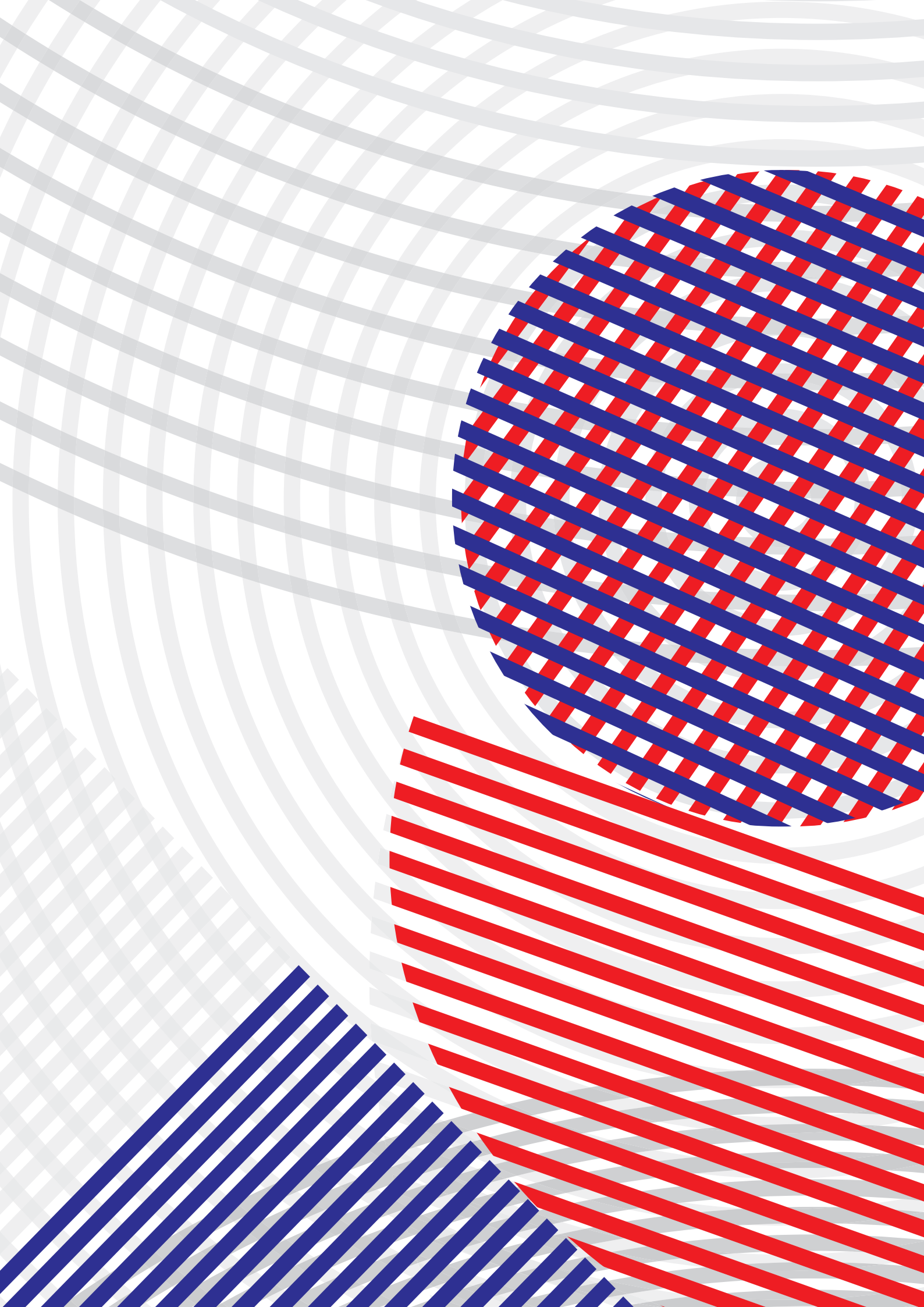
59. Conn VS, Groves PS. Protecting the power of interventions through proper reporting. *Nurs Outlook*. 2011;59(6):318–25.
60. Pinnock H, Barwick M, Carpenter CR, et al. Standards for reporting implementation studies (StaRI) statement. *BMJ*. 2017;356.
61. Shippee ND, Shah ND, May CR, Mair FS, Montori VM. Cumulative complexity: a functional, patient-centered model of patient complexity can improve research and practice. *J Clin Epidemiol*. 2012;65(10):1041–51.
62. Bleijenberg N, Janneke M, Trappenburg JC, et al. Increasing value and reducing waste by optimizing the development of complex interventions: Enriching the development phase of the Medical Research Council (MRC) Framework. *Int J Nurs Stud*. 2018;79:86–93.





# Part 1

**Unravelling the development,  
the evaluation and the  
contextual factors of complex  
proactive care programs for  
older people living at home**



# 2

## **Unravelling complex primary care programmes to maintain independent living in older people: a systematic overview**

Smit LC, Schuurmans MJ, Blom JW, Fabbricotti IN, Jansen APD, Kempen GIJM, Koopmans R, Looman WM, Melis RJF, Metzelthin SF, Moll van Charante EP, Muntinga ME, Ruikes FGH, Spoorenberg SLW, Suijker JJ, Wynia K, Gussekloo J, De Wit NJ, and Bleijenberg N.

*Journal of Clinical Epidemiology.* 2018; 96, 110-119.

## ABSTRACT

**Background:** Complex interventions are criticized for being a ‘black box’, which makes it difficult to determine why they succeed or fail. Recently, nine proactive primary care programmes aiming to prevent functional decline in older adults showed inconclusive effects. The aim of this study was to systematically unravel, compare and synthesize the development and evaluation of nine primary care programs within a controlled trial to further improve the development and evaluation of complex interventions.

**Methods:** A systematic overview of all written data on the nine proactive primary care programmes was conducted using a validated item list. The nine proactive primary care programmes involved 214 general practices throughout the Netherlands.

**Results:** There was little or no focus on the 1) context surrounding the care programme, 2) modelling of processes and outcomes, 3) intervention fidelity and adaptation, and 4) content and evaluation of training for interventionists.

**Conclusion:** An in-depth analysis of the context, modelling of the processes and outcomes, measurement and reporting of intervention fidelity, and implementation of effective training for interventionists is needed to enhance the development and replication of future complex interventions.

## INTRODUCTION

Over the last decades, great emphasis has been placed on the development of complex interventions, which are defined as interventions with multiple interacting and synergetic components.<sup>1</sup> Several frameworks are available for the development and evaluation of complex interventions.<sup>1-5</sup> These frameworks highlight the importance of a systematic development and evaluation process.<sup>1,3,6</sup> Reporting guidelines have addressed the relevance of careful reporting to enhance replication and reduce research waste.<sup>7-13</sup> However, no systematic overview was found that combines insights from frameworks and from reporting guidelines on the development and evaluation of complex interventions aiming to improve future designs and outcomes. In 2008, the Dutch Ministry of Health, Welfare, and Sport commissioned the Dutch National Care for Elderly Programme (NCEP) with a budget funding of 80 million euros. The NCEP had the goal of developing a more proactive, integrated health care system for older patients. Research groups from The Netherlands could apply for a grant when they had a study proposal on how they could achieve proactive and integrated care for older people. As a result, more than 70 scientific projects were conducted and financed within the NCEP between 2009 and 2015.<sup>14</sup> Of these 70 projects, nine large scaled trials, were all funded by the NCEP program and all had the goal to preserve or improve daily functioning as a primary outcome among community-living older people in The Netherland. These trials used the same questionnaire for evaluation, i.e. the TOPIC-MDS.<sup>14</sup> All nine trials were proactive primary care programmes aimed at maintaining independent living in community-dwelling older people which have been evaluated in controlled trials.<sup>15-23</sup> Proactive indicate early identification of patient at risk and early detection of possible health problems to prevent adverse health outcomes and acute care. These nine proactive care programs consist of a nurse-led care plan and had a significant role in the execution of the proactive primary care programme for registered nurses or practice nurses in primary care.

To date, none of these proactive primary care programmes have demonstrated clinically relevant effects on daily functioning.<sup>15-23</sup> The multiple interacting and synergetic components of these proactive primary care programmes are often criticized for their 'black box' concept. Not knowing the contents of the black box makes it difficult to understand why an intervention succeeds or fails. Within the nine controlled trials, uniform outcome parameters were collected and evaluated within comparable contexts, providing a unique opportunity to further study the process of development and evaluation of these complex interventions.<sup>1,8,24</sup> Therefore, we assessed the details of the development and evaluation processes of the nine proactive primary care programmes that have been evaluated within the



NCEP. The aim of this study was to systematically unravel, compare and synthesize the development and evaluation process of nine primary care programs within a controlled trial to further improve the development and evaluation of complex interventions for (frail) older adults who live at home.

## METHODS

### Design

A systematic overview of all written data on the nine proactive primary care programmes – retrieved from the principal researcher of each proactive primary care programme – was conducted using a validated itemized list developed based on the literature on complex interventions. The itemized list was used as a tool to systematically extract data to unravel, compare and synthesize the development and evaluation process of nine proactive primary care programmes within a controlled trial. Ethical approval was not required.

### Eligibility criteria for the proactive primary care programmes

This study included randomized controlled trials that investigated the effectiveness of proactive primary care programmes in the Netherlands. The selection of studies were based on the fact that all included studies used the same questionnaire to evaluate the effect of the proactive primary care program as indicated by the NCEP.<sup>14</sup>

The following inclusion criteria were applied:

- The study was conducted within the NCEP between 2009 and 2015.
- The intervention included a nurse-led care plan as part of the proactive primary care programme for (frail) older persons.
- Registered nurses or practice nurses in primary care had a significant role in the execution of the proactive primary care programme.

### Data collection

The principal investigators and research groups involved in the development and evaluation of the nine proactive primary care programmes were contacted by email. The researchers were invited to provide all available data and materials regarding the development and evaluation of the interventions, such as (research) reports, publications, theses, yearly reports for funders, educational/training

materials and information concerning the recruitment and training of the interventionists. The goal was to systematically unravel, compare and synthesize the available information to gain insights into the similarities and differences in the development and evaluation of these proactive primary care programmes. For one proactive primary care programme (Programme 8), only published data could be obtained because the project was finished and the principal researcher was no longer available.

### **Development of the itemized list**

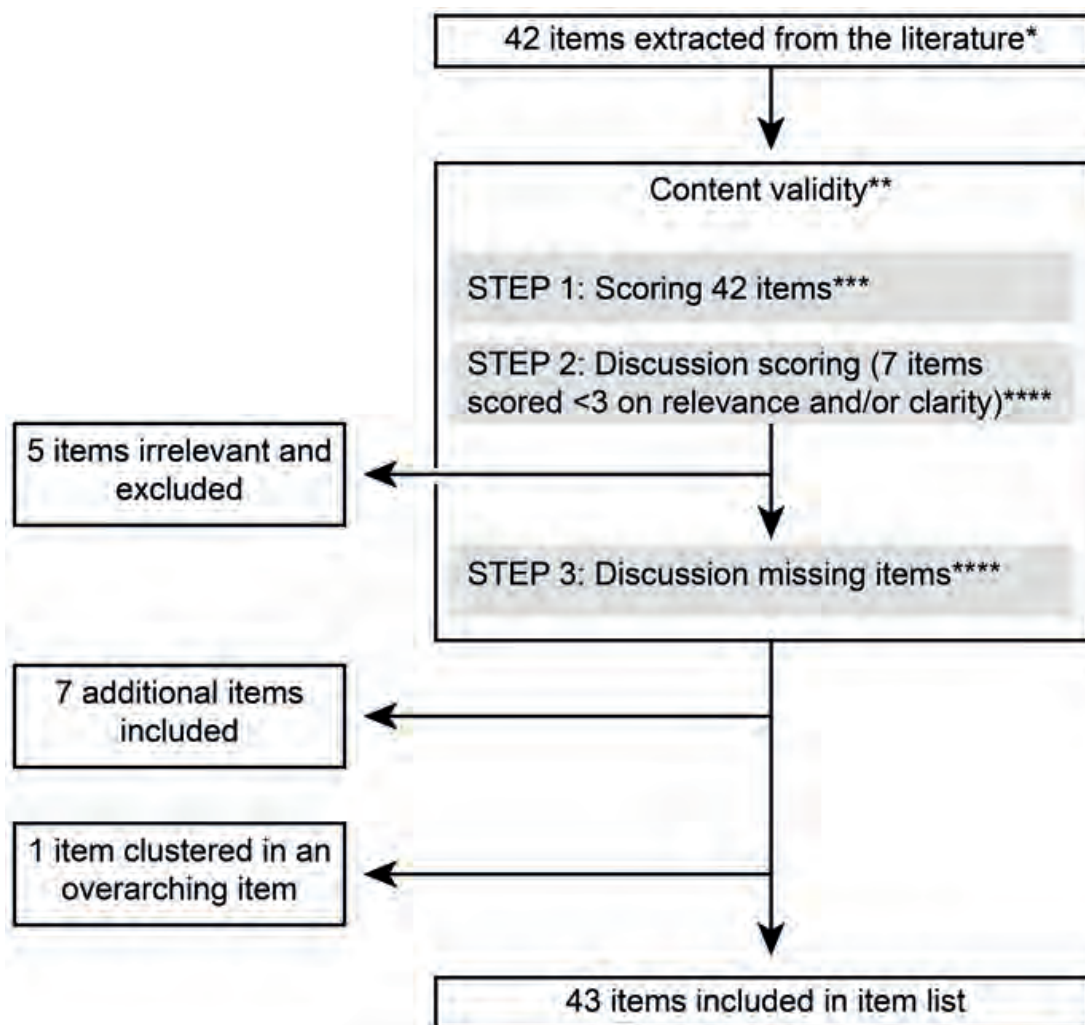
To systematically unravel the obtained data and compare it with the best practices promoted in the literature, an itemized list was developed. Firstly, items on transparent reporting,<sup>7,11,25</sup> process evaluations<sup>26-30</sup> and guiding frameworks<sup>1,6</sup> were obtained from the literature. Secondly, the Medical Research Council (MRC) framework for developing and evaluating complex interventions was used as a guide to evaluate the content and methodology of the included proactive primary care programmes. The MRC framework includes four phases: the development, feasibility/piloting, evaluation and implementation of complex interventions.<sup>1</sup> The current study focused on the first three phases of the MRC framework since the implementation phase had not yet been completed and/or evaluated for all proactive primary care programmes. Thirdly, information regarding the training, preparation and education level of interventionists, i.e., those who delivered the proactive primary care programme, was found to be important to report and was therefore added to the itemized list.<sup>9,31,32</sup> As a result, a preliminary list of 42 items was developed that comprised 24 items covering the MRC framework and 18 items covering the recruitment and training of the interventionists (Figure 1).

### ***Content validity of the itemized list***

The content validity of the preliminary itemized list was assessed by an expert panel of ten experts in the field of the development and evaluation of complex interventions. All experts were Dutch researchers in the field of medicine and nursing, and had experience with developing, evaluating, implementing and reporting complex interventions. The assessment was conducted in three steps (Figure 1).

First, the experts were asked to score the relevance and clarity of each item on a five-point scale, with a higher score indicating greater relevance and clarity. Second, in a meeting with the expert panel, the items that received a score <3 for relevance and clarity from at least one expert were discussed. As a result, five items were found to be irrelevant, such as “was the control group in the care programme described”, “motivation of the interventionists to carry out the care programme”,

and “what were the domains and competencies for training from the Dutch Federation of University Medical Centers (NFU)”. Third, the expert panel discussed whether items were missing from the list. Based on consensus, seven items were identified as missing, such as “investigating the needs of the provider and receiver” and “describing contextual factors”. One item, “were the components of the care programme described” was clustered with an overarching item, “was the content of the care programme described”. The final itemized list consisted of 43 items, of which 29 covered the development, pilot and evaluation phases of the MRC framework and 14 covered aspects of the recruitment and training of the interventionists. For a detailed description of each item, see Appendix A.



**Figure 1. Flowchart of the development of the itemized list**

*Notes:* \*Transparent reporting of complex interventions, process evaluations and guiding frameworks. \*\*Panel of 10 experts in complex interventions. \*\*\*Independent scoring by all experts to identify the relevance and clarity (separately) of each item, based on a five-point scale. A score of 1 indicated strongly disagree and 5 indicated strongly agree. \*\*\*\*A meeting was organized to first discuss the independent scoring <3 on relevance and/or clarity and then discuss whether items were missing on the item list.

## **Systematic data extraction**

The itemized list was used as a tool to systematically assess (by LS) the extent to which the items related to development and evaluation were described in the nine proactive primary care programmes. One person (LS, who was not involved in one of the nine care programs) extracted the data and determined whether information was available or not. The assessment categorized each item as “described”, “partially described” or “not described”.

## ***Member check of the systematic data extraction***

The results of the systematic data extraction (summarized in Figure 2 and 3) were sent to the principal investigator of each proactive primary care programme with a request to assess their internal validity. The principal researcher of each program was asked to check the analysis for errors and incorrect interpretations (validation step).<sup>33</sup> In case of disagreement, the researcher was asked to provide written evidence (e.g., additional documents, files or materials). If the provided evidence was sufficiently convincing and adequate (which was assessed by LS and NB independently), the category was changed. For example, item 7 (were the needs of the provider and receiver mapped) was, before member check, assessed as no information was described, however the principal researcher delivered an additional document of their proposal which included information on the needs of the receiver. So, the assessment of item 7 changed into information partially described. In total, 34 (range 1-10 per programme) of the 43 rated items were changed following the member check by 8 research groups. Programme 8 did not undergo a member check because the project was finished.

## **RESULTS**

The proactive primary care programmes all consisted of the early identification of older people at risk for functional decline, followed by multidisciplinary, integrated nurse-led care for those older people at risk provided by specially trained practice nurses. The nurse-led care consisted of a comprehensive geriatric assessment at home, evidence-based care planning and care coordination. Although the overall aims were identical, the proactive primary care programmes differed in the methods used to identify patients at risk, intervention components, composition of the multidisciplinary team, age of the target group and setting (urban or rural). The nine proactive primary care programmes involved 214 general practices and included a total of 15,058 older adults, of whom 9,155 (60.8%) were women with a

mean age of 80.2 years. The proactive primary care programmes were implemented across different geographical areas in the Netherlands and had a 12- to 24-month follow-up period (see Appendix B for characteristics of the care programmes).

The results of the systematic analysis of the development, piloting and evaluation process regarding the MRC framework are provided in Figure 2.

### **Development phase**

Seven of the 12 items within the development phase were adequately described by all proactive primary care programmes. All proactive primary care programmes described their aim and content, and all were adequately based on existing theories and literature. The proactive primary care programmes clearly described who received and delivered the programme's services. Two out of nine proactive primary care programmes identified the needs of the older people in advance (Programmes 3 and 5). Three proactive primary care programmes identified the needs of the interventionists (Programmes 1, 5 and 6). No proactive primary care programme modelled the processes and outcomes. Two proactive primary care programmes (partially) described potential barriers and facilitators of the context in which the intervention should occur (Programmes 1 and 8), while no proactive primary care programme described contextual factors. The intensity of six proactive primary care programmes was unclear (Programmes 1-6). Detailed information on the development phase is provided in Appendix C.

### **Feasibility and piloting phase**

Seven proactive primary care programmes conducted a pilot study to test feasibility and/or accessibility (Programmes 1-3, 5, and 7-9). However, only four of these proactive primary care programmes adequately described the results of the pilot study (Programmes 2, 3, 7 and 8). Detailed information on the feasibility and piloting phase is provided in Appendix D.

### **Evaluation phase**

All the proactive primary care programmes evaluated the effectiveness of their primary and secondary outcomes, and eight conducted a cost-effectiveness study. Which effect the intervention had on the outcome measurement and the related costs compared to usual care were adequately described. Two proactive primary care programmes conducted an extensive process evaluation (items 19 through 26) (Programmes 3 and 8). Three items regarding the process evaluation, such as the recruitment of participants and the satisfaction with the dose of the intervention received on the part of both the providers (interventionists) and receivers (older people), were adequately described by several proactive primary

care programmes. Whether the proactive primary care programmes were delivered as planned (i.e., fidelity) was partially examined by six proactive primary care programmes (Programmes 1, 2, 4, 6, 7 and 9), and only three proactive primary care programmes extensively described the fidelity (Programmes 3, 5 and 8). The barriers and facilitators in the context of delivering care were described in two proactive primary care programmes (Programmes 3 and 8). These proactive primary care programmes also described the programme's reach, e.g., the extent to which the programme reached frail older people. Detailed information on the evaluation phase is provided in Appendix E.

### **Interventionists and training**

The results of the systematic analysis of the interventionists and training are provided in Figure 3.

Two proactive primary care programmes provided information regarding the recruitment of interventionists, such as job description, educational level and the number of recruited interventionists (Programmes 1 and 5). However, only one proactive primary care programme provided information regarding the characteristics of the recruited interventionists (Programme 1). The main methods (Programmes 1-3, 7-9) and the main content (Programmes 1-3, 5, 7-9) of the training were described in most proactive primary care programmes. However, the proactive primary care programmes did not provide detailed information on didactical and teaching methods. Three proactive primary care programmes tested the knowledge of the interventionist after the training (Programmes 1, 7 and 9). However, only one proactive primary care programme described the results of this test (Programme 1). Four of the nine proactive primary care programmes provided information regarding the evaluation of the training (Programmes 1, 5, 7 and 8). No proactive primary care programme examined the effectiveness of the training, e.g., by measuring behavioural changes. Detailed information regarding the interventionists and their training is provided in Appendix F.

MRC stage	Item	Description	Program 1	Program 2	Program 3	Program 4	Program 5	Program 6	Program 7	Program 8	Program 9
Development	1	Was the problem defined?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	2	Was the intervention goal defined?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	3	Was there support in the literature?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	4	Were there theoretical underpinnings of the intervention?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	5	Was the content of the intervention described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	6	Intervention duration and intensity	Green	Green	Green	Green	Green	Green	Green	Green	Green
	7	Were the needs of the provider and receiver mapped?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	8	Who delivered the intervention?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	9	Who received the intervention?	Green	Green	Green	Green	Green	Green	Green	Green	Green
Piloting	10	Were contextual factors examined?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	11	Were potential barriers and facilitators mapped?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	12	Were process and outcome procedures/phases modelled?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	13	Was a feasibility/pilot study conducted?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	14	Were the results of the pilot described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	15	Was the study design described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	16	Were the primary outcomes described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	17	Were secondary outcomes described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	18	Were outcomes in subgroups described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
19	Was fidelity described?	Green	Green	Green	Green	Green	Green	Green	Green	Green	
Evaluation	20	Was recruitment described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	21	Was the context described (e.g. barriers and facilitators)?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	22	Was retention of the participants described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	23	Dose received (target group)	Green	Green	Green	Green	Green	Green	Green	Green	Green
	24	Dose received (satisfaction target group)	Green	Green	Green	Green	Green	Green	Green	Green	Green
	25	Dose received (satisfaction research group)	Green	Green	Green	Green	Green	Green	Green	Green	Green
	26	Intervention reached	Green	Green	Green	Green	Green	Green	Green	Green	Green
	27	Was the materials and tools used during implementation described?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	28	Was a cost-effectiveness analysis conducted?	Green	Green	Green	Green	Green	Green	Green	Green	Green
	29	Were the results of the cost-effectiveness analysis described?	Green	Green	Green	Green	Green	Green	Green	Green	Green

Legend:  
■ Fully described item  
■ Partially described item  
■ Non-described item

Figure 2. Systematic analysis of the development, piloting and evaluation phases

Item	Description	Program 1	Program 2	Program 3	Program 4	Program 5	Program 6	Program 7	Program 8	Program 9
30	Was the method of recruitment of the interventionists described?									
31	Was the job description of the interventionists included in the job posting?									
32	Was the requested education level for interventionists described?									
33	Were the numbers of recruited interventionists and those who delivered the intervention described?									
34	Were the characteristics of the interventionists described?									
35	Was the method of the training described?									
36	Was the content of the training described?									
37	Was the individual who provided the training described?									
38	Were the duration and intensity of the training described?									
39	Did the interventionists undergo an assessment or exam, and if so, how were they tested?									
40	Were the test results described?									
41	Was the training evaluated?									
42	Were the materials and tools of the training available to the interventionists?									
43	Was there follow-up training?									

Legend:  
 Fully described item  
 Partially described item  
 Non-described item

Figure 3. Systematic analysis of the recruitment and training of the interventionists



# DISCUSSION

This study systematically examined nine proactive primary care programmes to enhance the development and evaluation process of complex interventions for (frail) older people. Five main conclusions can be drawn from this systematic analysis. First, all the proactive primary care programmes had clear problem identification and theoretically underpinned content. Second, the context and current practice in which the proactive primary care programmes were conducted were not adequately described. Third, the modelling of processes and outcomes was absent in all of the analysed proactive primary care programmes. Fourth, fidelity was partially described in two-thirds of the proactive primary care programmes. Fifth, the training of the interventionists was evaluated in only three proactive primary care programmes. However, the effectiveness of the training was not reported by any of the proactive primary care programmes examined.

## Strengths and weaknesses of principal findings

This study demonstrated that all the proactive primary care programmes had clear problem identification. In response to the problem identification, a theoretically underpinned intervention programme was developed. If and which effect these developed care programmes had on the outcome measurement and the related costs compared to usual care were also well described. This was not very surprising because the NCEP required these effectiveness and cost-effectiveness descriptions. In addition, the satisfaction of the older people who participated in the proactive primary care programmes was very well described for most proactive primary care programmes.

This study revealed that most proactive primary care programmes paid insufficient attention to analysing the context both prior to and during the evaluation phase. Understanding and investigating the context, such as current practices and existing the needs of the providers and patients, and knowledge of the target population and interventionists, is crucial to enhance the effectiveness of complex interventions. Many reporting guidelines encourage comprehensive reporting of the context to enhance implementation and prevent the failure of replication.<sup>7,8,12,13,25</sup> Knowing the context can contribute to a better understanding of the implementation, as interventions may be effective in one setting but not in others.<sup>6,9,12,34-36</sup> This is of influence whether the implementation strategy can be directly applied or will need adapting.<sup>12</sup> Furthermore, a comprehensive description of the context could also prevent the failure of replication.<sup>12,13</sup> To avoid this research waste, i.e., correctable weaknesses in the design, execution or analysis of complex interventions,<sup>37</sup> every component of the proactive primary care programme should fit the context in

which the proactive primary care programme is conducted.<sup>38,39</sup> To overcome the risk of inadequate implementation and the failure to replicate, future development of interventions should therefore focus on the implementation context.<sup>35,40</sup> In 2009, the literature regarding implementation was integrated into a single, consolidated framework to provide a pragmatic structure for approaching the complex, interacting and multilevel constructs that may be faced during implementation.<sup>35</sup> The resulting Consolidated Framework for Implementation Research is promising and can be integrated throughout the development and evaluation of complex interventions.<sup>35,40</sup> In addition to this, the standard for reporting implementation studies statement (StaRI) was recently published, aiming to enhance transparent and accurate reporting of implementation studies.<sup>12</sup>

Furthermore, the modelling of processes and outcomes was absent in the proactive primary care programmes. It appears that modelling of processes and outcomes is the least examined and understood item of this study, which has also been reported in the literature.<sup>41</sup> Clarifying how an intervention works makes the 'black box' more transparent.<sup>42</sup> The literature contains different models, such as the logic model, to assist with the general approach to building a complex intervention.<sup>43</sup> In 2015, Sermeus proposed the following five-step modelling scenario as guidance for building a complex intervention: 1) evaluate existing evidence, 2) install a project team, 3) obtain consensus among stakeholders on crucial intervention components, 4) model the components in a process flow to provide the necessary resources and 5) describe the components in concrete detail.<sup>41</sup> More attention is needed to develop tools and methods to determine how interventions might work and to assist in modelling processes and outcomes.

This study showed that intervention fidelity, i.e., the extent to which the intervention was delivered as planned,<sup>30</sup> was well described in only three proactive primary care programmes<sup>44-46</sup> and was partially described in six studies. Fidelity was difficult to compare across programmes because it was measured differently.<sup>16,22,23,45,47-49</sup> Measuring intervention fidelity may reveal whether a lack of success is due to inappropriate service delivery or programme inadequacies.<sup>26,29,50</sup> Intervention fidelity can be divided into five subcategories: content, frequency, duration, coverage and timeliness.<sup>29,51</sup> Many prior studies, as well as the proactive primary care programmes in this study, have focused solely on frequency or duration.<sup>52</sup> Assessments of fidelity should focus on the effective components of an intervention.<sup>53</sup> However, when the effective components are unknown, the fidelity assessment should focus on the definitions of all intervention components prior to the start of the intervention,<sup>54</sup> keeping the five subcategories of fidelity in mind.<sup>55</sup> The delivery of each component should then be compared with the description of

how it was planned during development. Despite the extensiveness of this issue and the challenges that may be faced, all the subcategories of fidelity should be measured to achieve a comprehensive picture of fidelity.<sup>29,52,55</sup> To better evaluate fidelity, the five subcategories of fidelity should be considered when operationalizing and when measuring the fidelity of each intervention component. Interpreting fidelity should be balanced with the important issues regarding adaptation of intervention- and implementation strategies.<sup>7,12,25</sup> Unfortunately, our study did not collect data regarding the adaptations that have been made within the nine proactive primary care programs. To fit the implementation context, interventions are frequently adapted during the implementation process. These adaptations can consist of different types of adaptations such as planned or purposeful changes to the design or delivery of an intervention or unintentional deviations from the intervention as originally developed.<sup>56</sup> To understand the nature of the adaptations that were made in particular contexts as well as the impact on intervention outcomes involves exploring whether these adaptations improve the contextual fit or compromise the functioning.<sup>24,56</sup> Exploring the adaptations may be best achieved with a comprehensive understanding of the intervention theory and qualitative methods.<sup>30</sup> A system for classifying the types of adaptations that are made when interventions are implemented was developed and provide helpful guides to report on the balance between fidelity and adaptation.<sup>56</sup> For future assessments of fidelity, a single, generic approach with the use of reporting guidelines regarding adaptations is highly recommended.

This study revealed that most proactive primary care programmes paid no or little attention to the recruitment and training of interventionists when developing and evaluating complex interventions. The content of the programmes was mostly well described, but descriptions of the underlying didactical methods were lacking. Furthermore, training was evaluated in only three proactive primary care programmes, and none evaluated its effectiveness. The training of interventionists prior to intervention delivery is an important aspect of the transition from the planning-stage concept of the programme to its effective implementation.<sup>34,57</sup> To understand whether the training is effective and whether the interventionists are able to apply the intervention in clinical practice, it is important to know whether the training is effective in changing the behaviour of the interventionists.<sup>58</sup> Future complex interventions should pay more attention to the development and evaluation of interventionist training.

### **Strengths and weaknesses of this study**

This study has several strengths. First, this is, to our knowledge, the first study to systematically examine, compare and synthesize nine different proactive primary care programmes aimed at maintaining the independent living of older people

at home. The findings of this systematic analysis contribute to enhancing our understanding of the development and evaluation process of complex interventions. The obtained insights into these processes will lead to recommendations for the development and evaluation of future complex interventions. Secondly, not only the published data used but also all the written evidence available for each proactive primary care programme were included. Detailed or extended information regarding programmes is not always included in publications. The inclusion of all written evidence provides comprehensive insight in how the proactive primary care programmes were developed and evaluated. Third, a generic itemized list was generated based on the literature regarding complex interventions and was used as a tool to systematically examine the proactive primary care programmes. In future, this itemized list may be used by other researchers as a checklist in the development and evaluation of complex interventions.

Some weaknesses of this study should also be addressed. First, the included proactive primary care programmes were all developed and evaluated in the Netherlands and focused on the older Dutch population and the Dutch health care context. Therefore, the generalizability of the findings to other European countries may be limited. However, the goal of this study was to obtain insights into the development and evaluation of complex interventions, which is not dependent on country. From the literature, it is known that the development and evaluation of complex interventions is not always adequate.<sup>58</sup> This study provides evidence identifying aspects that are in need of attention. Second, the assessment of items was based solely on descriptions of the written data.<sup>59</sup> Although many processes regarding the development of an intervention are performed subconsciously or are simply not recorded or are inaccurately recorded, it was not feasible to consider unwritten data. In addition, this study wanted to take into account and describe the adaptation of an intervention to a specific context. However, the written data collected for the systematic analysis did not include data on adapting interventions during implementation. Although we considered obtaining insights into the adaptation of the interventions by interviewing the principal researchers, we decided not to do so. Qualitative research methods to explore the extent of adaptation using unwritten data might have introduced recall bias since the trials were conducted between 2010-2014, which would have had an impact on our outcome measures.<sup>59,60</sup> Unwritten data, specifically adaptations of the intervention and implementation strategies are very important to address when designing and evaluating complex interventions and should have therefore more attention in the future. Third, no formal reliability analyses were conducted in our study. However, several steps were taken to improve the reliability of the results. Step one, the results of the systematic data extraction (summarized in Figures 2 and 3) were sent to the

principal investigator of each proactive primary care programme with a request to assess their internal validity. The principal researcher was asked to check the analysis for errors and incorrect interpretations.<sup>33</sup> Step two, in case of disagreement, the researcher was asked to provide written evidence (e.g., additional documents, files or materials). Step three, if the provided evidence was sufficiently convincing (which was assessed by LS and NB independently), the category was changed. In total, 34 items (range 1-10 per programme) were changed based on convincing additional documents. Most of the convincing additional documents were not provided during the first request of all the documents regarding the intervention which was the main reason that items changed. Fourth, the decision to label an item as “described” and “partially described” was based on the operationalization of the item list (Appendix A). When information on a specific item was not fully described because information was missing, then the decision was made to classify that as “partially described”. The first author (LS), who was not involved in the design and conduct of the nine trials, rated the items. However, when LS was not sure about the rating, a second investigator (NB) was asked to independently judge a specific item of a specific study. Face validity was tested because the primary investigators were asked to review the final tables (appendix II-VI) and figures (Figures 2 and 3).

### **How to move further in complex interventions**

The implications of this work for future research, clinical practice and policy can be summarized as follows: every component of a complex intervention should be carefully developed based on the literature, the subcategories of fidelity and the implementation context. Researchers should expect the intervention to produce at least marginal gains in terms of patient outcomes.<sup>1</sup> Richards emphasized the importance of the “amalgamation of marginal gains”.<sup>61</sup> A multicomponent intervention can obtain large effects only if all the components fit together perfectly.<sup>61</sup> Examining all components in-depth and fitting them to the context may lead to optimally designed interventions that contribute to improved patient outcomes.<sup>59</sup> Additionally, an understanding of all components and underlying processes could also lead to the avoidance of ineffective components. In other words, the modelling of processes and outcomes is an important aspect of the development of complex interventions that could enhance the effect size of patient outcomes, which is often small in complex interventions. The measuring and reporting of intervention fidelity and adaptations to the implementation context requires much attention within the process evaluation. Generic approaches to measure intervention fidelity and understand adaptations to the implementation context could provide valuable, comparable and exchangeable information for interpreting effects on patient outcomes. The implementation of thorough and

effective training is an important aspect of obtaining sustainable behaviour changes in interventionists, which is a condition for adequate implementation.<sup>54</sup> Furthermore, the generic itemized list could be a useful checklist in the development and evaluation of complex interventions as well as in the assessment of complex interventions for researchers and research funders.

## CONCLUSION

This systematic analysis revealed that most proactive primary care programmes performed well, but several aspects of the development and evaluation process of complex interventions could be improved. To move further towards the development, evaluation and implementation of complex interventions, more attention should be paid to the in-depth analysis of context, measuring and reporting of intervention fidelity and adaptation to the implementation context, and implementation of thorough and effective training for interventionists. Further research should develop uniform methodology to enable standardized studies of context, modelling of processes and outcomes, intervention fidelity, adaptation to the implementation context and educational efforts.

# REFERENCES

1. Craig P, Dieppe P, Macintyre S, et al. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008;337:a1655.
2. Grol R, Wensing M, Eccles M. *Improving patient care: the implementation of change in clinical practice*. Edinburgh :Elsevier; 2005.
3. Bartholomew L, Parcel G, Kok G, Gottlieb N. *Intervention Mapping: designing theory and evidence-based health promotion programs*. Mountain View, CA: Mayfield Publishing Company; 2001.
4. Glasgow RE, McKay HG, Piette JD, Reynolds KD. The RE-AIM framework for evaluating interventions: what can it tell us about approaches to chronic illness management? *Patient Educ Couns*. 2001;44(2):119-127.
5. Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health Psychology*. 2008;27(3):379.
6. Van Meijel B, Gamel C, Van Swieten-Duijfjes B, Grypdonck MH. The development of evidence-based nursing interventions: Methodological considerations. *J Adv Nurs*. 2004;48(1):84-92.
7. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ*. 2014;348:g1687.
8. Möhler R, Bartoszek G, Köpke S, Meyer G. Proposed criteria for reporting the development and evaluation of complex interventions in healthcare (CReDECI): guideline development. *Int J Nurs Stud*. 2012;49(1):40-46.
9. Conn VS, Groves PS. Protecting the power of interventions through proper reporting. *Nurs Outlook*. 2011;59(6):318-325.
10. Thabane L, Ma J, Chu R, et al. A tutorial on pilot studies: the what, why and how. *BMC Med Res Methodol*. 2010;10(1):1.
11. Craig P. A new CONSORT extension should improve the reporting of randomized pilot and feasibility trials. *J Clin Epidemiol*. 2017;84:30-32.
12. Pinnock H, Barwick M, Carpenter CR, et al. Standards for Reporting Implementation Studies (StaRI) Statement. *BMJ*. 2017;356:i6795.
13. Boutron I, Altman DG, Moher D, Schulz KF, Ravaud P. CONSORT statement for randomized trials of nonpharmacologic treatments: a 2017 update and a CONSORT extension for nonpharmacologic trial abstracts. *Ann Intern Med*. 2017;167(1):40-47.
14. Lutomski JE, Baars MA, Schalk BW, et al. The development of the Older Persons and Informal Caregivers Survey Minimum DataSet (TOPICS-MDS): a large-scale data sharing initiative. *PloS One*. 2013;8(12):e81673.
15. Bleijenberg N, Drubbel I, Schuurmans MJ, et al. Effectiveness of a proactive primary care program on preserving daily functioning of older people: a cluster randomized controlled trial. *J Am Geriatr Soc*. 2016;64(9):1779-1788.

16. Blom J, Den Elzen W, Van Houwelingen AH, et al. Effectiveness and cost-effectiveness of a proactive, goal-oriented, integrated care model in general practice for older people. A cluster randomised controlled trial: Integrated Systematic Care for older People—the ISCOPE study. *Age Ageing*. 2016;45(1):30-41.
17. Metzeltin SF, Van Rossum E, De Witte LP, et al. Effectiveness of interdisciplinary primary care approach to reduce disability in community dwelling frail older people: cluster randomised controlled trial. *BMJ*. 2013;347:f5264.
18. Looman WM, Fabbriotti IN, De Kuyper R, Huijsman R. The effects of a pro-active integrated care intervention for frail community-dwelling older people: a quasi-experimental study with the GP-practice as single entry point. *BMC Geriatr*. 2016;16(1):43.
19. Hoogendijk EO, Van Der Horst HE, Van De Ven PM, et al. Effectiveness of a geriatric care model for frail older adults in primary care: results from a stepped wedge cluster randomized trial. *Eur J Intern Med*. 2016;28:43-51.
20. Ruikes FG, Zuidema SU, Akkermans RP, Assendelft WJ, Schers HJ, Koopmans RT. Multicomponent Program to Reduce Functional Decline in Frail Elderly People: A Cluster Controlled Trial. *J Am Board Fam Med*. 2016;29(2):209-217.
21. Stijnen M, Vrijhoef H, Jansen M, Candel M, Duimel-Peeters I. Effectiveness of a nurse-led home visitation programme on health-related quality of life and disability among potentially frail community-dwelling older people in primary care: a longitudinal, quasi-experimental study. Towards proactive care for potentially frail older people in general practice 2015:121-144.
22. Suijker JJ, Van Rijn M, Buurman BM, et al. Effects of nurse-led multifactorial care to prevent disability in community-living older people: cluster randomized trial. *PLoS One*. 2016;11(7):e0158714.
23. Uittenbroek RJ, Kremer HP, Spoorenberg SL, Reijneveld SA, Wynia K. Integrated care for older adults improves perceived quality of care: results of a randomized controlled trial of embrace. *Journal Gen Intern Med*. 2017;32(5):516-523.
24. Hawe P, Shiell A, Riley T. Complex interventions: how “out of control” can a randomised controlled trial be? *BMJ*. 2004;328(7455):1561-1563.
25. Möhler R, Köpke S, Meyer G. Criteria for Reporting the Development and Evaluation of Complex Interventions in healthcare: revised guideline (CReDECI 2). *Trials*. 2015;16(1):204.
26. Grant A, Treweek S, Dreischulte T, Foy R, Guthrie B. Process evaluations for cluster-randomised trials of complex interventions: a proposed framework for design and reporting. *Trials*. 2013;14(1):15.
27. Baranowski T, Stables G. Process evaluations of the 5-a-day projects. *Health Educ Behav*. 2000;27(2):157-166.
28. Saunders RP, Evans MH, Joshi P. Developing a process-evaluation plan for assessing health promotion program implementation: a how-to guide. *Health Promot Pract*. 2005;6(2):134-147.



29. Carroll C, Patterson M, Wood S, Booth A, Rick J, Balain S. A conceptual framework for implementation fidelity. *Implement Sci.* 2007;2(1):40.
30. Moore GF, Audrey S, Barker M, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ.* 2015 Mar 19;350:h1258.
31. Lette M, Baan CA, Van Den Berg M, De Bruin SR. Initiatives on early detection and intervention to proactively identify health and social problems in older people: experiences from the Netherlands. *BMC Geriatr.* 2015;15(1):143.
32. Glasziou P, Chalmers I, Altman DG, et al. Taking healthcare interventions from trial to practice. *BMJ.* 2010;341:c3852.
33. Creswell JW. *Research design: Qualitative, quantitative, and mixed methods approaches.* London: Sage publications; 2013.
34. Campbell NC, Murray E, Darbyshire J, et al. Designing and evaluating complex interventions to improve health care. *BMJ.* 2007;334(7591):455-459.
35. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4(1):50.
36. Shippee ND, Shah ND, May CR, Mair FS, Montori VM. Cumulative complexity: a functional, patient-centered model of patient complexity can improve research and practice. *J Clin Epidemiol.* 2012;65(10):1041-1051.
37. Ioannidis JP, Greenland S, Hlatky MA, et al. Increasing value and reducing waste in research design, conduct, and analysis. *Lancet.* 2014;383(9912):166-175.
38. Chalmers I, Glasziou P. Avoidable waste in the production and reporting of research evidence. *Obstet Gynecol.* 2009;114(6):1341-1345.
39. Chalmers I, Bracken MB, Djulbegovic B, et al. How to increase value and reduce waste when research priorities are set. *Lancet.* 2014;383(9912):156-165.
40. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the Consolidated Framework for Implementation Research. *Implement Sci.* 2016;11(1):72.
41. Sermeus W. *Modelling process and outcomes in complex interventions.* In: Richards D, Hallberg IR, editors. *Complex interventions in health: an overview of research methods,* London: Routledge; 2015, p. 111.
42. Campbell M, Fitzpatrick R, Haines A, Kinmonth AL, Sandercock P, Spiegelhalter D, et al. Framework for design and evaluation of complex interventions to improve health. *BMJ.* 2000;321(7262):694-696.
43. Kellogg W. *Logic model development guide.* Michigan: WK Kellogg Foundation; 2004.
44. Metzelthin SF, Daniëls R, Van Rossum E, et al. A nurse-led interdisciplinary primary care approach to prevent disability among community-dwelling frail older people: a large-scale process evaluation. *Int J Nurs Stud.* 2013;50(9):1184-1196.

45. Muntinga ME, Van Leeuwen KM, Schellevis FG, Nijpels G, Jansen AP. From concept to content: assessing the implementation fidelity of a chronic care model for frail, older people who live at home. *BMC Health Serv Res.* 2015;15(1):18.
46. Stijnen MM, Jansen MW, Duimel-Peeters IG, Vrijhoef HJ. Nurse-led home visitation programme to improve health-related quality of life and reduce disability among potentially frail community-dwelling older people in general practice: a theory-based process evaluation. *BMC Fam Pract.* 2014;15(1):173.
47. Bleijenberg N, Ten Dam VH, Drubbel I, Numans ME, De Wit NJ, Schuurmans MJ. Treatment Fidelity of an Evidence-Based Nurse-Led Intervention in a Proactive Primary Care Program for Older People. *Worldviews Evid Based Nurs.* 2016;13(1):75-84.
48. Janse B, Huijsman R, Fabbrocetti IN. A quasi-experimental study of the effects of an integrated care intervention for the frail elderly on informal caregivers' satisfaction with care and support. *BMC Health Serv Res.* 2014;14(1):140.
49. Ruikes FG, Van Gaal BG, Oudshoorn L, et al. The association between implementation and outcome of a complex care program for frail elderly people. *Fam Pract.* 2017:cmx065.
50. Oakley A, Strange V, Bonell C, Allen E, Stephenson J, RIPPLE Study Team. Process evaluation in randomised controlled trials of complex interventions. *BMJ.* 2006;332(7538):413-416.
51. Hasson H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. *Implement Sci.* 2010;5(1):67.
52. Dusenbury L, Brannigan R, Falco M, Hansen WB. A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. *Health Educ Res.* 2003;18(2):237-256.
53. Fixsen DL, Naoom SF, Blase KA, Friedman RM, Wallace F. *Implementation research: a synthesis of the literature.* Louis: University of South Florida de la Parte Florida Mental Health Institute; 2005.
54. Bellg AJ, Borrelli B, Resnick B, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health Psychol.* 2004;23(5):443.
55. Hasson H. *Intervention fidelity in clinical trials.* In: Richards D, Hallberg IR, editors. *Complex interventions in health: an overview of research methods.* London: Routledge; 2015.
56. Stirman SW, Miller CJ, Toder K, Calloway A. Development of a framework and coding system for modifications and adaptations of evidence-based interventions. *Implement Sci.* 2013;8(1):65.
57. Bradley F, Wiles R, Kinmonth AL, Mant D, Gantley M. Development and evaluation of complex interventions in health services research: case study of the Southampton heart integrated care project (SHIP). The SHIP Collaborative Group. *BMJ.* 1999;318(7185):711-715.

## Chapter 2

58. Sheeran P, Klein WM, Rothman AJ. Health behavior change: moving from observation to intervention. *Annu Rev Psychol.* 2017;68:573-600.
59. Ioannidis JP. Why most clinical research is not useful. *PLoS Med.* 2016;13(6):e1002049.
60. Hess DR. Retrospective studies and chart reviews. *Respir Care.* 2004;49(10):1171-1174.
61. Richards DA. Complex interventions and the amalgamation of marginal gains: A way forward for understanding and researching essential nursing care? *Int J Nurs Stud.* 2015;52(7):1143-1145.

## Appendix A. Operationalization itemized list

MRC stage	Item number	Item	Item description	References
Development	1	Was the problem clearly defined?	Was the problem clearly defined and quantified? Was the population most affected, most at risk, or most likely to benefit from the intervention identified and quantified: Were the pathways by which the problem was caused and sustained described? Was there an exploration of whether these pathways were amenable to change and, if so, at which points? If possible, was the potential for improvement quantified? Overall, did the problem definition match the proposed intervention?	6, 34
	2	Was the intervention goal clearly defined?		1, 8
	3	Was there support in the literature?	Was there use of systematic reviews or other high levels of evidence that (1) underpinned the choice of the intervention and (2) allowed the choice of intervention components in greater depth?	1, 6, 8
	4	Was there an underlying theory of the proposed intervention?	Which theory underpinned the intervention? What was the rationale for this theory?	6
	5	Was the content of the intervention described?	What was the content, who delivered the intervention, and when and how was the intervention delivered?	1, 7, 8
	6	Duration and intensity of intervention	What was the duration (total) and intensity of the intervention, e.g., how many hours were indicated for home visits, training, and meetings, and what was the number of follow-up visits?	7

7	Identification of the needs of the interventionist and receiver	Were the (care) needs, perceptions, and capacities of intervention recipients regarding the identified problem and proposed solution/ intervention elucidated during the development phase? Were the needs, perceptions and capacities of interventionists regarding the identified problem and proposed solution/intervention elucidated during the development phase?	6
8	Who delivered the intervention?	Were the interventionists and their backgrounds and characteristics described?	1, 6
9	Who received the intervention?	Were the study population and the inclusion and exclusion criteria clearly described?	1, 6
10	Were contextual factors examined?	Has a current practice analysis been conducted? Were contextual factors (factors that shape theories of how the intervention works, that affect (and may be affected by) implementation, intervention mechanism and outcomes) examined in advance to prevent a misfit between the intervention and current practice?	6, 7, 30
11	Were potential barriers and facilitators regarding the delivery or content of the intervention identified?	Were potential barriers and facilitators of the intervention identified in advance?	8
12	Was there modelling of process and outcome procedures/phases?	Did the authors describe how the information from the literature was synthesized and mapped, for example, into a logic model, flowchart or figure? Was the choice of active components clear? Was any modelling scenario used for this purpose/roadmap? What was the efficacy of each of the components of the intervention? What was the underlying relationship between the active components? What confounders and effect moderators were identified as important to consider during development?	1, 41, 42

Piloting	13	Was a pilot study conducted?	The intervention should have been pilot-tested to determine the feasibility, acceptability, and practicability of the complex intervention. The pilot test should have taken into account the key uncertainties that had been identified during the development process.	1, 6, 10, 11
	14	Were the results of the pilot study described?	Information on how the intervention was tested. For detailed information, see the checklists of Möhler et al. <sup>8</sup> and Thabane et al. <sup>10</sup>	8, 10
Evaluation	15	Was the study design described?	Which design, such as RCT, IRT, or CRT, was used and why? How were the data collected during the intervention?	1
	16	Were the primary outcomes described?		1
	17	Were secondary outcomes described?		1
	18	Were outcomes in subgroups described?	Effects of the intervention on subgroups.	1
	19	Was fidelity described?	Quantify the extent to which the intervention was delivered as planned to the target group in terms of the following aspects: coverage of the intervention, how often the intervention was delivered and the duration of the intervention.	7, 28, 29
	20	Was recruitment described?	Which procedures were used to enrol general practitioners and elderly people in the intervention? What were the reasons for non-participation?	27, 28
	21	Was the context described (e.g., barriers and facilitators present when the intervention was delivered)?	Where was the intervention performed? Describe the barriers and facilitators identified during the process evaluation that may have influenced the intervention outcomes.	8, 27, 28
22	Was retention of participants described?	How were the participants continuously maintained concerning data collection?	27	

23	Dose received (target group)	Did the elderly participants receive the dose that was originally intended, as described in the study protocol? Was the number and intensity described? Were the number and types of problems included in the care plan clear? Were all goals subsequently followed by actions performed by the interventionists described?	28
24	Dose received (satisfaction target group)	How did older people experience the intervention? Did the intervention satisfy the health needs of the older people?	28
25	Dose received (satisfaction research group)	How did the researchers experience the intervention? Did it meet their expectations?	
26	Intervention reached	Quantify the proportion of the target population that participated in the intervention. Describe the subjects who did and did not participate. Were the included participants represented?	27, 28
27	Was there a description of all the (training) materials and tools during implementation?	Were the materials and tools described? Was there (open) access (e.g., an online appendix or URL) available?	7, 8, 28
28	Was a cost-effectiveness analysis conducted?		8
29	Were the results of the cost-effectiveness analysis described?		8
Recruitment of interventionists	30	Was the method of recruitment of the interventionists described?	
	31	Was the job description of the interventionists included in the job posting?	9
	32	Was the requested education level for interventionists described?	7

	33	Were the numbers of recruited interventionists and those who delivered the intervention described?	9
	34	Were the characteristics of the interventionists described?	7, 9
Training of interventionists	35	Was the method of the training described?	7
	36	Was the content of the training described?	7
	37	Was the individual who provided the training described?	7
	38	Was the duration and intensity of the training described?	7
	39	Did the interventionists undergo an assessment or exam after the training?	
	40	Were the test results described?	
	41	Was the training evaluated?	
	42	Were the materials and tools of the training available to the interventionists?	7
	43	Was there follow-up training during the intervention period?	



## Appendix B. Characteristics of the included multicomponent proactive care programmes

Programme	Design	N	Setting	Follow-up months	Intervention	Primary outcomes	Secondary outcomes
Programme 1 U-PROFIT study	Three-armed cluster randomized trial	3092	39 general practices (GPs) in the Utrecht region with more than 44,000 older people. Community-dwelling people aged 60 years and older were approached.	12	The first intervention was U-PRIM, a screening and monitoring intervention based on routine care data. The screening used automated risk-based detection (three criteria) within electronic medical records to select older people with frailty. The second intervention was U-PRIM followed by U-CARE, a nurse-led personalized care intervention that included a CGA, tailor-made care planning, and care coordination provided by trained nurses in primary care.	1. Activities of Daily Living (Katz-15 ADL/IADL)	1. Quality of life (RAND-36, EQ-5D) 2. Mortality 3. Number of nursing home admissions 4. Number of emergency department and out-of-hours GP surgery visits 5. Caregiver burden (self-rated burden scale)
Programme 2 ISCOPE study	Observer-blinded cluster randomized controlled trial	4236	59 GPs in the region of Leiden, the Netherlands. Community-dwelling people aged 75 years and older were approached.	12	The ISCOPE study used their developed ISCOPE screening questionnaire with 4 domains of health: functional, somatic, psychological, and social. For participants with problems in $\geq 3$ domains, general practitioners (GPs) created an integrated care plan using a functional geriatric approach.	1. Quality of life (Cantril's Ladder) 2. Disability in BADL and IADL (GARS)	1. Satisfaction with delivered care

<p>Programme 3 PoC study</p>	<p>Two-armed cluster randomized controlled trial</p>	<p>346</p>	<p>12 GPs in the region of Sittard and its surroundings. Community-dwelling people aged 70 years and older were approached.</p>	<p>24</p>	<p>Frail older people were screened using the GFI. After a CGA by a GP nurse and (when necessary) additional assessments by the GP, an individual action plan was created. The action plan was related to a flexible toolbox of interventions that had been developed by a multidisciplinary team.</p>	<p>1. Disability (GARS)</p>	<p>1. Depressive symptomatology (Depression subscale, Hospital Anxiety and Depression Scale) 2. Social support interactions (Social Support List - Interaction version) 3. Fear of falling (Short Falls Effic. Scale International) 4. Social participation (Maastricht Social Participation Profile) 5. Mortality 6. Health care utilization and related costs</p>
<p>Programme 4 WICM study</p>	<p>Quasi-experimental trial</p>	<p>417</p>	<p>8 GPs located in Walcheren. Community-dwelling people aged 75 years and older were approached.</p>	<p>12</p>	<p>Frailty was preventively detected with the GFI in elderly individuals living at home. Geriatric nurse practitioners and secondary care geriatric nursing specialists were assigned as case managers and coordinated the care that was agreed upon in a multidisciplinary meeting. The general practitioner practice functioned as a single entry point and supervised the coordination of care.</p>	<p>1. Quality of life (ICECAP EQ-6D, RAND-36, Cantril's self-anchoring ladder) 2. Caregiver: Quality of life (RAND-36, Cantril's anchoring scale)</p> <p>1. Perceived health (SF-36) 2. Social functioning (SF-36) 3. Mental wellbeing (SF-36) 4. Physical functioning (Katz-15 ADL/IADL) 4. Health care use (self-reported or by GP)</p>	

Programme 5	1147	35 GPs in West-Friesland and Amsterdam-Zuid. Community-dwelling people aged 65 years and older were approached.	24	The Geriatric Care Model at a micro-level: home visits by a PN (every 6 months) for CGA (RAI-CHA), a tailored care plan based on the outcomes of home visits (preferences of the older adult concerning identified needs and problems) and multidisciplinary team consultation and meetings (MTM). The Geriatric Care Model at a meso-level: a geriatric expert team conducting three main tasks, expert knowledge transfer (to PNs, GPs, and professionals involved in care for the target group), and building and maintaining local networks of care organizations to enhance the coordination of care at the patient level.	1. Quality of life (SF-12)	1. Health-related quality of life (EQ-5D) 2. Independence in ADL (Katz-15) 3. Psychological wellbeing (RAND-36) 4. Social functioning (RAND-36) 5. Self-reported health (RAND-36) 6. Acute hospital admissions 7. (Un)met care needs 7. Process outcomes 8. Carer outcomes 9. Direct and indirect costs
ACT study						
Programme 6	536	12 GPs in the municipality of Nijmegen. Community-dwelling people aged 70 years and older were approached.	12	EasyCare Tos was used to screen potential frail elderly who received a CGA. The intervention consisted of four key elements: (1) multidisciplinary team work, (2) proactive care planning, (3) case management, and (4) medication reviews. Each GP assembled one or two multidisciplinary teams. These team members closely collaborated to ensure the integration of cure, care and welfare. Face-to-face multidisciplinary team meetings were held at least twice per year for each frail elder, during which care plans were reviewed and adapted.	1. ADL (Katz-15 ADL/IADL)	1. Health-related quality of life (EQ-5D+C) 2. Psychological and social functioning (RAND-36) 3. Nursing home and hospital admissions 4. Mortality 5. Caregiver burden (CarerQol)
Care Well study						

Programme 7 EMBRACE study	Randomized controlled trial	1476	15 GPs in the municipalities of Stadskanaal, Veendam and Pekela. Community-dwelling people aged 75 years and older were approached.	12	Older adults were classified into three risk profiles, based on the KP Triangle, as determined by annual screening with self-report questionnaires. The profile “Robust” included adults without complex care needs and with a relatively low frailty level. The profile “Frail” included those with a higher level of frailty who were at risk of developing complex care needs. The profile “Complex care needs” included older adults with complex care needs. A multidisciplinary Elderly Care Team – consisting of a GP, an elderly care physician, and two case managers (district nurse and social worker) – provided individualized, proactive, and preventive care and support to the older adults in their profile.	1. Complexity of care needs (IM- E-SA) 2. Frailty (GFI self-report) 3. Health status (EQ-5D, EQ-5D-VAS)	1. Wellbeing (GWI) 2. ADL (Katz-15 ADL/ IADL) 3. Quality of life (RAND-36) 4. Impact of interventions (GAS) 5. Perceived chronic illness care (ACIC)
Programme 8 [G]OLD study	Longitudinal, quasi-experimental study	1527	24 GPs in Maastricht Heuvelland and Parkstad. Community-dwelling people aged 75 years and older were approached.	18	Practice nurses from intervention practices (1) visited older people at home for a comprehensive assessment of their health and wellbeing; (2) discussed the results with the GP; (3) formulated a care and treatment plan together with the patient; (4) referred patients to care and/or wellbeing facilities; and (5) monitored and coordinated care and follow-up.	1. Quality of life (RAND-36) 2. Disability ADL and IADL (GARS)	1. Attitude towards ageing (PGC Morale Scale) 2. Admission to a nursing home or home for older people 3. Health care utilization 4. Mortality

Programme 9 FIT study	Cluster randomized trial	2281 10 GPs in the region of Alkmaar and 7 GP practices in Amsterdam-Noord. Community- dwelling people aged 70 years and older were approached.	12	Older persons who were at increased risk of functional decline (ISAR-PC score $\geq 2$ ) received a CGA, an individually tailored care and treatment plan consisting of multifactorial, evidence-based interventions and subsequent nurse-led care coordination.	1. Physical functioning (Katz-15 ADL/IADL)	1. Health-related quality of life (EQ-6D) 2. Psychological and social functioning (RAND-36) 3. Health care utilization 4. Incidence of falls 5. Evaluation of providers and the burden of caregivers (CarerQol) 6. Mortality
--------------------------	--------------------------------	--	----	--	---	--

Acronyms: U-PROFIT study: *Utrecht primary care PROactive frailty intervention study*, ISCOPE study: *Integrated Systematic Care for Older Persons study*, PoC study: *Prevention of care study*, WICM study: *Walcheren Integrated Care Model study*, Care Well study: *Care Well study*, ACT study: *Adult Care in Transition*, Embrace study: *model for integrated care study*, [G]OLD study: *OLD the healthy way study*, FIT study: *Functionbehoud In Transitie study*.

## Appendix C. Phase 1 of the MRC Framework: Development

Study	Problem identification & definition (items 1-2)	Identification of the evidence base (items 3-4)	Identification or development of theory (items 5-6)	Determination of the needs of the providers and participants (items 7-9)	Examination of current practice (items 10-11)	Intervention design and modelling of processes and outcomes (item 12)
Programme 1	The aim was to achieve higher self-sufficiency, more functional integrity, and improved quality of life for frail older people through structured early detection of frail older people and structured, integrated, multidisciplinary care and treatment services.	A literature study was conducted in which the highest levels of evidence were used.	The theories (e.g., Chronic Care Mode with guidance from the Medical Research Council Framework) that were used during development were sufficiently described. The duration of the intervention was described; however, the intensity (e.g., how many hours were indicated for home visits, training, and meetings, and number of follow-up visits) was not described.	Only the needs of the providers were examined.	Contextual factors were not examined in advance. Potential barriers and facilitators were examined during the feasibility study.	N.A.

Programme 2	The aim was to restore, maintain or maximize functional independence, or to compensate for loss of autonomy with appropriate support by identifying older people with complex problems with a screening questionnaire followed by a care plan using a functional geriatric approach for the identified older people.	A literature study was conducted in which the highest levels of evidence were used.	The theory (i.e., integrated, horizontal care model aimed at global health outcomes) that was used during development was sufficiently described. The duration of the intervention was described; however, the intensity was not described.	No needs of the providers or participants were examined.	N.A.	N.A.
Programme 3	The aim was to have a primary care interdisciplinary programme to prevent loss of function among frail older people.	A systematic review and narrative overview of the effectiveness of existing interventions for disabilities in frail older people was conducted.	The theories (i.e., Intervention Mapping and the 5a Behavioural Change Model) that were used during development were sufficiently described. The duration of the intervention was described; however, the intensity was not described.	Only the needs of the participants were examined.	N.A.	N.A.





<p>6</p> <p>Programme Care Well study</p>	<p>The aim was to prevent functional decline, improve the quality of life, and reduce or delay hospital and nursing home admissions of community-dwelling frail older people.</p>	<p>A literature review was conducted in which the highest levels of evidence were used.</p>	<p>The theory (i.e., a Chronic Care Model that was adapted to the Dutch health care system) that was used during development was sufficiently described. The duration of the intervention was described; however, the intensity was not described.</p>	<p>Only the needs of the providers were examined.</p>	<p>N.A.</p>
<p>7</p> <p>Programme Embrace study</p>	<p>The aim was to examine the effectiveness of a population-based model for integrated elderly care on patient outcomes, quality of care, health care use and costs through clear problem identification.</p>	<p>A literature review was conducted in which the highest levels of evidence were used.</p>	<p>The theories (i.e., a Chronic Care Model and the KP triangle population health management model) that were used during the development were sufficiently described. Additionally, the duration and intensity of the intervention were well described.</p>	<p>No needs of the providers were examined. For the needs assessment of participants, an ICF-based Core Set reflecting relevant health-related problems of community-living older adults was composed.</p>	<p>N.A.</p>

Programme 8 [G]OLD study	The aim was to examine the effects and feasibility of the early detection of health problems among community-dwelling older people and their subsequent referral to appropriate care and/or wellbeing facilities by general practices.	A literature review was conducted in which the highest levels of evidence were used.	The theories (i.e., the Chronic Care Model and the Guided Care Model) that were used during development were sufficiently described. Additionally, the duration and intensity of the intervention were well described.	No needs of the providers or participants were examined.	Contextual factors were not examined in advance. Potential barriers and facilitators were examined during the feasibility study.	N.A.
Programme 9 FIT study	The aim was to examine whether functional decline in community-dwelling older persons could be delayed or prevented by a comprehensive geriatric assessment, multifactorial interventions and nurse-led care coordination.	A literature review was conducted in which the highest levels of evidence were used.	The theory (i.e., the Chronic Care Model) that was used during development was sufficiently described. Additionally, the duration and intensity of the intervention were well described.	No needs of the providers or participants were examined.	N.A.	N.A.

Acronyms: U-PROFIT study: *Utrecht primary care PROactive frailty intervention study*, ISCOPE study: *Integrated Systematic Care for Older Persons study*, PoC study: *Prevention of care study*, WICM study: *Walcheren Integrated Care Model study*, Care Well study: *Care Well study*, ACT study: *Adult Care in Transition*, Embrace study: *model for integrated care study*, [G]OLD study: *OLD the healthy way study*, FIT study: *Functioniebehoud In Transitie study*.

## Appendix D. Phase 2 of the MRC Framework: Feasibility and piloting

Study	Testing procedures (items 13-14)
Programme 1 U-PROFIT study	A pilot study was conducted that aimed to identify uncertainties regarding the interventions. Three experienced registered nurses (from different GPs who were involved during the development phase) assessed the intervention for 6 weeks, during which time 30 patients were enrolled. As a result, the intervention was found to be feasible in clinical practice. Qualitative data suggested that the intervention provided increased knowledge, structured care and better understanding about patient needs.
Programme 2 ISCOPE study	A pilot study was conducted. The ISCOPE screening questionnaire was first discussed with a sample of older representatives (n=20). The questionnaire was then piloted at 3 general practices (n=369), and their general practitioners (GPs) were asked to rate the complex problems of these individuals. After this pilot, the GPs received feedback on the questionnaire and were interviewed about the content of the questionnaire, its results, and any differences that emerged compared with their own impressions. As a result, the GPs agreed that the questionnaire yielded results that were applicable in their practice and that the older persons with complex problems (as identified with the questionnaire) were eligible for integrated care. The pilot also showed that the rate of older people with problems in 3 and 4 domains appeared to be higher (28%) than the expected rate from the literature study (8-10%).
Programme 3 PoC study	A pilot study was conducted in which two GPs, four practice nurses, two occupational therapists, two physical therapists and 41 elderly people participated to evaluate the feasibility of the intervention. Older people were positive about the opportunity to tell their story during the pilot study. Professionals were also positive but doubted whether the elderly had sufficient ability to reflect on their activity patterns because older people are generally unfamiliar with expressing their problems and concerns in terms of activities. Professionals believed that team meetings provided a more complete picture of the elderly and yielded a common vision regarding treatment, which led to a better understanding of the expertise of other professionals. The educational programme and coaching of the team were considered relevant to achieving an effective interdisciplinary collaboration. The methodologies of the toolbox components required an adjustment of their daily actions from problem-solving to supporting self-management. Finally, follow-up was one of the elements that were not sufficiently applied.
Programme 4 WICM study	No pilot study was conducted.
Programme 5 ACT study	A pilot study showed that the PRISMA questionnaire was an accurate instrument for determining frailty in a primary care setting.
Programme 6 Care Well study	No pilot study was conducted.

Programme 7 Embrace study	<p>A pilot study was conducted on case management for people (<math>\geq 75</math> years old) with complex care needs. Twenty older adults were included and received six months of intensive supervision by a multidisciplinary team consisting of a case manager, their general practitioner and an elderly care physician. This multidisciplinary team worked closely with home care welfare and paramedical services to achieve the integration of care in the areas of housing, welfare and health. After 6 months, the complex care needs were resolved in 13 older adults and remained in 7 older adults.</p> <p>Another pilot study was conducted regarding the Embrace intervention and included 100 older adults (including participants from the case management pilot study). Using case managers from different disciplines (district nurses and social workers), a broader view of the areas of housing, welfare and care was achieved. The case managers were able to use each other's knowledge, expertise and network. A triage instrument on the complexity of care needs and the level of frailty was used to assign older people to different risk profiles. The results of self-report questionnaires were highly consistent with the experiences of the case manager.</p>
Programme 8 [G]OLD study	<p>A pilot study that focused on feasibility was conducted with 240 older people from 21 GP practices. GPs and PNs found the intervention feasible in daily practice. They assessed the CGA as useful but identified that minor adjustments were necessary for improvement (e.g., layout, substitution or tests). Practice nurses often failed to record follow-up actions for defined problems in the care and treatment plans for the elderly. Future educational programmes for practice nurses should address this issue. The findings were used to improve the intervention for the evaluation of the main trial.</p>
Programme 9 FIT study	<p>A pilot study was conducted to assess part of the developed methodology/tools and to test and validate the intervention (the ISAR-PC and the CGA).</p>

*Acronyms: U-PROFIT study: Utrecht primary care PROactive frailty intervention study, ISCOPE study: Integrated Systematic Care for Older Persons study, PoC study: Prevention of care study, WICM study: Walcheren Integrated Care Model study, Care Well study: Care Well study, ACT study: Adult Care in Transition, Embrace study: model for integrated care study, [G]OLD study: OLD the healthy way study, FIT study: Functiebehoud In Transitie study.*

## Appendix E. Phase 3 of the MRC Framework: Evaluation

Study	Effectiveness (items 15-18)	Change process (items 19-27)	Cost-effectiveness (items 28-29)
Programme 1 U-PROFIT study	<p>After 12 months, participants in the U-PRIM and U-PRIM + U-CARE groups had significantly less decline in daily functioning than the participants in the control group, as measured with the Katz-15 questionnaire. Older people in the U-PRIM + U-CARE group had more contact with their general practice compared with that of the other two groups. No overall difference was demonstrated in quality of life, but disaggregation by education showed that highly educated elderly in the U-PRIM + U-CARE group had improved quality of life in the physical domain, while highly educated elderly in the other two groups had a decline. Within one year, the intervention showed an effect. In the long term, it is expected that these effects will be stronger because the new procedure regarding the intervention will then be fully established in general practice.</p>	<p><b>Fidelity:</b> To some extent, i.e., what the nurses did and exploring the dose delivered. <b>Satisfaction elderly:</b> Older people in the U-CARE group indicated in interviews that the “elderly care practice nurse” was of value compared with current care. Older people reported that the practice nurse had more time than the GP and assisted them in finding the right care. Elderly individuals indicated that it was important that the practice nurse connected the care to the individual needs of the patient. <b>Satisfaction interventionist:</b> Practice nurses and general practitioners reported that it was difficult to provide proactive and structured care to older patients with multiple morbidities, different cultural backgrounds and low socioeconomic status. Barriers were a lack of time and financial compensation. Most general practitioners and practice nurses indicated that the programme added value to the coordination of care and allowed them to provide structured care.</p>	<p>After a year, both the U-PRIM intervention and the combined U-PRIM + U-CARE intervention were found to be cost-effective compared with the usual care (with a probability of 87% and 91%, respectively, in the “willingness to pay” of € 20,000 per quality-adjusted life years). This result was mainly due to the finding that the direct and indirect medical costs in the intervention groups were lower than in the control group.</p>

<p>Programme 2 ISCOPE study</p>	<p>The intervention was not found to be effective. All the participants exhibited slight declines in all outcome measures of health during the year of the study. There was no difference between the intervention and control groups. The same applied to the degree of complexity. With regard to the use of health care, there were also no differences. Satisfaction with care: At 12 months, there was a greater difference in satisfaction with the general practitioner in the treatment group than in the control group. Between the groups, there were no differences in confidence or satisfaction with/trust in interventionists. Informal caregivers: There were no differences in perceived health, perceived burden of care, quality of life or hours of care provided to the elderly among caregivers in the intervention and control groups.</p>	<p><b>Fidelity:</b> To some extent, i.e., exploring the satisfaction with delivered care. <b>Dose received elderly:</b> N.A. <b>Dose received interventionist:</b> The intervention led to a greater understanding of the care situation of older people and more focus on the functioning of older people, and the desires of the elderly themselves were clearer. Impeding factors were time investment, funding/support, working methodically, and shaping the multidisciplinary consultation.</p>	<p>There were no effects on health care utilization or health care costs. After 24 months, no difference in use of care was found between the intervention and control groups; therefore, no difference was found in quality-adjusted life years (QALY).</p>
---	--	---	--

<p>Programme 3 PoC study</p>	<p>The results showed that there were no significant differences between the groups with regard to any primary (limitations in activities of daily activities) or secondary outcomes (depressive symptoms, social support, anxiety about falling, social participation and quality of life). The pre-planned subgroup analysis revealed no other findings. It can be concluded that the study results do not provide empirical evidence for the effectiveness of the intervention.</p>	<p><b>Fidelity:</b> The analysis of the logs showed that some parts of the intervention protocol were not properly followed: 1) the problem analysis and the preliminary plan were often not discussed during team meetings, as indicated in the protocol; 2) only half of the participating elderly received a second home visit to discuss the care plan; 3) the toolbox components were not frequently used; and 4) there were a limited number of evaluation and follow-up times. However, the protocol did provide structure for the care for elderly in primary care and increased the focus on prevention.</p> <p><b>Dose received elderly:</b> Older people were satisfied; they felt recognized by their health care professionals and experienced support in dealing with their problems and the fulfilment of their needs.</p> <p><b>Dose received interventionist</b> Health professionals felt that the intervention provided a useful structure for the delivery of geriatric primary care and increased the attention paid to the preventive treatment of vulnerable elderly. The largest improvement was in multidisciplinary cooperation. Despite the usefulness of the team meetings, they were seen as time-consuming and sometimes difficult to coordinate within the organization and between all interventionists. Interventionists reported that some parts of the intervention protocol were time-consuming and difficult to implement and that a more intensive education and educational programme were required.</p>	<p>With a time horizon of 24 months, a cost-effectiveness analysis (CEA) and cost-utility analysis (CUA) were performed. The total cost over 24 months tended to be higher in the intervention group than in the control group (€ 26.503 versus € 20.550, <math>P=0.08</math>) There were no significant differences between the groups with regard to restrictions on activities of daily living or quality of life.</p>
----------------------------------	--	---	---

<p>Programme 4 WICM study</p>	<p>The intervention increased the quality of care. Consistency, continuity and integration of care improved, leading to higher satisfaction among frail elderly and health professionals. The intervention had a positive effect on the quality of life of the elderly. No effects were found on mental health, social functioning or self-reliance. Health care use did not differ from care as usual, which was seen as a positive effect. No differences regarding quality of life, satisfaction with care or skilled health care professionals were found.</p>	<p><b>Fidelity:</b> To some extent, i.e., exploring the satisfaction with delivered care. <b>Dose received elderly:</b> The intervention resulted in an improvement in the quality of life and the satisfaction with care. Participants who received the intervention became more satisfied with the following aspects: information, attention, security, living environment, client orientation/demand driven, consistency in care, treatment, professionalism, availability, reliability, staff and amount of care without increasing the use of care. The visits were appreciated by the elderly. They liked that someone took the time to talk with them.</p> <p><b>Dose received interventionist:</b> Interventionists were more satisfied with their working conditions and the consistency and continuity of the care process.</p>	<p>After one year, the intervention was not cost-effective, and the costs per quality-adjusted life year were high.</p>
-----------------------------------	--	---	---



<p>Programme 5 ACT study</p>	<p>Despite the sufficiently high implementation rate of the intervention, no improvements in patient outcomes were observed (Table 1; primary outcome + secondary outcomes 1-7 &amp; 9), although better quality of life, fewer unmet needs and fewer (acute) hospital admissions were observed in the participating frail elderly. The intervention led (after 12 months) to greater IADL function preservation in three groups of elderly individuals: participants who received home care at the start of the intervention, participants without a partner and participants older than 80 years.</p>	<p><b>Fidelity:</b> Adherence to the geriatric assessments and care plans was high but decreased over time. Adherence to multidisciplinary consultations was initially poor but increased over time. We found that individual differences in adherence between practice nurses and primary care physicians were moderate, while differences in participant responsiveness (satisfaction and involvement) were more distinct. Nurses deviated from protocol due to contextual factors and personal work routines.</p> <p><b>Dose received elderly:</b> Participants who received the intervention experienced more customer-oriented care at each time point. Participants who received the intervention experienced (during an intervention period of 6 months) more autonomy regarding decisions about the timing and frequency of care than other participants. Zaken over timely identification uit zonwm rapport zouden nog toegevoegd kunnen worden (abstract van meesturen, bv IFIC?)</p> <p><b>Dose received interventionist:</b> Participating health care professionals were, on average, satisfied with the new process (the geriatric care model).</p>	<p>The differences in the cost of the geriatric care model and usual care were not significant.</p>
----------------------------------	---	---	---

<p>Programme 6 Care Well study</p>	<p>The intervention was found to be ineffective for functional status and quality of life. The mean changes in the sum scores on the Katz-15 index between baseline and follow-up did not differ significantly between the intervention and control groups; in the intervention group, the elders worsened by 0.8 points on the Katz-15 index versus 0.5 points in the control group. The estimated effect size was 0.4 and was not significant. Additionally, no difference was found in mean changes on the EQ-5D between the intervention and control groups, with an effect size of zero.</p> <p><b>Fidelity:</b> To some extent, e.g., exploring the dose delivered.</p> <p><b>Dose received elderly:</b> Participants appreciated the comprehensive and proactive approach that included medications and attention to welfare and the role of the case manager. They were often involved in the process of proactive care, and their wishes and preferences were taken into account. The majority of the participants appreciated the support they received from the case manager and the cooperation of the case manager with the GP.</p> <p><b>Dose received interventionist:</b> The interventionists appreciated the intervention. It was important for the interventionists that there was sufficient time available.</p>	<p>The intervention was not shown to be cost-effective at the current follow-up period of twelve months. It is possible that a longer follow-up period might lead to hypothesized cost savings through an active reduction of second-line care costs. In addition, it is possible that the intervention during the post-test was not sufficiently implemented.</p>
<p>Programme 7 EMBRACE study</p>	<p>After one year, participants experienced 47% fewer health problems, and the remaining problems were perceived as less severe (a decrease in severity of 1.7 points on a 10-point scale). The change in health status of older adults was the same compared with that of those who received usual care. Older adults in the intervention group reported a larger increase in perceived quality of care than those who received usual care. The advantages of the intervention were more common in the “frail” and “complex care needs” risk profiles. Participants reported in interviews (qualitative study) that they felt safe, secure and more in control due to the care and support from Embrace.</p> <p><b>Fidelity:</b> To some extent, e.g., exploring the dose delivered.</p> <p><b>Dose received elderly:</b> Participants reported in interviews (qualitative study) that they felt safe, secure and in control due to the care and support from Embrace.</p> <p><b>Dose received interventionist:</b> The intervention was appreciated by the interventionists. They also reported a significant increase in the perceived level of implementation of integrated care.</p>	<p>The average total costs were higher for the Embrace group than for usual care but were associated with small advantages in health-related outcomes. Embrace was therefore not considered cost-effective according to current standards. Older adults with complex care needs, however, showed risk profile improvements. The long-term cost-effectiveness should be investigated.</p>

<p>Programme 8 [G]OLD study</p>	<p>The intervention had no positive effects on the quality of life or independence of older people. The only difference from the elderly in the control group was that the participants in the intervention were, on average, slightly less limited by their physical health in their daily activities after six and eighteen months.</p>	<p><b>Fidelity:</b> Overall, the home visitation programme was delivered completely, according to protocol, to only 38.0% of the 721 study participants. Several threats to the completion of the delivery of the intervention were identified, including lack of time. Second, a few new or complex health and/or wellbeing problems were detected, which were the main cause of the lack of post-discussions, the absence of care and treatment plans for specific cases, and limited interdisciplinary cooperation.</p> <p><b>Dose received elderly:</b> All older people were satisfied with the home visit, regardless of whether problems were detected, mostly because it offered them the ability to express their daily concerns. They were very positive about the PN and felt that they could discuss everything with him/her. The home visit was neither too short nor too long, and they felt that everything that they considered important was discussed.</p> <p><b>Dose received interventionist:</b> Both PNs and GPs were satisfied with the home visitation programme. It resulted in more attention for older people, closer collaboration between the GPs and PNs, and a comprehensive picture of older people's functioning and social network. This positive attitude made them willing to find solutions for barriers encountered during the implementation (i.e., monitoring older people via other disease management programmes).</p>	<p>N.A.</p>
---------------------------------	---	--	-------------

Programme 9 After 12 months, there was no difference in the functioning between the control group and the intervention group, as measured by the modified Katz ADL. Additionally, no difference in function was observed between the two groups after 18 or 24 months. No differences in the secondary outcomes, such as quality of life and psychological wellbeing, were found between the control group and the intervention group. The study did not demonstrate that a proactive multidisciplinary intervention of 12 months could prevent loss of function.

**Fidelity:** To some extent, i.e., exploring the dose delivered.

**Dose received elderly:** N.A.

**Dose received interventionist:** GPs and nurses were predominantly positive about the intervention. The full list of geriatric conditions, which was evident by the decline of the CGA and the prioritization of the elderly themselves, was seen as an added value compared with that of the usual care by a GP. In addition, the toolkit (including the roadmaps for the 24 most common geriatric problems) provided substantial structure and guidance for the nurses in the preparation of care treatment. A major focus was the educational programme of GPs: although the nurses were extensively trained and had interventions during the study, the GP educational programme began slowly and included no interventions. The GPs understood the problems of the elderly fairly well, but some of them were not yet thinking in problem-oriented and proactive manners. After the educational programme, the nurses did think in a problem-oriented manner and had a proactive approach to managing problems.

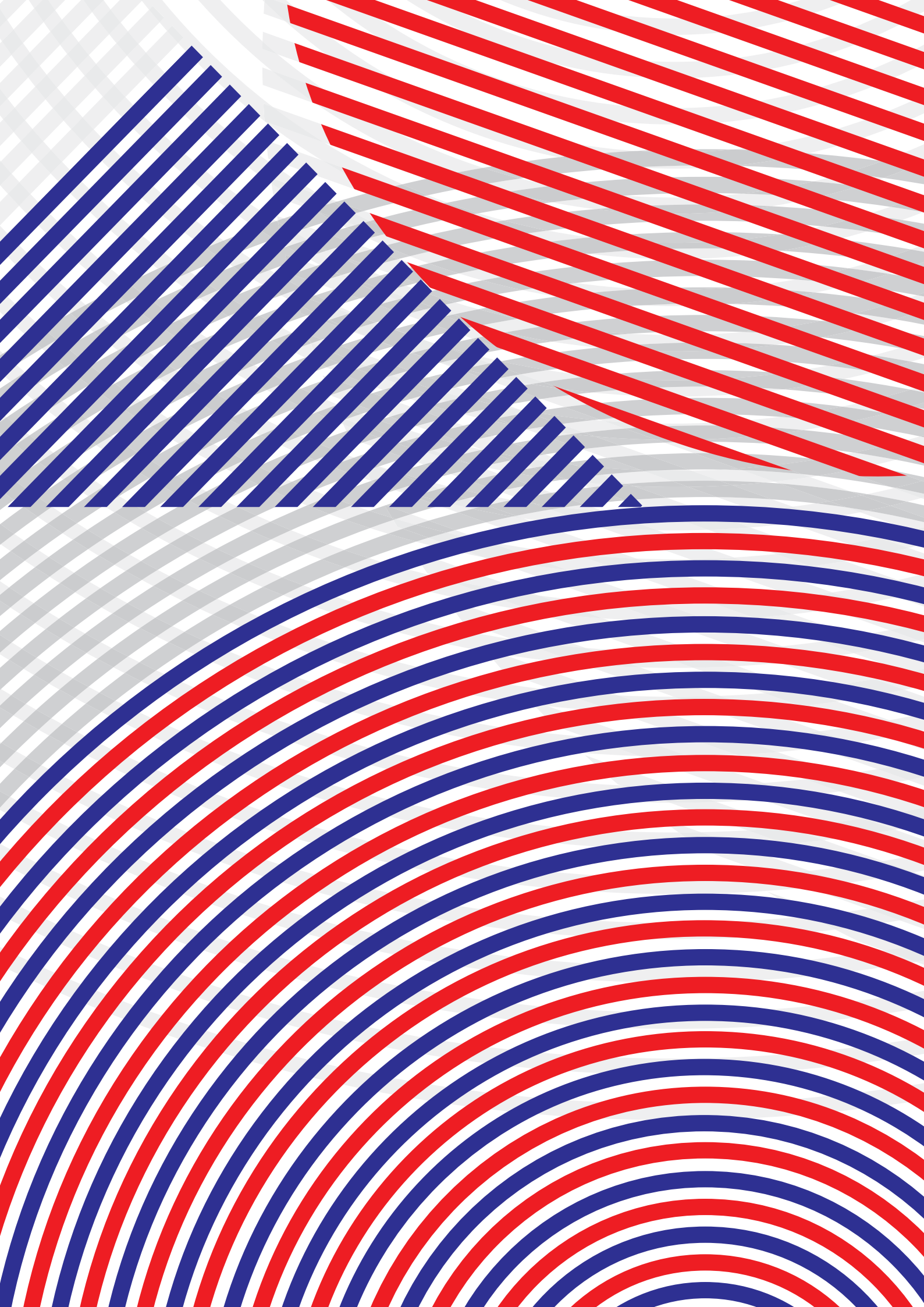
*Acronyms: U-PROFIT study: Utrecht primary care PROactive frailty intervention study, ISCOPE study: Integrated Systematic Care for Older Persons study, PoC study: Prevention of care study, WICM study: Walcheren Integrated Care Model study, Care Well study: Care Well study, ACT study: Adult Care in Transition, Embrace study: model for integrated care study, [G]OLD study: OLD the healthy way study, FIT study: Functiebehoud In Transitie study.*

## Appendix F. Interventionists and training

Study	Interventionists and training
Programme 1 U-PROFIT study	GPs and practice nurses (PNs). GPs and PNs of U-CARE received special training in working with the frailty screening GFI questionnaire, conducting a CGA and making care plans.
Programme 2 ISCOPE study	GPs and PNs. The training was based on a programme developed for GPs with expertise in geriatrics and was followed by both GPs and PNs. Different learning styles were used, including theory, case discussions, reflections on group discussions, and planning the intervention in one's own practice.
Programme 3 PoC study	GPs, PNs, physiotherapists and occupational therapists. Previously, all interventionists were trained in aspects of the intervention (such as screening procedures and self-management principles). To become accustomed to the intervention protocol, health professionals trained with small numbers of frail older people, who were not included in the study, under the supervision of the project team.
Programme 4 WICM study	PNs, nurses and nurse specialists in geriatrics were present. Depending on the treatment goals, individuals from other disciplines were also invited (such as pharmacists, geriatricians, geriatric physiotherapists or mental health workers). The nurse specialist in geriatrics (highly complex care) and an older people –PN (low complex care) were counsellors. Training was provided regarding frail older people, working with the GP information system, the preparation of care plans, designing a multidisciplinary consult and the use of EasyCare.
Programme 5 ACT study	A geriatric team, which consisted of a GP and an RN specialized in care for the elderly, led the PNs in performing the care. Every month, a supervision meeting was conducted in which PNs also received training on demand. PNs all received training in care plans, conducting a CGA, guidelines on frequently occurring health problems, and collaboration/social cards. In addition, PNs participated in tailor-made training. Prior to the intervention, all nurses participated in a three-day course on motivational interviewing, followed by training on the job. Furthermore, practice nurses and members of the geriatric team participated in a one-day RAIview workshop before performing the intervention. Every six months, a refresher course on RAIview and motivational interviewing was provided.
Programme 6 Care Well study	Every GP practice in the intervention represented one or two multidisciplinary care teams, which comprised a doctor, a community and/or practice nurse, an elderly care physician and an elderly people (welfare) worker. The following competencies were included in the training: screening, communication of health needs determination/integrated diagnostics, integral care planning, monitoring/evaluation, collaboration/social card, coordination of care, and ICT application.
Programme 7 Embrace study	Fifteen Elderly Care Teams consisted of a GP, two case managers (district nurse and social worker) and an elderly care physician. All Elderly Care Team professionals were trained in working according to the principles of Embrace, including, for example, proactive and preventive work and working with the electronic record system.

Programme 8 [G]OLD study	GPs and PNs were involved. PNs received two days of training before the study. Central elements of the training included acquiring communication skills, gaining knowledge of health problems, health services for older people, and learning how to assess older people's physical, psychological, mental and social functioning by means of a multidimensional instrument. Between the two training sessions, each PN performed five home visits with randomly chosen older people during a try-out phase.
Programme 9 FIT study	GPs and PNs were involved. PNs received training based on a developed programme, Elderly Care. Prior to the trial, nurses learned the content and use of the study protocol, the CGA and how to create and implement an individualized care plan. During the training, attention to care coordination, patient empowerment and motivational interviewing were emphasized. Every 6 weeks, a refresher course on the content of the study protocol was provided, and complex cases were discussed. Geriatrics participated in no discussions and less training than PNs.

*Acronyms: U-PROFIT study: Utrecht primary care PROactive frailty intervention study, ISCOPE study: Integrated Systematic Care for Older Persons study, PoC study: Prevention of care study, WICM study: Walcheren Integrated Care Model study, Care Well study: Care Well study, ACT study: Adult Care in Transition, Embrace study: model for integrated care study, [G]OLD study: OLD the healthy way study, FIT study: Functiebehoud In Transitie study.*



# 3

## **Influence of organizational context on patient outcomes regarding the effectiveness of a proactive primary care program: a longitudinal observational study.**

Smit LC, De Wit NJ, Nieuwenhuizen ML, Schuurmans MJ, and Bleijenberg N.

Under review



## ABSTRACT

**Background:** The effectiveness of health care interventions is co-determined by contextual factors. Unknown is the extent of this impact on outcomes. Therefore, this study aims to explore the impact of organizational contextual factors on patient outcomes of a proactive primary care program for older people.

**Methods:** A longitudinal 12 month observational non-comparative follow-up study was conducted. Characteristics of the primary care practices were: practice neighbourhood socio-economic status, single general practice versus healthcare centre and professional- frail older patient ratio per practice of general practitioners and nurses. Factors regarding delivering the program were the interventionist (practice nurse/district nurse), number of years since the start of the implementation and choice of age threshold for frailty screening. Patient outcomes were daily functioning, hospital admissions, emergency department visits, general practice out-of-hours consultations. Linear and generalized linear mixed models were used.

**Results:** A total of 827 frail older people were registered at baseline. Delivery of the program by a district nurse compared to a practice nurse was significantly associated with a decrease in daily functioning on patient-level ( $\beta=2.19$ ;  $P < 0.001$ ). Duration since implementation of three years compared to nine years was significantly associated with less out-of-hours consultations to a general practice (OR 0.11;  $P = 0.001$ ). Applying frailty screening from the age of 75 compared to those targeted from the age of 60, a significant increase in emergency admissions was observed (OR 5.26;  $P= 0.03$ ).

**Conclusion:** Function of interventionist, years since implementation and choice of age threshold for frailty screening were associated with patient outcomes when delivering a primary care program. When implementing a complex primary care program, practices should acknowledge that implementation is an ongoing process and be aware of choices made at baseline that fit their unique context impacting outcomes.

## INTRODUCTION

The traditional research pipeline from study to practice takes 17 years; moreover, only 14% of the original research will be translated into practice.<sup>1,2</sup> One of the explanations for this gap is that the use of traditional intervention research designs (such as randomized controlled trials) implies a controlled implementation context which does not mirror the complex, dynamic and less-resourced real-world settings.<sup>3,4</sup> To obviate the leaking pipeline of research waste, more emphasis should be given to the implementation context in intervention research.<sup>5-7</sup> Understanding the influence of context is necessary to explain why certain patient outcomes are achieved or simply failed to generalize study findings to different settings.<sup>8,9</sup>

In literature, several unique frameworks address contextual factors.<sup>8</sup> Although they do take context into account, no single framework is sufficiently comprehensive about the definition and application of context.<sup>8,10,11</sup> Context can be defined as the place where an intervention is delivered (e.g. primary care setting) according to the context and implementation of complex interventions (CICI) framework.<sup>12</sup> The organizational environment is part of this setting, also referred as organizational support, which includes the organization of work, staff workload and staff training.<sup>8,9,12,13</sup>

In the last decade, many proactive, integrated care programs for frail older people living in the community have been evaluated and implemented in clinical practice. In the Netherlands, the U-PROFIT program, a proactive care program to preserve daily functioning, was evaluated in a large cluster-randomized trial in which no effect was found.<sup>14</sup> A modified U-PROFIT 2.0 program, including social work and district nursing as well, was implemented in primary care to examine modifiable characteristics of primary care practices. Understanding the context in interpreting the findings of this program and generalizing beyond is needed.<sup>9,15,16</sup> Therefore, the aim of this study is to explore which characteristics of primary care practices influenced patient outcomes (e.g. daily functioning and acute admissions) in the context of a clinical effectiveness study, the U-PROFIT 2.0 program.

## METHODS

### Design and setting

A longitudinal observational non-comparative follow-up study of twelve months was conducted among frail older people in the region of Utrecht in the Netherlands from January 2016 till October 2017. The U-PROFIT 2.0 program was implemented

in seven general practices, which consisted of seventeen local general practitioners (GPs) providing proactive primary care to approximately 24885 patients aged 60 and older. With more than 340,000 inhabitants, Utrecht is the fourth biggest city in the Netherlands.

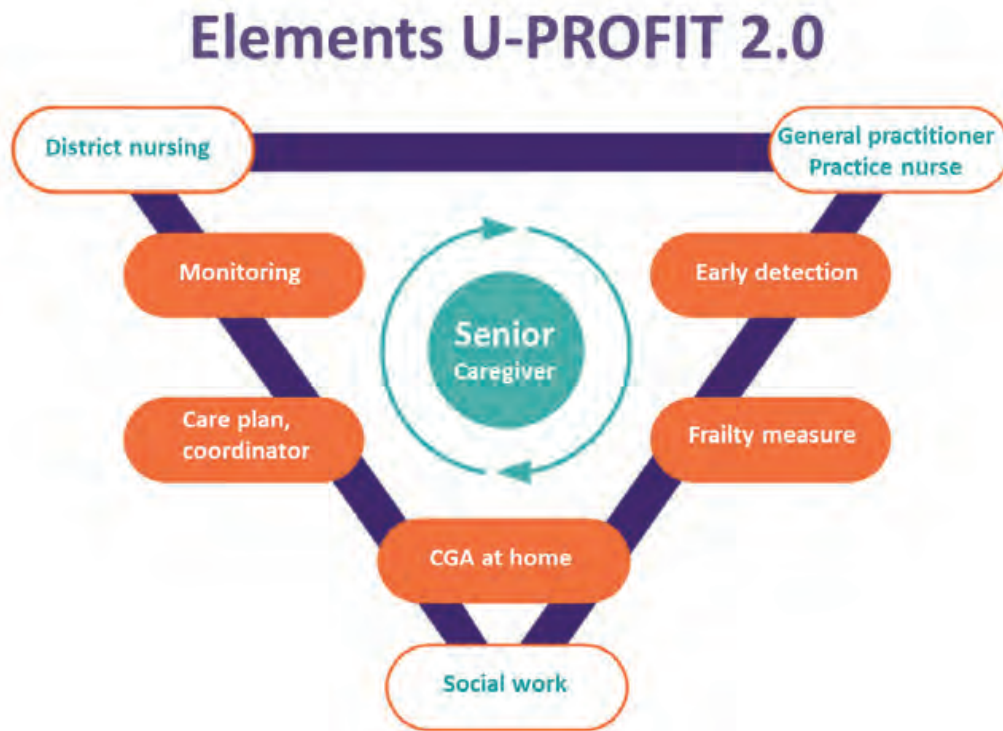
This study was approved by the University Medical Center Utrecht (UMCU) institutional review board with protocol ID 20/020939. Participants were informed and consented to the study when they returned the questionnaire at baseline. U-PROFIT 2.0 was implemented within routine primary care without research intentions to measure intervention effectiveness as this was already done based on the U-PROFIT 1.0.<sup>14</sup>

### **Intervention: Proactive Primary Care Program for older people U-PROFIT 2.0**

The proactive primary care program (Figure 1) is a complex intervention as it consists of multiple components involving multiple providers.<sup>17</sup> The U-PROFIT 2.0 program consists of two parts.

First, the program started with the U-PRIM screening and assessment to identify potentially frail older people.<sup>14,18</sup> The U-PRIM screening was based on routine care data using automated risk-based detection within electronic medical records.<sup>14,18</sup> The U-PRIM screening was based on routine care data using automated risk-based detection within electronic medical records.<sup>14,18</sup> A patient was included when the patient reached the age of 60 or older and met one of the following three criteria: 1) polypharmacy (five or more medications in chronic use); 2) multimorbidity defined as the Frailty Index score of 0.20 or greater which indicates potential frailty (amount of health deficits divided by the maximum of possible health deficits, a score between 0 and 1 represents the number of deficits present divided by the total number of deficits);<sup>19,20</sup> 3) consultation gap defined as older people who had not been with the general practitioner (except flu vaccination) for more than three years with the aim to screen potentially avoidance of primary care.<sup>14</sup> To identify frail older people, the Groningen Frailty Indicator (GFI) questionnaire was sent to those who were identified by the U-PRIM.<sup>21</sup> Patients were identified as frail when the GFI score was 4 or higher (scale 0-15).<sup>21</sup> In the second part of the program (U Care) a Comprehensive Geriatric Assessment (CGA) at home was conducted. Each general practice decided if either specially trained practice nurses or district nurses (e.g. interventionist) conducted the CGA and further delivering of the U-PROFIT 2.0 program. Based on the CGA, the interventionist developed a tailor-made care plan in consultation with the patient, and if needed, a social worker and GP. Care coordination and follow-up were provided by either the interventionists or social

worker which was based on the needs of the patient. The inclusion of social work was a second modification compared to the U-PROFIT 1.0. Furthermore, regular meetings between these professionals were set up. Compared with the previous U-PROFIT program,<sup>14</sup> the U-PROFIT 2.0 program consisted of a more close and integrated care collaboration between the general practice, the district nurse and social care professionals.



**Figure 1.** Schematic depiction of U-PROFIT 2.0.

## Outcomes

Four outcomes were determined. First, (instrumental) activities of daily living ((I) ADL) dependency was defined as an increase in depending on someone else when performing (instrumental) activities of daily living. Second, the number of hospital admissions within twelve months, third, the number of visits to an emergency (ER) department within twelve months, and fourth, the number of general practice out-of-hours consultations within twelve months were determined which are also referred as acute admissions.<sup>14,22</sup>

### Characteristics of primary care practices

In total, seven characteristics of the primary care practices were measured using a questionnaire of which four at general practice level and three regarding the choices made in the local delivery of the U-PROFIT program. We considered the following primary care practices characteristics; practice neighbourhood socio-economic status (SES) based on the postal areas determined using the Netherlands Institute for Social Research status scores,<sup>23</sup> general practice versus healthcare centre, professional-patient ratio per practice (full-time equivalent employment) of general practitioners and nurses per practice in relation to the total frail patient population they serve. Regarding the delivery of the program, the following factors were recorded: the number of years that U-PROFIT 2.0 was implemented if either the practice nurse or district nurse was in the lead in delivering the U-PROFIT 2.0; and choice of age threshold for frailty screening either *60 years and older* or *75 years and older*.<sup>24</sup>

### Measurements

The daily functioning of the older patients was measured by The Groningen Activity Restriction Scale (GARS) at baseline and after 12 months follow-up.<sup>25</sup> The GARS comprise of 18 questions about the degree to which someone is able to perform ADL (11 questions) and IADL activities (seven questions) independently. The four response options are: 1) 'Yes, I can do it fully independently without any difficulty', 2) 'Yes, I can do it fully independently but with some difficulty', 3) 'Yes, I can do it fully independently but with great difficulty', 4) 'No, I cannot do it fully independently, I can only do it with someone's help'. The results were dichotomized into being independent (options 1-3) or dependent (option 4), as described in the GARS manual.<sup>26</sup> Therefore, the GARS score ranged from 18 to 36, where a higher score indicated more dependency. This way of analyzing was chosen because losing one's independence is particularly critical and has a higher impact on people's lives than having difficulties (without dependency) in performing (I)ADL.<sup>27</sup> Acute admissions were measured with self-reported questionnaires.

Demographic information on age, gender, marital status, country of origin, education, polypharmacy and the hours of district nursing care per week was provided by the older patients by filling in questionnaires at baseline. Marital status was categorized into being married or living together, divorced, widowed, and unmarried. Educational level was categorized as low (upper secondary education or less), average (post-secondary non-tertiary education), and high (tertiary or university education) based on the International Classification of Education.<sup>28</sup> Polypharmacy was defined as a patient who had five or more medications in chronic use.<sup>29</sup>

## Statistical analysis

Case mean substitution was applied for the GARS when less than 50% of the total number of items were missing.<sup>26,30</sup> Non-response analysis was performed on age, gender, marital status, educational status, hours district nursing per week, polypharmacy, and GARS score at baseline to compare respondents and non-respondents by Chi-square test for binominal outcomes and Mann-Withney U-test for continuous outcomes. Statistical significance was set at  $P \leq 0.05$  (two-tailed). Multicollinearity was assessed by a correlation matrix.

To determine the association between primary care practices characteristics on the daily functioning linear mixed model (LMM) for a continuous outcome was used. To determine the association between primary care practices characteristics on acute admissions, generalized linear mixed models (GLMM) for dichotomized outcomes (hospital admissions, ER visits, and special GP visits) were used. LMM and GLMMs consider all available data points, including patients who missed the follow-up.<sup>31</sup> First, associations of primary care practices characteristics with daily functioning and acute admissions were examined in a stepwise backward multivariate model, including a random intercept for subjects to account for the repeated measurements, and a fixed intercept for each contextual factor and covariates. Second, the effect over time for daily functioning and acute admissions at 12 months follow-up was assessed as a fixed factor in the final models. Third, the interaction between time and baseline patient characteristics such as age, gender, marital status, country of origin, education, district nursing per week and polypharmacy was assessed. All models were adjusted for variables reported to be related to disability, such as gender, education, socioeconomic status, hours of district nursing per week, and polypharmacy.<sup>32</sup> Model fit was assessed using the -2 Log-likelihood ratio for GLMM analyses and Akaike's Information Criterion for LMM analysis. Primary care practices characteristics with a significance level of  $P \leq 0.05$  (two-tailed) were considered as statistically significant associated with the outcome. Results were reported as beta coefficients for the LMM and Odds Ratios for GLMM with standard errors and 95% confidence intervals (CI). All analyses were performed using the statistical program IBM SPSS Statistics for Windows (version 24.0; IBM Corp).

## RESULTS

### Study population

Seven GP practices providing proactive primary care to approximately 24885 patients aged 60 and older, of which 11,680 (46.9%) were potentially frail based on the U-PRIM screening. Subsequently, 7099 potential frail older people were contacted and received the GFI questionnaire. A total of 4984 GFI questionnaires were returned, representing a response rate of 70.2%. The number of patients who were indicated as frail by the GFI questionnaire (a score of 4 or higher) were 1821 (36.5%). Of these frail patients, 1467 (80.6%) received a CGA at home. A total of 827 (45.4% of those identified as frail after GFI) frail older people participated and filled in the study questionnaire at baseline, of which 545 (65.9%) were female (see Appendix A). The mean age was 80.0 years (SD 7.3), and 42.6% lived alone. Polypharmacy was observed in 44.1%.

At twelve months follow-up, only 469 frail older people participated and filled in the questionnaire, resulting in a 358 (43.3%) drop out (Table 1). Reasons for drop-out were relocation to another GP (1.2%), death (1.3%), refusal to participate (0.9%), feeling too weak to participate (0.9%), and unknown reasons (N=39.1%). A non-response analysis showed that non-responders had a significant higher GARS score at baseline compared to the responders ( $P < .001$ ). Compared to responders, non-responders appeared to have more hours of district nursing per week ( $P < .001$ ).

The median GARS score at baseline and at follow-up for limitations in daily functioning was 20 (IQR 4.0 at baseline and IQR at follow-up 5.0). The percentage of hospital admissions in the previous 12 months was at baseline 25.2% and at follow-up 28.4% respectively. The percentage of emergency admissions in the previous 12 months was at baseline 20.6% and 20.9% at follow-up. The percentage of participants with an emergency visit to a GP out-of-hours service in the previous 12 months was at baseline 20.6%, and 25.9% at follow-up respectively.

### Outcomes

The results of the multivariable model for daily functioning and acute admissions are presented in Table 2 and 3 (see Appendix B for univariable analyses). A significant difference between the delivery of the U-PROFIT intervention by a district nurse compared to a practice nurse on a lower daily functioning at patient level was observed (increase of 2.19 points on the GARS score; CI 1.03 to 3.36;  $P = < 0.001$ ). Furthermore, a significant association was observed between age and risk of admission a higher age at screening (75 plus compared to 60 plus) and a higher odds ratio on emergency admissions (OR 5.26; CI 1.17- 23.60;  $P = 0.03$ ). A reduction

**Table 1. Number of participants on T0 and T1 measurement.**

General Practice	Number of participants T <sub>0</sub> -measurement (%)	Number of participants T <sub>1</sub> -measurement (%) <sup>a</sup>	Number of dropouts (%) <sup>b</sup>
1	71 (12.5)	33 (7.0)	38 (10.6)
2	98 (17.3)	60 (12.8)	38 (10.6)
3	96 (11.6)	42 (9.0)	54 (15.1)
4	165 (20.0)	84 (17.9)	81 (22.6)
5	86 (15.2)	55 (11.7)	31 (8.7)
6	66 (11.7)	48 (10.2)	18 (5.0)
7	245 (43.3)	147 (31.3)	98 (27.4)
Total	827 (100.0)	469 (100.0)	358 (100.0)

**Notes:** <sup>a</sup> Number of participants measured based on all four outcomes (e.g. daily function and care consumption). <sup>b</sup> Dropouts reasons: relocation (N= 7), admission to nursing home (N= 3), refusal to participate (N= 7), felt too weak to participate (N=7), deceased (N= 11) and unknown (N= 323).

**Table 2. Multivariable LMM between contextual factors and daily functioning.**

	Daily functioning			
	$\beta$	SE	CI (95%)	<i>p value</i>
<b>Delivering intervention</b>	2.19	.59	1.03-3.36	<.001

**Notes:** p < .05, \_\_ p < .01, \_\_\_ p < .001. Adjusted for age, sex, education, polypharmacy and hours of district nursing per week. No significant associations were found for the following contextual factors; SES score, health center, FTE GPs population ratio, FTE PNs population ratio, UPROFIT implemented, age of screening.

**Table 3. Multivariable GLMM analyses between contextual factors and acute admissions.**

	Acute admissions							
	ER visits				GP out-of-hours visits			
	$\beta$	SE	CI (95%)	<i>p value</i>	$\beta$	SE	CI (95%)	<i>p value</i>
<b>FTE PNs population ratio</b>	-0.001	0.001	-0.002-0.00	.01				
<b>Om U implemented</b>								
3 years vs. 9 years					-2.22	0.65	-3.51- 0.94	.001
4 years vs. 9 years					-0.08	0.84	-1.73-1.57	.92
<b>Age of screening</b>	1.66	0.76	0.16-3.16	.03				

**Notes:** p < .05, \_\_ p < .01, \_\_\_ p < .001. Adjusted for age, sex, education, polypharmacy and hours of district nursing per week. No significant associated outcomes for hospital admissions were observed. No significant associations were found for the following contextual factors; SES score, health center, FTE GPs population ratio, delivering of intervention.



in GP out-of-hours consultations was observed when the UPROFIT intervention was implemented three years compared to nine years (OR 0.11; CI-0.03 to 0.39;  $P = 0.001$ ). An increase in practice nurse-patient ratio (i.e. number of patients per 1 FTE practice nurse) appeared to be associated with fewer emergency admissions (OR 0.99; CI 1.00 to 1.00;  $p=0.01$ ). No contextual factors were significantly associated with hospital admissions. Furthermore, no significant interactions of time with patient characteristics were found that could explain possible inequalities in health over time.

## DISCUSSION

This study explored the influence of primary care practices characteristics on daily functioning and acute admissions in context of the clinical effectiveness of the U-PROFIT 2.0 study. The delivery of the UPROFIT intervention by a district nurse compared to a practice nurse was associated with a higher level of dependency in daily functioning. If the UPROFIT intervention was implemented three years ago compared to nine years ago, this was significantly associated with fewer GP out-of-hours consultations. When the choice was made to screen potential frail older people within the UPROFIT intervention from the age of 75 compared to the choice of screening from the age of 60 years, a significant higher odds on emergency admissions was observed.

Our study showed that when the intervention was implemented less long, this was significantly associated with less GP out-of-hours consultations. This may indicate that the effect of the intervention will fade over time. Similar proactive primary-care programs published in literature paid no or little attention to the training of interventionists which could inhibit successful implementation.<sup>7,33</sup> The review of Lorthios-Guilledroit and colleagues (2018) revealed that training can be seen as an opportunity for professionals to become informed about program fidelity, to learn about the program's target population, and to practice the required skills.<sup>34</sup> Moreover, training can also increase professionals' confidence in their ability to deliver the program.<sup>35</sup> More research is needed to examine the effect of continuous education on the sustainability of outcomes within complex (primary) healthcare interventions.

The delivery of the UPROFIT intervention by a district nurse compared to a practice nurse was associated with a higher level of dependency on daily functioning. In clinical practice, there is variation in the type of patient to whom the different nurses deliver care. Practice nurses generally provide care to older people with

chronic conditions, while district nurses provide care to older people with complex and multiple care needs with IADL and ADL impact.<sup>36,37</sup> The association we identified in this study may reflect the normal variation in patient outcomes. Older people receiving care from district nurses are less likely to improve on patient outcomes than older people who only visit their practice nurse. In this light, the choice to deliver the UPROFIT intervention by either a practice nurse or a district nurse should not be made on practice level but patient level.

This study showed that screening potential frail older people from the age of 75 compared to the choice of screening from the age of 60 years showed a significant increase in emergency admissions. We were not surprised by this finding as with age, the disease burden increases (e.g. biological ageing).<sup>38</sup> There is no consensus in the literature about the optimal cut-off age for frailty screening.<sup>39</sup> However, in 2013, a consensus meeting of six societies called for screening of all persons 70 years and older for frailty.<sup>40</sup> In our study, the frailty screening was the first step in the proactive care approach, and GP practices determined the age threshold (e.g. either 60+ or 75+) based on their caseload and number of patients with a low SES. Low SES is defined as a risk factor on the rate of biological ageing, which is a fundamental pathway linking SES and health.<sup>41</sup> Furthermore, lowering the age threshold (to 60+), will possibly increase the number of potential frail older people and place a burden of administrative work of the health care professionals, which is a barrier to program implementation.<sup>42</sup> This finding suggests that screening above 70 years with SES moderate-high and at age 60 years for those with a low SES is an alternative choice in delivering proactive care for older people.

Concerning the choices to be made by a general practice, the context in which the GP practice is delivering care is important in decision-making processes, which already starts during the development phase of the intervention.<sup>6,7,43,44</sup> Most intervention research assumes a distinction between intervention and context, however many health interventions are intended to modify contexts and thereby become part of the context in which health is produced.<sup>9</sup> The UPROFIT program can therefore be conceived as an 'event in a system' in order to generate a complete understanding of the relationship between the UPROFIT and its context.<sup>9</sup> Furthermore, the complex care needs of older people targeted by an intervention will also differ from one context to another<sup>45</sup>, meaning that the same intervention may have different consequences if implemented in a different setting.

### Strengths and limitations

As far as we have known, this is the first study that examines primary care practices characteristics of the provided health care for their association with daily functioning and acute admissions in a large, well-defined sample of frail community-dwelling older people. This study had some limitations as well. First, this study had an explorative nature and determined no causality. Second, this study could not account for the reach and fidelity/ adaptation of interventions (the degree that they were delivered and taken up as planned in the targeted group).<sup>46,47</sup> Understanding the black box of intervention delivery is essential and therefore recommended to take into account in future studies to comprehensively explain the found associations on patient outcomes. Third, this study had a selective inclusion due to the use of self-reported questionnaires.<sup>48</sup> Therefore, a relatively independent population of older people was included. This phenomenon was also observed within the original UPROFIT intervention trial effects.<sup>14</sup> Although the mean age was almost six years higher (80.0, sd 7.3) compared to the trial participants (74.2 sd 8.4). Still, the included older people in this study had probably little room for improvement in daily functioning. Moreover, the use of self-report ADL and IADL scales have a low sensitivity for detecting small changes, which could have underestimated our effects.<sup>49,50</sup> Fourth, the drop-out rate of our study of 43.3% (N= 358) was high and specifically observed in those older people who were more dependent in their daily functioning and has twice as much district nursing. This is in line with the studies of Suijker and colleagues (2014) and van Dalen and colleagues (2014), who examined differences between respondents and non-respondents at baseline and indicated that non-respondents had more often ADL dependency and received more home visits from their general practitioner.<sup>51,52</sup> A plausible consequence of the high non-response in our study is an underestimation of the results. Note, however, that differences between dropouts after baseline and those who did not drop out were small and that eleven out of fourteen variables were assessed.

### CONCLUSION

Several primary care practices characteristics were associated with daily functioning and acute admissions of community-dwelling older people that receive a proactive primary care program. This study showed that the organizational context is vital regarding the choices made in delivering a complex primary care program. The impact of these choices on patient outcomes should be monitored to give direction in the implementation process. Incorporating this ongoing implementation process can result in better-balanced choices to enhance effective proactive care for older people living in the community.

## REFERENCES

1. Balas EA, Boren SA. Managing clinical knowledge for health care improvement. *Yearb Med Inform.* 2000;9 Suppl 1:65-70.
2. Green LW, Ottoson JM, Garcia C, Hiatt RA. Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Annu Rev Public Health.* 2009;30:151-174.
3. Huebschmann AG, Leavitt IM, Glasgow RE. Making health research matter: a call to increase attention to external validity. *Annu Rev Public Health.* 2019;40:45-63.
4. Green LW. Closing the chasm between research and practice: evidence of and for change. *Health Promot J Austr.* 2014;25 Suppl 1:25-29.
5. Stirman SW, Miller CJ, Toder K, Calloway A. Development of a framework and coding system for modifications and adaptations of evidence-based interventions. *Implement Sci.* 2013;8:65.
6. Bleijenberg N, De Man-Van Ginkel JM, Trappenburg JC, et al. Increasing value and reducing waste by optimizing the development of complex interventions: Enriching the development phase of the Medical Research Council (MRC) Framework. *Int J Nurs Stud.* 2018;79:86-93.
7. Smit LC, Schuurmans MJ, Blom JW, et al. Unravelling complex primary-care programs to maintain independent living in older people: A systematic overview. *J Clin Epidemiol.* 2018;96:110-119.
8. Nilsen P, Bernhardsson S. Context matters in implementation science: a scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. *BMC Health Serv Res.* 2019;19 Suppl 1:189.
9. Craig P, Di Ruggiero E, Frolich KL, et al. *Taking account of context in population health intervention research: guidance for producers, users and funders of research.* Canadian Institutes of Health Research (CIHR)-National Institute for Health Research (NIHR) Context Guidance Authors Group. Southampton: National Institute for Health Research. 2018. <https://doi.org/10.3310/cihr-nihr-01>. Accessed 23 Oct 2020.
10. Li SA, Jeffs L, Barwick M, Stevens B. Organizational contextual features that influence the implementation of evidence-based practices across healthcare settings: a systematic integrative review. *Syst Rev.* 2018;7 Suppl 1:72.
11. Pfadenhauer LM, Mozygemba K, Gerhardus A, et al. Context and implementation: a concept analysis towards conceptual maturity. *Z Evid Fortbild Qual Gesundheitsw.* 2015;109:103-14.
12. Pfadenhauer LM, Gerhardus A, Mozygemba K, et al. Making sense of complexity in context and implementation: the Context and Implementation of Complex Interventions (CICI) framework. *Implement Sci.* 2017;12(1):1-7.
13. Squires JE, Graham I, Bashir K, et al. Understanding context: A concept analysis. *J Adv Nurs.* 2019;75 Suppl 12:3448-3470.

14. Bleijenberg N, Drubbel I, Schuurmans MJ, et al. Effectiveness of a proactive primary care program on preserving daily functioning of older people: a cluster randomized controlled trial. *J Am Geriatr Soc.* 2016;64 Suppl 9:1779e88.
15. Bleijenberg N, Drubbel I, Ten Dam VH, Numans ME, Schuurmans MJ, De Wit NJ. Proactive and integrated primary care for frail older people: Design and methodological challenges of the Utrecht primary care PROactive Frailty Intervention Trial (U-PROFIT). *BMC Geriatr.* 2012;12:16.
16. Moore GF, Audrey S, Barker M, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ.* 2015;350:h1258.
17. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new medical research council guidance. *BMJ.* 2008;337:a1655.
18. Drubbel I, De Wit NJ, Bleijenberg N, Eijkemans RJC, Schuurmans MJ, Numans ME. Prediction of adverse health outcomes in older people using a frailty index based on routine primary care data. *J Gerontol A Biol Sci Med Sci.* 2013;68A:301–308.
19. Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of deficits as a proxy measure of aging. *Sci World J.* 2001;1:323–336.
20. Rockwood K, Mitnitski A. Frailty defined by deficit accumulation and geriatric medicine defined by frailty. *Clin Geriatr Med.* 2011;27:17–26.
21. Steverink N, Slaets JPJ, Schuurmans H, Van Lis M. Measuring frailty. Development and testing of the Groningen Frailty Indicator (GFI). *Gerontologist.* 2001;41:236-237
22. Van Den Brink D, Lutomski JE, Qin L, et al. TOPICS-MDS: Veelzijdige bron voor wetenschappelijke en maatschappelijke kennisgeneratie ten behoeve van de ouderenzorg. *Tijdschr Gerontol Geriatr.* 2015;46:78-91.
23. Bijl R, Boelhouwer J, Cloin M, Pommer E. *The Social State of the Netherlands 2011*. In: The Netherlands Institute for Social Research, Status scores. 2012. Available from: [https://www.innovatiefinwerk.nl/sites/innovatiefinwerk.nl/files/field/bijlage/ssn\\_2011.pdf](https://www.innovatiefinwerk.nl/sites/innovatiefinwerk.nl/files/field/bijlage/ssn_2011.pdf). Accessed Oct 23, 2020.
24. Jorgensen T, Johansson S, Kennerfalk A, Wallander MA, Svardsudd K. Prescription drug use, diagnoses, and healthcare utilization among the elderly. *Ann Pharmacother.* 2001;35 Suppl 9:1004-1009.
25. Kempen GI, Miedema I, Ormel J, Molenaar W. The assessment of disability with the Groningen Activity Restriction Scale. Conceptual framework and psychometric properties. *Soc Sci Med.* 1996;43 Suppl 11:1601–10.
26. Kempen GI, Doeglas DM, Suurmeijer TPBM. *Groningen Activity Restriction Scale (GARS): een handleiding*. 2nd ed. UMCG / Rijksuniversiteit Groningen: Research Institute SHARE; 2012
27. Het Veld LPO, Beurskens AJ, De Vet HC, Van Kuijk SM, Hajema K, Kempen GI. The ability of four frailty screening instruments to predict mortality, hospitalization and dependency in (instrumental) activities of daily living. *Euro J Ageing.* 2019;16 Suppl 3:387-394.

28. UNESCO: *Institute of Statistics International Classification of Education ISCED*. 2018. Available from: <http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf>. Accessed Oct 23, 2020.
29. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr*. 2017;17 Suppl 1:230.
30. Fox-Wasylyshyn SM, El-Masri MM. Focus on Research Methods Handling
31. Missing Data in Self-Report Measures. *Res Nurs Health*. 2005;28:488-495.
32. Molenberghs G, Kenward M. *Missing Data in Clinical Studies*. New York: John Wiley; 2007.
33. Bleijenberg N, Zuithoff NP, Smith AK, De Wit NJ, Schuurmans MJ. Disability in the individual ADL, IADL, and mobility among older adults: a prospective cohort study. *J Nutr Health Aging*. 2017;21 Suppl 8:897-903.
34. Deschodt M, Laurent G, Cornelissen L, et al. Core components and impact of nurse-led integrated care models for home-dwelling older people: a systematic review and meta-analysis. *Int J Nurs Stud*. 2020;105:103552.
35. Lorthios-Guillement A, Richard L, Filiatrault J. Factors associated with the implementation of community-based peer-led health promotion programs: a scoping review. *Eval Program Plann*. 2018;68:19-33.
36. Vissman AT, Eng E, Aronson RE, et al. What do men who serve as lay health advisers really do? Immigrant Latino men share their experiences as Navegantes to prevent HIV. *AIDS Educ Prev*. 2009;21 Suppl 3:220-232.
37. Kroneman M, Boerma W, Van Den Berg M, Groenewegen P, De Jong J, Van Ginneken E. The Netherlands: health system review. *Health Syst Transit*. 2016;18 Suppl 2:1-239.
38. Van Eenoo L, Declercq A, Onder G, et al. Substantial between-country differences in organising community care for older people in Europe-a review. *Eur J Public Health*. 2016;26: 213-219.
39. Niccoli T, Partridge L. Ageing as a risk factor for disease. *Curr Biol*. 2012; 22 Suppl 17:R741-R752.
40. Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP. Frailty: implications for clinical practice and public health. *Lancet*. 2019;394 Suppl 10206:1365-1375.
41. Morley JE, Vellas B, Van Kan GA, et al. Frailty consensus: A call to action. *J Am Med Dir Assoc*. 2013;14:392-397.
42. Adams JM, White M. Biological ageing: a fundamental, biological link between socio-economic status and health? *Eur J Public Health*. 2004; 14 Suppl 3:331-334.
43. Barlow JH, Bancroft GV, Turner AP. Volunteer, lay tutors' experiences of the Chronic Disease Self-Management Course: being valued and adding value. *Health Educ Res*. 2005; 20 Suppl 2:128-136.
44. Pinnock H, Barwick M, Carpenter CR, et al. Standards for reporting implementation studies (StaRI) statement. *BMJ*. 2017;356:i6795.

45. Moore GF, Evans RE, Hawkins J, et al. From complex social interventions to interventions in complex social systems: Future directions and unresolved questions for intervention development and evaluation. *Evaluation*. 2019;25 Suppl 1:23–45.
46. Bonell C, Oakley A, Hargreaves J, Strange V, Rees R. Assessment of generalisability in trials of health interventions: suggested framework and systematic review. *BMJ*. 2006;333 Suppl 7563:346-349.
47. Fixsen DL, Naoom SF, Blase KA, Friedman RM, Wallace F. *Implementation research: a synthesis of the literature*. Louis: University of South Florida de la Parte Florida Mental Health Institute; 2005.
48. Bellg AJ, Borrelli B, Resnick B, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health Psychol*. 2004;23:443.
49. Althubaiti A. Information bias in health research: definition, pitfalls, and adjustment methods. *J Multidisc Healthc*. 2016;9:211.
50. Lin JS, Whitlock EP, Eckstrom E, et al. Challenges in synthesizing and interpreting the evidence from a systematic review of multifactorial interventions to prevent functional decline in older adults. *J Am Geriatr Soc*. 2012;60:2157–2166.
51. White DK, Wilson JC, Keysor JJ. Measures of adult general functional status: SF-36 physical functioning subscale (PF-10), Health Assessment Questionnaire (HAQ), Modified Health Assessment Questionnaire (MHAQ), Katz Index of Independence in Activities of Daily Living, Functional Independence Measure (FIM), and Osteoarthritis-Function-Computer Adaptive Test (OA-function-CAT). *Arthritis Care Res (Hoboken)* 2011;63 Suppl 11:S297–S307.
52. Suijker JJ, Buurman BM, Van Rijn M, et al. A simple validated questionnaire predicted functional decline in community-dwelling older persons: prospective cohort studies. *J Clin Epidemiol*. 2014;67:1121–30.
53. Van Dalen MT, Suijker JJ, MacNeil-Vroomen J, et al. Self-report of healthcare utilization among community dwelling older persons: a prospective cohort study. *PloS One*. 2014;9:e93372.

### Appendix A. Baseline characteristics

Practice	Total <sup>a</sup>	GP 1 <sup>b</sup> :	GP 2 <sup>c</sup> :	GP 3 <sup>d</sup> :	GP 4 <sup>e</sup> :	GP 5 <sup>f</sup> :	GP 6 <sup>g</sup> :	GP 7 <sup>h</sup> :
Number of older people ≥ 60 years	24885	1871	3597	4319	4189	2974	2343	5592
Number of potential frail people aged ≥ 60 years	11680	936	870	2619	2813	513	490	3439
Socioeconomic status score <sup>i</sup>	N.A.	-0.93	-1.54	0.69	1.87	-0.62	-0.87	-1.09
Health centre, yes/no	N.A.	Yes	Yes	Yes	Yes	Yes	Yes	no
FTE GPs	N.A.	2.31	4.3	7.3	2.6	7.2	4.6	2.0
1 FTE GP on population ratio	N.A.	424.20	175.06	350.40	275.86	64.44	101.08	470.56
FTE PNs	N.A.	0.84	0.56	1.63	0.40	0.70	0.80	0.50
1 FTE PN on population ratio	N.A.	1166.67	371.78	1569.33	903.23	662.86	581.25	2570.00
Years Om U implemented	N.A.	3.0	4.0	9.0	9.0	9.0	9.0	9.0
Trained in Om U, Yes/No	N.A.	Yes	No	Yes	Yes	Yes	Yes	Yes
Delivering intervention, PN/PN+DN <sup>j</sup>	N.A.	PN	PN+DN	PN+DN	PN	PN+DN	PN+DN	PN
Age of screening Om U, > 60/>75 years	N.A.	>60	>60	>75	>60	>60	>60	>75>
<b>Participant</b>								
Gender, N (%)								
Male	282 (34.1)	27 (38.0)	38 (38.1)	31 (32.3)	49 (28.8)	26 (30.2)	22 (32.3)	89 (36.3)
Female	545 (65.9)	44 (62.0)	60 (61.9)	65 (67.7)	116 (71.2)	60 (69.8)	44 (67.7)	156 (63.7)
Age, mean ± SD	80.0 ± 7.3	85.0 ± 7.2	73.5 ± 8.1	84.2 ± 6.5	80.2 ± 7.1	76.4 ± 10.0	77.9 ± 6.9	83.1 ± 5.2
Dutch origin, N (%)	747 (90.3)	68 (95.8)	85 (88.5)	92 (95.8)	143 (86.7)	77 (89.5)	55 (84.6)	227 (92.7)





	Total <sup>a</sup>	GP 1 <sup>b</sup> :	GP 2 <sup>c</sup> :	GP 3 <sup>d</sup> :	GP 4 <sup>e</sup> :	GP 5 <sup>f</sup> :	GP 6 <sup>g</sup> :	GP 7 <sup>h</sup> :
Marital status, N (%)								
<i>Married</i>	344 (41.6)	20	50	33	52	41	39	109
<i>Widow /widower/partner deceased</i>	352 (42.6)	39 (54.9)	30 (30.6)	52 (54.2)	79 (48.2)	30 (34.9)	15 (22.7)	107 (43.7)
<i>Divorced</i>	70 (8.5)	6 (8.5)	12 (12.2)	5 (5.2)	16 (9.8)	11 (12.8)	7 (10.6)	13 (5.3)
<i>Single</i>	53 (6.4)	6 (8.5)	5 (5.1)	6 (6.25)	17 (10.3)	4 (4.7)	3 (4.6)	12 (4.9)
<i>Sustainable living/unmarried</i>	7 (0.9)	0 (0.0)	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.0)	4 (1.6)
Education, N (%) <sup>k</sup>								
<i>Low</i>	116 (14.0)	4 (5.8)	19 (20.0)	10 (10.4)	49 (29.9)	12 (14.1)	11 (16.9)	11 (4.5)
<i>Moderate</i>	530 (64.1)	47 (68.1)	64 (67.4)	75 (78.1)	102 (62.2)	67 (78.8)	39 (60.0)	136 (55.7)
<i>High</i>	172 (20.8)	18 (26.1)	12 (12.6)	11 (11.5)	13 (7.9)	6 (7.1)	15 (23.1)	97 (39.8)
GARS, median ( IQR) (range 18-36)	20 (5.0)	21 (4.0)	20 (4.0)	21 (6.0)	20 (5.3)	21 (4.0)	20 (4.25)	20 (4.0)
Daily activities problems, N (%)								
<i>None/barely</i>	485 (58.7)	39 (55.7)	53 (58.9)	56 (58.9)	91 (56.9)	50 (58.8)	34 (54.0)	162 (66.4)
<i>Moderate</i>	186 (22.5)	21 (30.0)	20 (22.2)	18 (18.9)	42 (26.3)	18 (21.2)	14 (22.2)	53 (21.7)
<i>Serious<sup>l</sup></i>	136 (16.4)	10 (14.3)	17 (18.9)	21 (22.1)	27 (16.9)	17 (20.0)	15 (23.8)	29 (11.9)
Visits general practitioner, N (%) <sup>l</sup>								
<i>Times</i>	141 (16.9)	17 (24.3)	11 (11.7)	19 (20.2)	33 (21.2)	9 (10.8)	9 (13.8)	43 (18.1)
<i>2-3 times</i>	273 (33.0)	27 (38.6)	29 (30.9)	25 (26.6)	56 (35.9)	32 (38.6)	13 (20.0)	91 (38.2)
<i>4-6 times</i>	228 (27.6)	18 (25.7)	24 (25.5)	26 (27.7)	35 (22.4)	18 (21.7)	25 (38.5)	82 (34.5)
<i>&gt;6 times</i>	158 (19.1)	8 (11.4)	30 (31.9)	24 (25.5)	32 (20.5)	24 (28.9)	18 (27.7)	22 (9.2)
Medicines on receipt, N (%)								
<i>medicines</i>	72 (8.7)	8 (11.8)	1 (1.0)	13 (14.0)	15 (9.4)	2 (2.4)	3 (4.7)	30 (12.3)
<i>medicines</i>	146 (17.7)	16 (23.5)	5 (5.2)	22 (23.7)	24 (15.1)	8 (9.5)	11 (17.2)	60 (24.7)
<i>medicines</i>	225 (27.2)	29 (42.6)	15 (15.5)	24 (25.8)	41 (25.8)	22 (26.2)	15 (23.4)	79 (32.5)
<i>&gt; 5 medicines</i>	365 (44.1)	15 (22.1)	76 (78.4)	34 (36.6)	79 (49.7)	52 (61.9)	35 (54.7)	74 (30.5)

	Total <sup>a</sup>	GP 1 <sup>b</sup> :	GP 2 <sup>c</sup> :	GP 3 <sup>d</sup> :	GP 4 <sup>e</sup> :	GP 5 <sup>f</sup> :	GP 6 <sup>g</sup> :	GP 7 <sup>h</sup> :
District nursing, N (%) <sup>m</sup>								
None	635 (76.8)	37 (52.9)	88 (91.7)	62 (66.0)	122 (77.2)	70 (82.4)	52 (78.8)	204 (83.6)
< 2 hours/week	56 (6.8)	10 (14.3)	2 (2.1)	9 (9.6)	8 (5.1)	6 (7.1)	6 (9.1)	15 (6.1)
2-3 hours/week	52 (6.3)	12 (17.1)	3 (3.1)	11 (11.7)	8 (5.1)	4 (4.7)	3 (4.5)	11 (4.5)
3-7 hours/week	48 (5.8)	9 (12.9)	0 (0.0)	8 (8.5)	16 (10.1)	5 (5.9)	3 (4.5)	7 (2.9)
> 7 hours/week	22 (2.7)	2 (2.9)	3 (3.1)	4 (4.3)	4 (2.5)	0 (0.0)	2 (3.0)	7 (2.9)
Hospital admission, N (%) <sup>l</sup>	208 (25.2)	13 (18.8)	32 (33.0)	21 (22.6)	40 (24.8)	29 (34.1)	21 (31.8)	52 (21.4)
ER admission, N (%) <sup>l</sup>	170 (20.6)	7 (10.1)	27 (27.8)	18 (19.1)	35 (22.0)	14 (16.5)	20 (30.3)	49 (20.2)
Nursing home admission, N (%) <sup>l</sup>	48 (5.8)	3 (4.3)	2 (2.1)	9 (9.6)	8 (5.0)	3 (4.7)	5 (7.6)	18 (7.4)
GP out-of-hours consultations <sup>ln</sup>	170 (20.6)	7 (10.1)	23 (23.7)	23 (24.7)	41 (25.5)	20 (23.5)	14 (21.5)	42 (17.3)

**Notes:** IQR = interquartile range; SD = standard deviation., FTE= full-time equivalent

a N= 17 general practices, n = 827 participants. b N= 1 general practice, n= 71 participants. c N= 4 general practices, n= 98 participants. d N= 1 general practice, n= 96 participants. e N= 6 general practices, n= 165 participants. f N= 1 general practice, n= 86 participants. g N= 1 general practice, n= 66 participants. h N= 4 general practices, n= 245 participants

i Based on ZIP code, Socioeconomic status low = score > 1; medium= score - 1 - 1; high = score <-1.

j Intervention delivered by Practice Nurse or delivered by both Practice Nurse and District Nurse

k Low = primary school or less, moderate = more than primary school, craft school or secondary school, high = more than secondary school.

l Last twelve months.

m Hours of district nursing per week.

l Special visits general practitioner out of office hours (during evenings, nights and weekends).



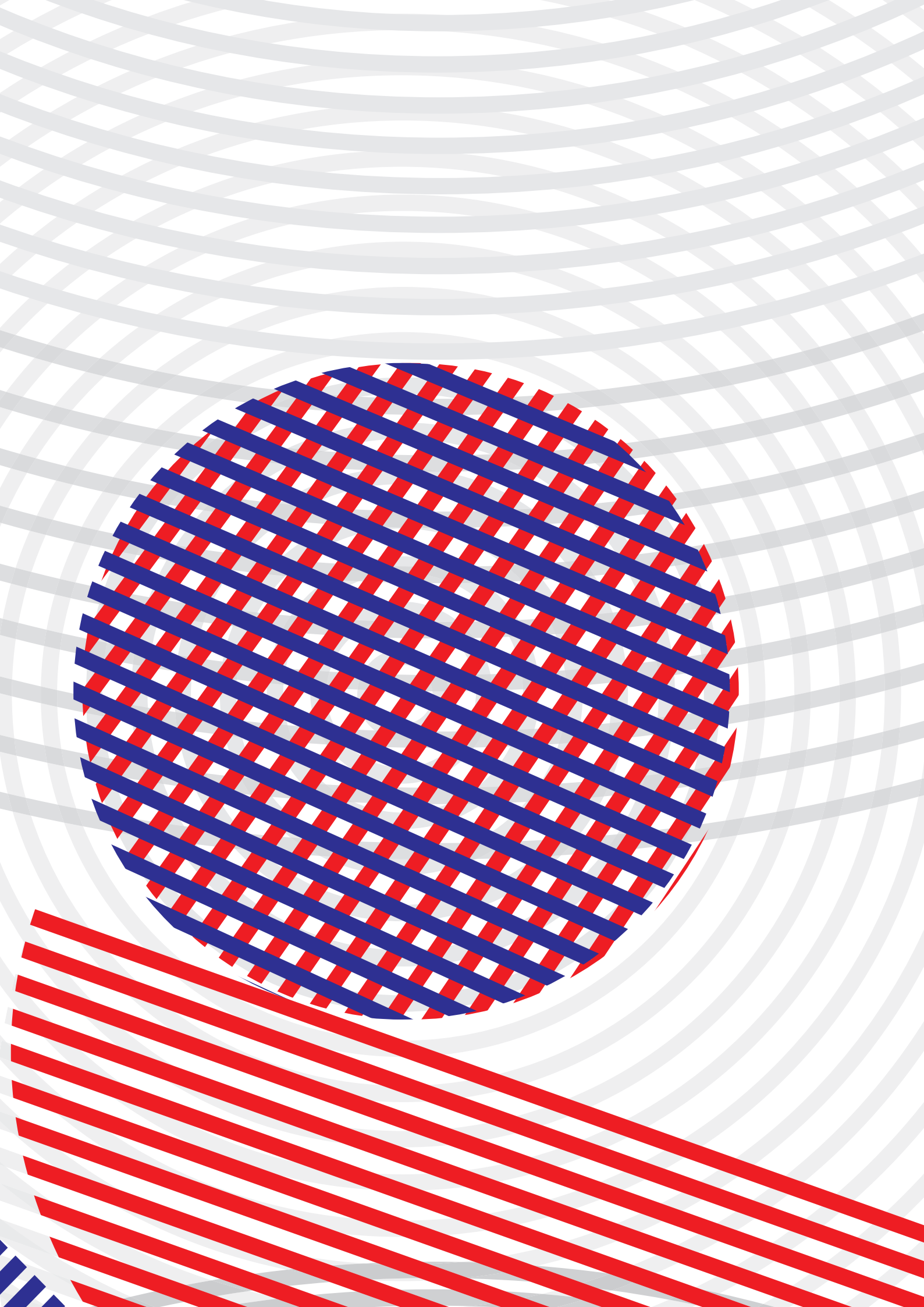
## Appendix B.

Table a. Univariable linear regression analyses between contextual factors and daily functioning.

	$\beta$	SE	CI (95%)	<i>p</i> value
SES score	-.62	.14	-.88- -.35	<.001
Health centre	1.04	.20	.65-1.44	<.001
1 FTE GP on population ratio	-.002	0.001	-.003- .000	.02
1 FTE PN on population ratio	.000	.000	-.001- .000	0.01
<b>Om U implemented</b>				
3 years vs. 9 years	.23	.37	-.41-1.06	.39
4 years vs. 9 years	-.74	.31	-1.35- -.13	.02
<b>Delivering intervention,</b>				
Age of screening	-.29	.20	-.69-.10	.15

Table b. Univariable logistic regression analyses between contextual factors and acute admissions.

	Acute admissions											
	Hospital admission				ER visits				GP out-of-hours visits <sup>a</sup>			
	$\beta$	SE	CI (95%)	p value	$\beta$	SE	CI (95%)	p value	$\beta$	SE	CI (95%)	p value
SES score	.02	.09	.86-1.20	.857	.10	.09	.93-1.32	.269	-.12	.10	.74-1.07	.213
Health centre	-.38	.14	.53-.90	.01	-.25	.14	.59-1.02	.074	-.05	.14	.72-1.26	.731
FTE GPs population ratio	.002	.000	1.001-1.003	<.001	.001	.000	1.000-1.002	.009	.001	.000	1.000-1.002	.014
FTE PNs population ratio	.000	.000	1.000-1.000	<.001	.000	.000	1.000-1.000	.049	.000	.000	1.000-1.000	.158
<b>Om U implemented</b>												
<i>3 years vs. 9 years</i>	.51	.27	.99-2.83	.005	1.03	.34	1.43-5.44	.003	1.14	.38	1.50-6.56	.002
<i>4 years vs. 9 years</i>	-.36	.18	.49-1.00	.048	-.23	.20	.54-1.16	.796	-.40	.19	.46-.99	.042
<b>Delivering intervention,</b>												
<i>Age of screening</i>	-.41	.13	.52-.85	.001	-.29	.14	.57-.98	.033	-.17	.14	.64-1.11	.228
	.34	.13	1.09-1.83	.006	.13	.14	.87-1.49	.344	.11	.14	.84-1.47	.452



# 4

## **Value of Social Network Analysis for Developing and Evaluating Complex Healthcare Interventions: A Scoping Review**

4

Smit LC, Dikken J, Schuurmans MJ, De Wit NJ, and Bleijenberg N.

*BMJ Open* 2020;10:e039681.

## ABSTRACT

**Background:** Most complex health care interventions target a network of health care professionals. Social network analysis (SNA) is a powerful technique to study how social relationships within a network are established and evolve. We identified in which phases of complex health care intervention research SNA is used and the value of SNA for developing and evaluating complex health care interventions.

**Methods:** A scoping review was conducted using the Arksey and O'Malley methodological framework. We included complex healthcare intervention studies using SNA to identify the study characteristics, level of complexity of the health care interventions, reported strengths and limitations, and reported implications of SNA. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews 2018 was used to guide the reporting.

**Results:** Among 2,466 identified studies, 40 studies were selected for analysis. At first, the results showed that SNA seems underutilized in evaluating complex intervention research. Second, SNA was not used in the development phase of the included studies. Third, the reported implications in the evaluation and implementation phase reflect the value of SNA in addressing the implementation and population complexity. Fourth, pathway complexity and contextual complexity of the included interventions were unclear or unable to access. Fifth, the use of a mixed methods approach was reported as a strength, as the combination and integration of a quantitative and qualitative method clearly establishes the results.

**Conclusion:** SNA is a widely applicable method that can be used in different phases of complex intervention research. SNA can be of value to disentangle and address the level of complexity of complex health care interventions. Furthermore, the routine use of SNA within a mixed method approach could yield actionable insights that would be useful in the transactional context of complex interventions.

## INTRODUCTION

The development and evaluation of interventions in health care are often considered to be complex.<sup>1</sup> This complexity has been defined in various ways.<sup>2,3</sup> A consolidated definition for complex interventions was therefore formulated by Guise et al., (2017); *“All complex interventions have two common characteristics; they have multiple components (intervention complexity) and complicated/ multiple causal pathways, feedback loops, synergies, and/or mediators and moderators of effect (pathway complexity). In addition, they may also have one or more of the following three additional characteristics; target multiple participants, groups, or organizational levels (population complexity); require multifaceted adoption, uptake, or integration strategies (implementation complexity); or work in a dynamic multidimensional environment (contextual complexity).”*<sup>4</sup>

Additionally, interventions can be conceptualized as having ‘core components’ i.e. the essential and indispensable elements of the intervention and an ‘adaptable periphery’ i.e. adaptable elements, structures, and systems related to the intervention and organization into which it is being implemented.<sup>5,6</sup> The effectiveness of complex interventions is critically influenced by their contexts.<sup>7-9</sup> Context is often used synonymously with setting and environment and includes static (e.g., the physical environment) and dynamic aspects in terms of professionals, relationships or networks.<sup>8</sup> Because of the heterogeneity of the contexts in which complex interventions are embedded, there is still no adequate translation of how to accommodate to the context in good clinical practice.<sup>8,10</sup> Furthermore, most complex interventions in health care research target a network of different (health care) professionals from multiple sectors and disciplines that is commonly driven by interactions. Such networks form the backbone of a system (e.g., hospital, general practice) by directing the collective power of diverse individuals and groups to achieve mutually relevant goals and objectives.<sup>11</sup> However, there is a lack of intervention studies exploring the underlying network structure and how this structure affects intervention outcomes as well as the contribution that different actors such as interventionists play in a network.<sup>12</sup>

Social network analysis (SNA) is a scientific method to study underlying network structures. SNA is a powerful technique that aims to characterize and study how social relationships within a network, e.g., among persons, groups, or organizations, are established and evolve.<sup>13</sup> The use of SNA has been suggested for designing and evaluating complex interventions with the goal of understanding and examining complex interactions among or between networks.<sup>9,12,14-19</sup> The aim of this scoping review was to identify and determine the value of SNA in studies that develop or evaluate complex interventions in health care research.



The research questions were as follows:

1. In which complex healthcare intervention research phases and level of complexity is SNA used?
2. What value do researchers report in the use of SNA for developing and evaluating complex healthcare interventions?

## **MATERIALS AND METHODS**

A scoping review was conducted to report a wide search for evidence addressing our research questions without specific quality assessment which is common for scoping reviews.<sup>20,21</sup> After identifying the research question, the following steps were conducted: identifying relevant studies; selecting studies based on predefined inclusion criteria; charting the data; and collating, summarizing and reporting the results. Although presented as a series of stages, the process was iterative. Steps were repeated when needed to ensure that the literature was reviewed in a comprehensive way.<sup>20</sup> The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews 2018 was used to guide the reporting.<sup>22</sup> Ethical approval or patient consent was not required.

### **Search strategies**

Intervention-based studies using SNA in the field of health care were identified through a systematic search using logical operator-based combinations of key terms to identify potentially relevant publications from the EMBASE, PsycINFO, CINAHL and PubMed databases. The search strategy included the use of a combination of key terms related to complex health interventions and keywords related to SNA (see Box 1). For each database, we worked with a librarian from the health care discipline to develop a list of relevant keywords. The database searches were conducted from the third week of April 2019 to the end of April 2019. Reference lists of relevant reviews were hand searched.

### **Inclusion criteria**

Complex healthcare intervention studies were defined as the earlier described consolidated definition for complex interventions by Guise and colleagues (2017).<sup>4</sup> Only empirical studies were included when the health care intervention was targeted the individual or community level. Interventions targeting institutional networks (which may include federal agencies (e.g., CDC), local government agencies (e.g., city health departments), non-government organizations (NGOs), and

<b>Box 1.</b> Search strategy
<b>Pubmed</b>
("intervention"[All Fields] OR program[All Fields] OR programme[All Fields] OR ("clinical trials as topic"[MeSH Terms] OR ("clinical"[All Fields] AND "trials"[All Fields] AND "topic"[All Fields])) OR "clinical trials as topic"[All Fields] OR "trial"[All Fields]) OR ("Evaluation"[Journal] OR "Evaluation (Lond)"[Journal] OR "evaluation"[All Fields])) AND ("social network analysis"[All Fields] OR "network analysis"[All Fields]) AND ("2004/01/01"[PDAT] : "2019/04/30"[PDAT])
<b>PsychInfo</b>
("intervention" OR program OR programme OR trial OR evaluation) AND ("social network analysis" OR "network analysis")
<b>EMBASE</b>
('intervention'/exp OR 'intervention' OR 'program'/exp OR program OR programme OR 'trial'/exp OR trial OR 'evaluation'/exp OR evaluation) AND ('social network analysis'/exp OR 'social network analysis' OR 'network analysis'/exp OR 'network analysis') AND (2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py OR 2019:py) AND ('article'/it OR 'article in press'/it OR 'review'/it) AND [embase]/lim NOT ([embase]/lim AND [medline]/lim)
<b>CINAHL</b>
("intervention" OR program OR programme OR trial OR evaluation) AND ("social network analysis" OR "network analysis")

private health organizations (e.g., hospitals and healthcare providers) public and population health care programs were therefore excluded.<sup>23</sup> Additionally, studies had to report use of social network analysis in the design of the study for example i.e., social network mapping, assessment of network structure and properties, or analysis of network members). Studies were excluded if (1) social networks were mentioned, but the type of analysis was not reported; (2) the primary focus was social support, peer support, social capital, or other related topics, but did not report a SNA. Studies published in any language other than English were excluded from the review. The search was limited to studies published between January 2004 and April 2019. This time period was carefully chosen with the goal of including

relevant studies from the moment that the use of SNA in research was emerging.<sup>12</sup> If studies reported the same data in two or more journals, the second and subsequent submissions were excluded. While we did not include (systematic) reviews, we did check the references from these reviews to identify relevant and eligible articles to ensure that we were comprehensive in our search (Figure 1). Furthermore, we did not use the study quality as an inclusion criterion.<sup>20</sup> All studies that met the inclusion criteria were uploaded into Rayyan<sup>R</sup>, a web application for systematic reviews that aims to offer researchers a one-stop dashboard to work through the details of their processes while also allowing their collaborators the ability to see each other's work.<sup>24,25</sup>

### Study selection

The study selection involved two steps. First, the list of study titles resulting from the various searches was reviewed by two reviewers (LS and JD) independently, and each reference was assigned a value of “include”, “exclude” or “maybe”. Second, the reviewers independently assessed the abstracts of the included titles for relevance. In both steps, disagreement between the two reviewers was resolved by consensus, with input from a third author (NB) when necessary.

### Data extraction

Data were extracted from the included studies using a structured format that enabled us to 1) describe the study characteristics, 2) describe the level of complexity of the health care interventions 3) report the strengths and limitations of the application of SNA, and 4) report the implications of using SNA in complex intervention-based studies. To describe the study characteristics, data regarding the author, date of publication, country of the study, type of intervention, target of the SNA in the intervention design, SNA purpose and the metrics utilized were extracted. To describe the level of complexity of the health care interventions data was extracted based on the Complexity Assessment Tool for Systematic Reviews (iCAT\_SR). Six core dimensions and two optional dimensions were assessed by defined criteria (see Appendix A).<sup>26</sup> The eight dimensions covered the earlier described consolidated definition for complex interventions in which intervention complexity, implementation complexity, population complexity, pathway complexity and contextual complexity stood central. To describe the value of using SNA for developing and evaluating complex interventions, the strengths and limitations of the application of SNA were extracted from the included studies first. Next, the reported implications of using SNA were extracted. The data extraction process and format were initially piloted by the first two authors with five studies. In the next stage, each author independently extracted data from the remaining

studies. After extraction, the data were compared, and differences were discussed between the two reviewers, with input from a third author (NB) when necessary, until agreement was reached.

### **Collating, summarizing and reporting the results**

Following data extraction, a narrative synthesis was created to describe the included studies in terms of the study characteristics, level of complexity of the health care interventions, the reported strengths and limitations of the application of SNA, and the reported implications of using SNA in the development and evaluation of complex interventions. This narrative was intended to provide an overall description of the available evidence.<sup>20</sup>

## **RESULTS**

### **Studies identified**

After removing the duplicates, we identified 2466 potentially relevant studies, 20 of which we identified by hand searching. After abstract screening, 40 full-text studies were assessed for eligibility, resulting in 25 studies being included in the review (Figure 1). The publication year of the included complex intervention studies ranged from 2009 to 2019. The countries of origin were diverse; however, 11 studies (44%) were conducted in the USA. As shown in Table 1, the application of SNA in developing and evaluating complex interventions differed. Most studies (60%) used SNA to evaluate (partially) the effectiveness of an intervention. No study used SNA when developing an intervention. In two studies, SNA findings were used to provide information on the feasibility of the complex intervention.<sup>27,28</sup> The types of interventions, as well as the SNA purpose, were diverse. Most studies identified relationships between actors, while other studies collected data on the specific network type, such as knowledge exchange or patterns of collaboration (Table 1) (see Appendix B for the extended study characteristics and Appendix C for the application of SNA in the included studies).

### **Level of complexity of included studies**

The level of complexity of the included studies based on the iCAT\_SR is shown in Table 2.<sup>26</sup> Regarding the intervention complexity, only two studies reported one component intervention<sup>29,30</sup> while the other studies consisted of a multicomponent intervention whether or not offered as a bundle. Behaviour or actions of intervention recipients of the studies were diverse from single till dual or multiple target. The implementation complexity showed that the degree of tailoring the intervention was in ten studies inflexible (40%), eleven studies moderate (44%) and

in four studies highly flexible (16%). The level of skills required by those delivering the intervention was in most studies intermediate (84%) and for those receiving the intervention, was the level of skills required basic in most studies (88%). The population complexity was low in sixteen studies (64%) as the interventions directed only at single category of individuals within the individual level (e.g. professionals or patients), five studies (20%) were defined as multi-category as the interventions directed at two or more categories of individuals within the individual level (e.g. primary care professionals and primary care patients), four studies (16%) were defined as multi-level as the intervention directed at two or more levels. The pathway complexity was in twenty-one (84%) studies unclear or unable to assess, only four (16%) studies used a logic model to explain the nature of the causal pathway between the intervention and the outcome it is intended to effect. Three studies (12%) were defined as having a long variable pathway and one study (4%) having a short, linear path. Contextual complexity was, except for two studies (4%) which interventions could moderately dependent on individual-level factors, unclear or unable to assess.

### **Reported strengths and limitations of the application of SNA**

Table 3 provides an overview of the reported strengths and limitations. Of the included studies, six studies (24%) reported only strengths in the application of SNA for developing and evaluating complex interventions,<sup>31-36</sup> one study (4%) reported a limitation,<sup>37</sup> four studies (16%) did not report any strength or limitation,<sup>38-41</sup> and the remaining fourteen studies (56%) reported strengths as well as limitations in the application of SNA. Reported limitations of the application of SNA were focused on the study design and data collection. Regarding the study design, the lack of a qualitative component and lack of control group were reported as limitations because they prevent more in-depth understanding of the results and contribute to lower methodological rigor than that of some other analysis methods, which inhibits authors from stating the causal effects of an intervention.<sup>27,28,36,42</sup> A mixed method approach was reported as a strength for gaining an in-depth understanding of the results.<sup>29</sup> Reported limitations related to data collection were possible recall bias due to self-reported data, the challenge of obtaining responses, and nonrespondent data.<sup>19,28-30,37,43-46</sup> The absence of nonrespondent data may introduce potential bias and can therefore dramatically affect network representation.<sup>19</sup>

Reported strengths were that SNA data are easy to collect<sup>28</sup> and that data can be collected by various methods,<sup>19</sup> including specific SNA tools (NET map, Social Network Diagnostic Tool, and Partner Tool).<sup>31,40,47</sup> Regarding analysis, the quantitative results that SNA yields can be combined with other statistical approaches.<sup>34</sup> In addition, sociometrics may have superior value for overcoming

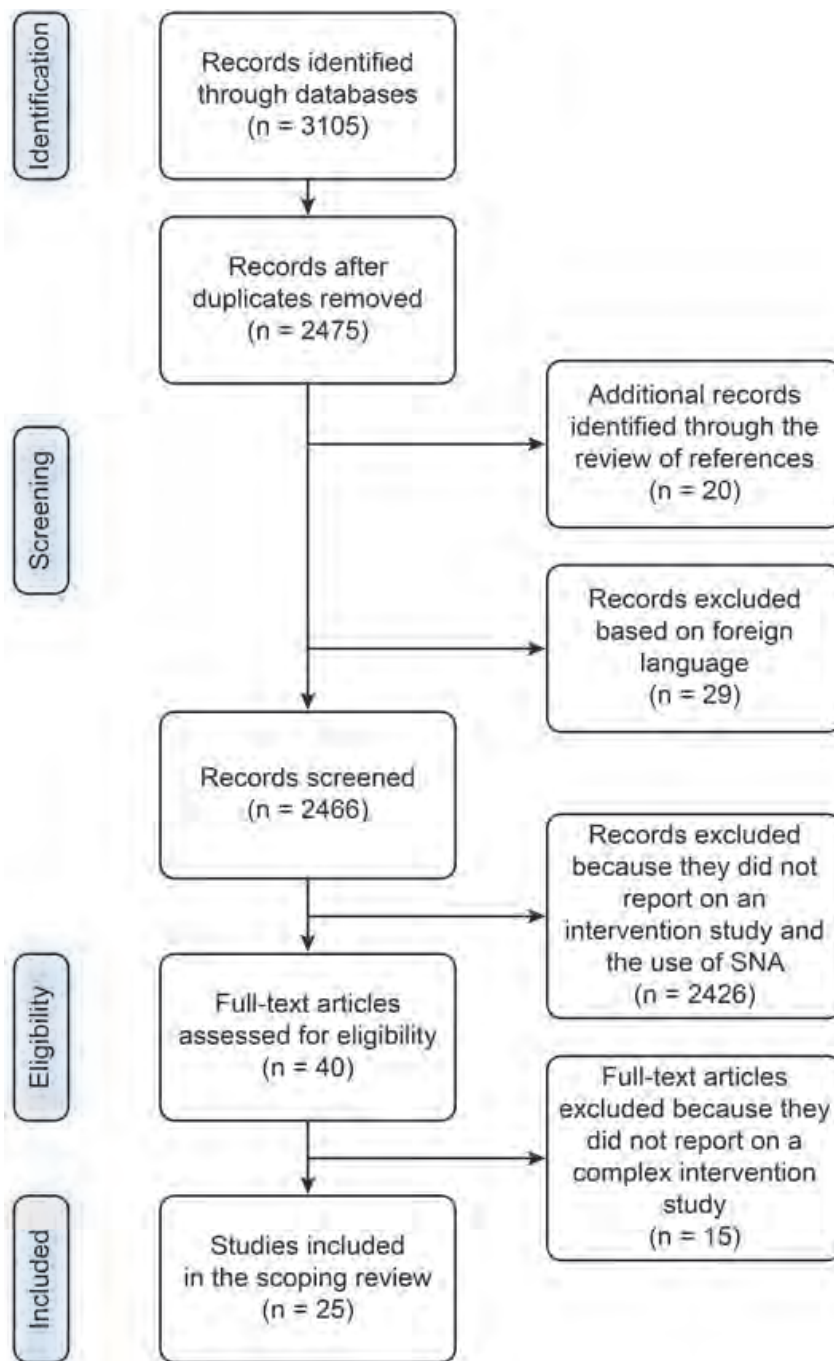


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta- Analyses flow diagram.

the shortcomings of ego network self-reported measures, but data collection from ego networks is more feasible and less expensive than sociometric network data collection.<sup>44</sup> SNA analysis is further strengthened because it is based on the number of relationships instead of only the number of individuals.<sup>43</sup> Additionally, the use of SNA programs to analyse data was reported as a strength in terms of the ease of use but as a limitation in terms of the need for special training and experience.<sup>19,27,44</sup> The visualization of SNA results can strengthen the interpretation of the results.<sup>44</sup> However, a reported limitation was that complexity cannot be captured in simplified

visuals.<sup>19</sup> Additionally, the interpretation of the results was reported as strength, as SNA provides insights into the relationships, positions, structure and strength of a network.<sup>19,31,48</sup> However, the generalizability of SNA results is limited due to the unique nature of a network.<sup>48,49</sup>

### **Reported implications and added value of SNA**

Fifteen studies reported implications of using SNA in developing and evaluating complex interventions.<sup>19,27,28,30,31,33,35,36,43-46,48-50</sup> Three studies reported the wider use of SNA in their topic of research, namely, interprofessional education, train-the-trainer programs and the evaluation of nursing interventions.<sup>27,45,46</sup> Figure 2 shows a graphical framework that summarizes reported strengths of the application of SNA and reported implications, and connects their content to the dimensions of complexity. The graphical framework depicts the ways SNA can be used in the various phases of complex intervention research in healthcare, in connection to complexity of the intervention, implementation, population, pathway, and context.

Regarding the development phase, the acceptability study by Rice and colleagues (2012)<sup>28</sup> reported that SNA can provide essential information in the design of large-scale efficacy studies. For the pilot phase, the educational intervention by Benton and colleagues (2015)<sup>27</sup> indicated that SNA offers an opportunity to introduce quantitative rigor to the selection of interventionists. Rice and colleagues (2012)<sup>28</sup> suggested that the identified people can disseminate innovations. SNA results can also inform the design of feasibility trials.<sup>50</sup> In regard to the evaluation phase, five studies reported implications.<sup>30,33,35,43,44</sup> One study that was characterized as an implementation study reported that SNA provides useful monitoring and evaluation data for both evaluation and implementation purposes.<sup>30</sup> The process evaluation study by Millery and colleagues (2017)<sup>35</sup> suggested that SNA allows analysis of the network as a whole system and at the individual organization level. Such analysis enables researchers to document systemic change beyond simple shifts in knowledge, attitudes, and skills. Both levels were reported to be very useful for an evaluation framework in a transactional context.<sup>35</sup> Some authors reported that SNA can measure network structural factors beyond the intervention, which is necessary to understand the broader context.<sup>44</sup> Furthermore, the effectiveness study by Held and colleagues (2019)<sup>43</sup> reported that SNA helps to identify points of leverage to create and improve targeted intervention strategies. For the implementation phase, the reported implications indicated that SNA provides an in-depth understanding of the barriers and/or facilitators of the diffusion and implementation of an intervention. SNA also offers actionable insights into the network of interest, such as insights into skill transfer and team effectiveness, which can guide the implementation of large-scale efficacy studies.<sup>28,36</sup>

Table 1. Study characteristics.

Study	Target of SNA			Intervention type		SNA purpose
	Pilot/feasibility phase	Evaluation phase	Implementation phase	Implementation phase	Implementation phase	
	Identification of interventionists	Acceptability	Effectiveness	Process evaluation	Implementation phase	
Banbury et al <sup>37</sup>		X			4	1 = Educational 2 = Network, peer, capacity-building 3 = Health promotion 4 = E-health 5 = Group-based 6 = Organizational 7 = Environmental change 8 = Disparity reduction 9 = Theory-based
Benton et al <sup>27</sup>	X				1	1 = Identify relationships 2 = Identify persons 3 = Identify knowledge exchange 4 = Identify patterns of collaboration
Bliuc et al <sup>29</sup>		X			2	
Campbell et al <sup>32</sup>		X			4	
Elreda et al <sup>34</sup>			X		5	
Gesell et al <sup>47</sup>		X			3	
Gesell et al <sup>41</sup>		X			3	
Held et al <sup>43</sup>		X			1	
Jippes et al <sup>50</sup>		X			7	
Katz et al <sup>33</sup>		X			1	



Table 1. (Continued)

Study	Target of SNA			Intervention type	SNA purpose
	Pilot/feasibility phase	Evaluation phase	Implementation phase		
	Identification of interventionists	Effectiveness	Process evaluation	1 = Educational 2 = Network, peer, capacity-building 3 = Health promotion 4 = E-health 5 = Group-based 6 = Organizational 7 = Environmental change 8 = Disparity reduction 9 = Theory-based	1 = Identify relationships 2 = Identify persons 3 = Identify knowledge exchange 4 = Identify patterns of collaboration
Li et al <sup>44</sup>			X	2	1
Márquez-Serrano et al <sup>46</sup>	X			1	3
Masumoto et al <sup>40</sup>	X			3	4
McGlashan et al <sup>48</sup>			X	7	1
Millary et al <sup>35</sup>			X	2	1
Moses et al <sup>31</sup>	X			1	1, 2
Nooraie et al <sup>42</sup>	X			6	3
Owen et al <sup>39</sup>	X			4	1
Phillips et al <sup>45</sup>	X			1	3,4

Table 1. (Continued)

Study	Target of SNA			Intervention type		SNA purpose
	Pilot/feasibility phase	Evaluation phase	Implementation phase	Implementation phase	Implementation phase	
	Identification of interventionists	Effectiveness	Process evaluation	1 = Educational 2 = Network, peer, capacity-building 3 = Health promotion 4 = E-health 5 = Group-based 6 = Organizational 7 = Environmental change 8 = Disparity reduction 9 = Theory-based	1 = Identify relationships 2 = Identify persons 3 = Identify knowledge exchange 4 = Identify patterns of collaboration	
Ramanadhan et al <sup>30</sup>				X	3	1, 3
Ramanadhan et al <sup>49</sup>				X	2	1, 3
Rice et al <sup>28</sup>	X				2	1
Rosas and Knight <sup>19</sup>		X			3	4
Spitzer-Shohat et al <sup>36</sup>				X	8	1
Yang et al <sup>38</sup>		X			9	1

**Table 2.** Complexity of included studies based on the Complexity Assessment Tool for Systematic Reviews (iCAT\_SR).

	Intervention complexity		Implementation complexity			Population complexity	Pathway complexity	Contextual complexity
<b>Studies</b>	Active components included in the intervention, in relation to the comparison	Behaviour or actions of intervention recipients or participants to which the intervention is directed	The degree of tailoring intended or flexibility permitted across sites or individuals in applying or implementing the intervention	The level of skill required by those delivering the intervention in order to meet the objectives	The level of skill required for the targeted behaviour when entering the included studies by those receiving the intervention, in order to meet the intervention objectives	Organisational levels and categories targeted by the intervention	The nature of the causal pathway between the intervention and the outcome it is intended to effect	The degree to which the effects of the intervention are dependent on the context or setting in which it is implemented
Banbury, 2017 <sup>37</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses
Benton et al., 2015 <sup>27</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	High level skills	High level skills	Single category	Unclear or unable to asses	Unclear or unable to asses
Blinc, 2016 <sup>29</sup>	One component	Single target	Inflexible Intervention	Basic skills	Basic skills	Multi-category	Unclear or unable to asses	Unclear or unable to asses
Campbell, 2014 <sup>32</sup>	More than one component	Single target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Multi-level	Unclear or unable to asses	Unclear or unable to asses
Elreda, 2016 <sup>34</sup>	More than one component and delivered as a bundle	Multi-target	Inflexible Intervention	Intermediate level skills	Basic skills	Multi-category	Unclear or unable to asses	Unclear or unable to asses
Gesell, 2013 <sup>47</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Multi-category	Pathway linear, short	Unclear or unable to asses
Gesell, 2016 <sup>41</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Multi-category	Pathway linear, short	Unclear or unable to asses

Table 2. (Continued)

	Intervention complexity			Implementation complexity			Population complexity	Pathway complexity	Contextual complexity
Held, 2019 <sup>43</sup>	More than one component	Single target	Inflexible Intervention	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Jippes, 2010 <sup>50</sup>	More than one component and delivered as a bundle	Single target	Inflexible Intervention	High level skills	Intermediate level skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Katz, 2012 <sup>33</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Li, 2012 <sup>44</sup>	More than one component and delivered as a bundle	Dual target	Highly tailored/flexible	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Márquez-Serrano, 2012 <sup>46</sup>	More than one component and delivered as a bundle	Multi-target	Highly tailored/flexible	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Masumoto, 2017 <sup>40</sup>	More than one component and delivered as a bundle	Dual target	Inflexible Intervention	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
McGlashan, 2017 <sup>48</sup>	More than one component	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Multi-level	Unclear or unable to asses	Unclear or unable to asses	
Millary, 2017 <sup>35</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Multi-level	Pathway variable, long	Unclear or unable to asses	
Moses, 2009 <sup>31</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Intermediate level skills	Single category	Unclear or unable to asses	Unclear or unable to asses	
Noorate, 2015 <sup>42</sup>	More than one component and delivered as a bundle	Dual target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Single category	Pathway linear, short	Unclear or unable to asses	
Owen, 2016 <sup>39</sup>	More than one component and delivered as a bundle	Multi-target	Inflexible Intervention	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses	

Table 2. (Continued)

	Intervention complexity				Implementation complexity			Population complexity	Pathway complexity	Contextual complexity
Phillips et al., 2016 <sup>45</sup>	More than one component and delivered as a bundle	Multi-target	Moderately tailored/flexible	Intermediate level skills	Basic skills	Single category	Pathway variable, long	Moderately dependent on individual-level factors		
Ramanadhan, 2010 <sup>30</sup>	One component	Multi-target	Inflexible Intervention	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses		
Ramanadhan, 2017 <sup>49</sup>	More than one component and delivered as a bundle	Single target	Highly tailored/flexible	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses		
Rice et al., 2012 <sup>28</sup>	More than one component	Multi-target	Inflexible Intervention	Intermediate level skills	Basic skills	Multi-category	Unclear or unable to asses	Unclear or unable to asses		
Rosas and Knight, 2019 <sup>19</sup>	More than one component and delivered as a bundle	Multi-target	Highly tailored/flexible	Intermediate level skills	Basic skills	Multi-level	Pathway variable, long	Moderately dependent on individual-level factors		
Spitzer-Shohat, 2018 <sup>36</sup>	More than one component	Dual target	Inflexible Intervention	Intermediate level skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses		
Yang 2012 <sup>38</sup>	More than one component and delivered as a bundle	Dual target	Inflexible Intervention	Basic skills	Basic skills	Single category	Unclear or unable to asses	Unclear or unable to asses		

Table 3. Reported strengths and limitations in the application of SNA in complex intervention research.

Application component	Strengths	Limitations
Design		
SNA as a method <sup>28,31,42,44,49</sup>	<p>SNA supports the conclusions from traditional analysis and generates new information.</p> <p>SNA reveals important intervention dynamics that would not be found with classical methods.</p> <p>SNA moves beyond individual level effects and captures system-level effects.</p> <p>Longitudinal SNA can reveal underlying social processes after the implementation of the intervention.</p> <p>A mixed methods approach clearly establishes the results.</p>	<p>The lack of a qualitative component results in a less comprehensive understanding of the results.</p>
Type of SNA method <sup>27,29,36</sup>		<p>Insight into the structure does not indicate causality.</p> <p>Due to the lack of a parallel control group, findings on the changes in social networks through the implementation of the intervention could simply be the result of natural tendencies in social networks over time and not the effect of the intervention per se.</p>
Control group <sup>28,42</sup>		
Data		
Data collection <sup>19,28,29,30,37,43-46</sup>	<p>Data are easily to collect.</p> <p>Primary data can be collected through several methods such as surveys, workshops, or interviews.</p> <p>SNA is applicable to all kind of networks.</p>	<p>The data collection method can be restrictive in examining relations involving more than two people.</p> <p>Self-reported data induces recall bias.</p> <p>There is a possibility for social desirability bias.</p> <p>Obtaining responses for (longitudinal) data collection can be challenging.</p> <p>The operationalization of the network type of interest can be interpreted in multiple ways.</p> <p>Constructing sociometric network data requires outreach work and knowledge of the community.</p> <p>Ego-centric network data collection is much more feasible and less expensive than sociometric network data collection.</p>

Table 3. (Continued)

Application component	Strengths	Limitations
SNA tools (NET map, Social Network Diagnostic Tool, Partner Tool) <sup>32,35,47</sup>	NET map is a tool for action research that yields visual quantitative and qualitative evaluation data; it enhances the sense of a shared purpose among network members. A social network diagnostic tool can monitor group programs during implementation and can guide program activities with the intent to build new social networks. The SNA Partner Tool produces a rich set of network metrics to describe the state of the network at baseline.	The Social Network Diagnostic Tool is not sensitive to the measurement of different mechanisms explaining social influences.
Nonrespondent data <sup>19,28,48</sup>		The absence of nonrespondent data may introduce potential bias, as nonrespondents' positions in the network may lead to them being difficult to contact in retrospect. Alternatively, the occurrence of missing data may be random due to staff turnover and changing contact details between the end of the intervention and the data collection period. Missing or erroneous data can dramatically affect network representation.
Analysis		
Quantitative metrics <sup>27,34</sup>	SNA provides a wide range of tools for quantifying the structure and strengths of networks (of interest) during an intervention. SNA can support multiple analyses of effectiveness at the individual level. SNA can be combined with other statistical approaches.	
Sociometrics <sup>30,44</sup>	Sociometrics have superior value in overcoming the shortcomings of ego network self-reported measures. Sociometrics strengthen studies. The use of programs as UCINET and NETDRAW is relatively easy, which makes SNA potentially attractive for routine use in program evaluation.	Network data analysis requires special training. SNA requires experience.
Use of SNA programs (e.g., UCINET, NETDRAW) <sup>27,19,44</sup>		

Table 3. (Continued)

Application component	Strengths	Limitations
Number of respondents <sup>43</sup>	SNA is focused on relationships instead of individuals (the number of respondents), which establishes the basis for the quantitative analysis (power).	
Results		
Visualization <sup>19,44</sup>	<p>Visuals are a resource for reflection about the structure and process.</p> <p>Visualization may change the self-perceptions of actors.</p>	<p>Results that are simply visualized do not take into account the actual complexity.</p> <p>The interpretation of visuals is sometimes difficult.</p>
Interpretation of results <sup>19,31,48</sup>	<p>SNA provides insight into the interactions that people have within an intervention.</p> <p>SNA is an informative approach to analyzing changes in professionals' networks.</p> <p>The network map helps identify and act on individuals who leave the network.</p> <p>The positions and expansion of network actors can be understood.</p> <p>The structure and strength of the network can be characterized, which facilitates the examination of changes in the structure over time, whether the network becomes more sparse or cohesive, and whether there are changes in people's strategic positions (e.g., central or peripheral).</p>	
Generalizability <sup>48,49</sup>		Limited or cautious generalization of the findings to other networks.



	Intervention complexity	Implementation complexity
Development phase	<p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>Monitoring data can guide the development of an intervention, design of feasibility trials and large-scale efficacy studies.</li> </ul> <p><b>SNA tools</b></p> <ul style="list-style-type: none"> <li>Describing the state of the network at baseline.</li> </ul>	<p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>Monitoring data can guide the development of an intervention, design of feasibility trials and large-scale efficacy studies.</li> </ul>
Pilot/feasibility phase	<p><b>SNA tools</b></p> <ul style="list-style-type: none"> <li>Guiding program activities.</li> <li>Tool for action research that yields visual quantitative and qualitative evaluation data.</li> <li>Enhancing the sense of a shared purpose among network members.</li> </ul>	<p><b>SNA data</b></p> <ul style="list-style-type: none"> <li>Identifying key individuals that can disseminate innovations or be interventionists.</li> <li>Bringing quantitative rigor to the selection of interventionists.</li> </ul>
Evaluation phase	<p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>SNA programs easy to use, attractive for routine use in program evaluation.</li> <li>Support multiple analyses of effectiveness at the individual level.</li> <li>Focusing on relationships instead of individuals, which establishes the basis for the quantitative analysis (power).</li> <li>Combining SNA with other statistical approaches.</li> </ul> <p><b>SNA data</b></p> <ul style="list-style-type: none"> <li>Documenting changes in networks of participants during program evaluation.</li> </ul>	<p><b>SNA data</b></p> <ul style="list-style-type: none"> <li>Visualization of SNA data are a resource for reflection about the structure and process of networks of interests.</li> </ul> <p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>Understanding the barriers and facilitators of the implementation of an intervention.</li> <li>Monitoring programs during implementation.</li> </ul>
Implementation phase	<p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>Guiding the implementation of large-scale efficacy studies.</li> </ul>	<p><b>Mixed methods SNA data</b></p> <ul style="list-style-type: none"> <li>Understanding the barriers and facilitators of the implementation of an intervention.</li> <li>Monitoring programs during implementation.</li> </ul>

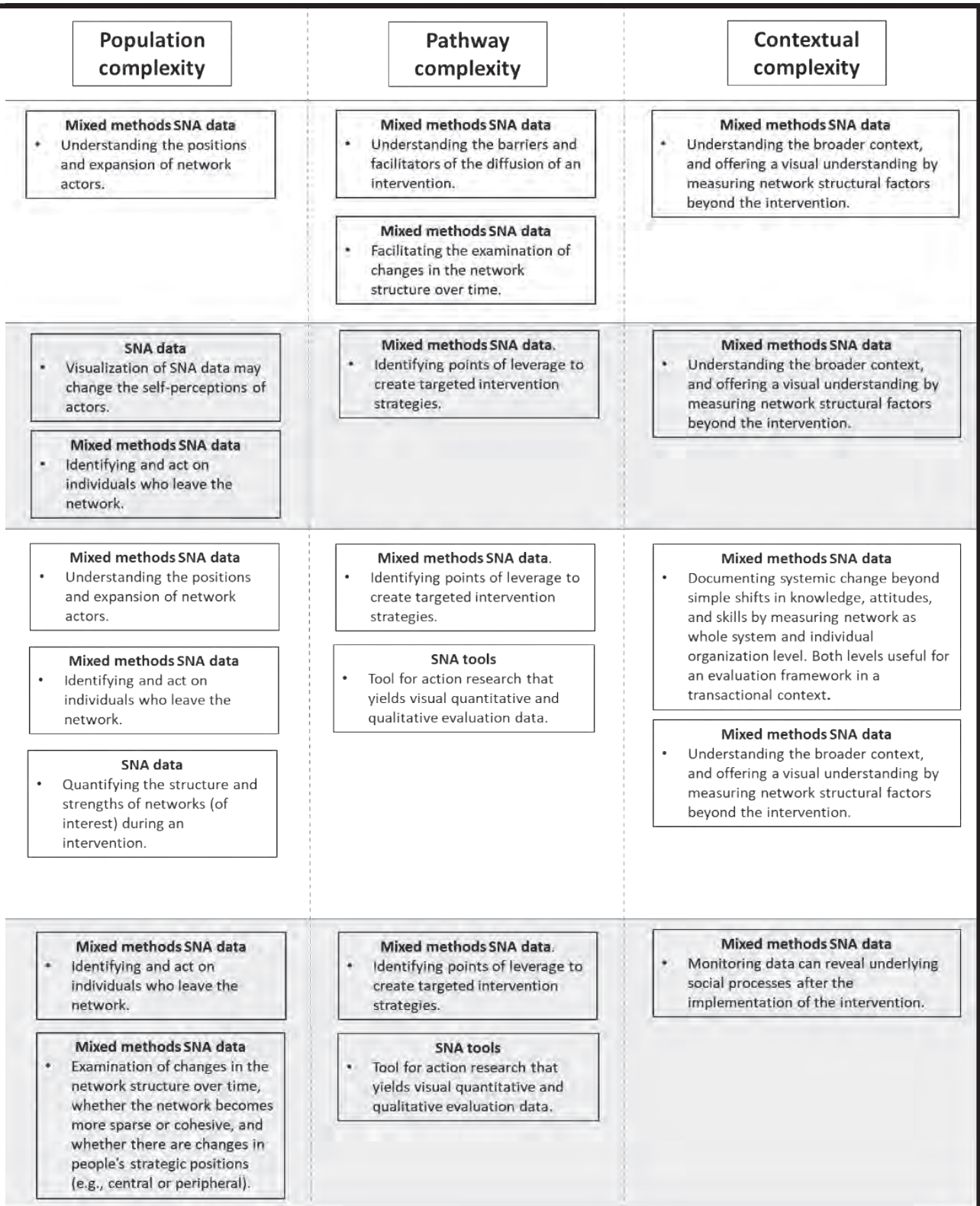


Figure 2. Graphical framework

# DISCUSSION

This scoping review described the specific use of SNA in different phases of complex intervention research, in different level of intervention complexity, as well as the value of using SNA for developing and evaluating complex interventions. Five main conclusions can be drawn from this analysis. First, SNA seems underutilized in evaluating complex intervention research. Second, SNA was not used in the development phase of the included studies. Third, the reported implications in the evaluation and implementation phase reflect the value of SNA in addressing the implementation and population complexity. Fourth, pathway complexity and contextual complexity of the included interventions were unclear or unable to access. Fifth, the use of a mixed methods approach was reported as a strength, as the combination and integration of a quantitative and qualitative method clearly establishes the results.

This study showed that SNA seems underutilized in evaluating complex intervention research. A total of 25 complex health care intervention-based studies published in the last 10 years in the field of health care were found that used SNA. This number is comparable to the findings of a systematic review reporting the application of SNA in health behavior intervention studies.<sup>51</sup> SNA has developed only over the past 20 years from a niche discipline in sociology to an approach applied in many fields of the physical and biological sciences.<sup>52</sup> SNA is focused on the structure of relationships and assumes that relationships are important.<sup>53</sup> Most complex interventions are embedded within a network of multiple (health care) professionals from multiple sectors and disciplines.<sup>11</sup> Recent studies, therefore, highlight the importance of understanding and examining networks and their interactions in complex intervention research.<sup>9,12,14-19</sup>

Although SNA has been used in the pilot, evaluation and implementation phase, this study showed that no study used SNA in the development phase. Several frameworks are available for the development and evaluation of complex interventions.<sup>1,54-58</sup> Optimizing the development of a complex intervention will enhance the intervention design, increase value and minimize the risk of subjects being exposed to ineffective interventions. A gap between the intervention and the implementation context often results in suboptimal treatment success<sup>59</sup> and SNA may contribute to bridge the gap and to understand the implementation context. During the development phase, SNA can provide strategies to consider the social context of program delivery, determine the appropriate methods and

communication needs, and identify particular change agents and opinion leaders in the network to focus on.<sup>60-62</sup> This suggests that SNA can be of great value when developing, complex interventions.

This study shows a significant potential of using SNA in addressing the implementation and population complexity in various ways. Although frameworks highlight the importance of a systematic development and evaluation of complex interventions, an iterative rather than linear process is recommended.<sup>1,54-58</sup> An iterative process allows researchers to consider the implementation complexity and population complexity prior to the implementation. When addressing implementation complexity, SNA could focus 1) on the skills required by the intervention providers who deliver the intervention and 2) the tailoring carried out by the intervention providers, regarding the receiver or context, in applying or implementing the intervention.<sup>26</sup> By addressing the population complexity, SNA can highlight the structures of the organizational levels and categories targeted by the intervention.<sup>26</sup> Since interventions itself might alter networks and since networks are dynamic and likely to change over time, researchers are therefore encouraged to collect network and outcome data of interest longitudinally (e.g. monitoring data) and cross-sectionally.<sup>51,43</sup> Furthermore, the use of monitoring SNA data can identify points of leverage to create and improve targeted intervention strategies.<sup>43</sup> Valente and colleagues (2015)<sup>60</sup> published a practical overview of how to use SNA for program implementation to understand which social network can be created, maintained, and accomplished.

This study showed that the pathway complexity and contextual complexity of most interventions were unclear or unable to access. The limited reporting regarding the use of a logic model which describe the nature of the causal pathway between the intervention and its effect, and contextual factors which can influence the effectiveness of an intervention, was also observed by Smit and colleagues (2018)<sup>10</sup> that examined complex primary health care interventions. SNA could be of value in addressing the contextual complexity as the degree to which the effects of the intervention are dependent on the context or setting in which it is implemented.<sup>26</sup> The Consolidated Framework for Implementation Research (CFIR) comprises 39 constructs organized across five major domains (e.g. intervention, outer setting, inner setting, characteristics of individuals and process), all of which interact to influence implementation and implementation effectiveness.<sup>5</sup> The study of Kirk and colleagues (2016)<sup>6</sup> provide a broad overview of CFIR constructs used in literature which can be directory in disentangling and addressing contextual complexity. In general, the graphic framework, introduced in this study, is a first step and can

be used in future research in this area. Additionally, more research is needed to assess the optimal way to use SNA in complex intervention research in healthcare, especially in relation to the five dimensions of complexity.

The included studies reported the use of a mixed methods approach to be a strength, as the combination and integration of a quantitative and qualitative method clearly establishes the results. All included studies were quantitative studies, consistent with their use of SNA, which is quantitative in nature. A strong reliance on quantitative methods was criticized. Adding a qualitative approach alongside quantitative procedures can be a solution to generate an in-depth understanding of the results.<sup>63,64</sup> SNA increasingly relies on both quantitative and qualitative approaches for data collection and analysis.<sup>65</sup> The development and evaluation of complex interventions often require multiple research questions which reflect the number of behaviors or actions that the intervention focuses on as part of the intervention complexity.<sup>26</sup> The use of mixed methods social network analysis (MMSNA) can be an appropriate means to answer these research questions in which the “13-step model” of Schooneboom (2018)<sup>66</sup> can guide researchers. Although the use of MMSNA is recommended, MMSNA still lacks conceptual clarity as, as the “when”, “how” and “why” of a mixed methods approach are rarely described.<sup>67</sup> However, MMSNA seems promising, and a mixed method approach is consistent with the multiphase model of complex intervention development and evaluation.

### **Strengths and limitations**

This study has several strengths. First, the data collection and data management processes were thorough. Two researchers selected the studies in accordance with the inclusion and exclusion criteria, which were determined beforehand. In addition, the data charting and synthesis of the results were also conducted by two researchers (LS and JD) working independently. The synthesis of the results was checked and confirmed by all authors to ensure the validity of the findings. Second, the literature search was conducted in four scientific databases, which is more than sufficient to include the central and relevant research evidence in healthcare.<sup>68</sup> In addition, the reference lists of the reviews in our search were hand searched to identify studies that otherwise potentially would have been missed. Third, the review process followed a universally agreed protocol (PRISMA Extension for Scoping Reviews 2018) to ensure the quality of reporting.<sup>22</sup> Additionally, in the analysis, the authors’ original expressions were used without any interpretations.

This review has some limitations. First, there is no sharp boundary between simple and complex health care interventions.<sup>1</sup> To overcome this limitation, the level of complexity was unraveled of all included studies based on the iCAT\_SR.<sup>26</sup> Second, this study did not critically appraise the included studies. However, the literature states that scoping reviews cannot identify gaps in the literature related to the low quality of research.<sup>69,70</sup> By not addressing the issues of quality appraisal, this study was able to include a larger range of study designs and methodologies than would have been included in a systematic review<sup>71</sup> thus, the emphasis of a scoping study is on comprehensive coverage rather than a particular standard of evidence.<sup>72</sup>

## CONCLUSION

Based on the application of SNA in 25 studies, we conclude that SNA is a valuable method to apply, but currently underutilized. SNA has been applied in the pilot, evaluation and implementation phases of complex intervention research. Although there is an absence of studies applying SNA in the development of complex interventions, the included studies reported the potential value of SNA in the development phase. Furthermore, SNA can be of value to disentangle and address the five dimensions of complexity of complex health care interventions. The routine use of SNA within a mixed method approach for developing and evaluating complex interventions could yield actionable insights that would be useful in the transactional context of complex interventions.

## REFERENCES

1. Craig P, Dieppe P, Macintyre S, et al. Developing and evaluating complex interventions: the new medical research council guidance. *BMJ*. 2008;337:a1655.
2. Guise J-M, Chang C, Viswanathan M, et al. Agency for Healthcare Research and Quality Evidence-based Practice Center methods for systematically reviewing complex multicomponent health care interventions. *J Clin Epidemiol*. 2014;67:1181e91.
3. Petticrew M, Anderson L, Elder R, et al. Complex interventions and their implications for systematic reviews: a pragmatic approach. *J Clin Epidemiol*. 2013;66:1209e14.
4. Guise J-M, Butler M, Chang C, Viswanathan M, Pigott T, Tugwell P. AHRQ series on complex intervention systematic reviews—paper 7: PRISMA-CI elaboration and explanation. *J Clin Epidemiol*. 2017;90:51-58.
5. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4:50.
6. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the consolidated framework for implementation research. *Implement Sci*. 2015;11(1):72.
7. Wells M, Williams B, Treweek S, Coyle J, Taylor J. Intervention description is not enough: evidence from an in-depth multiple case study on the untold role and impact of context in randomised controlled trials of seven complex interventions. *Trials*. 2012;13:95.
8. Craig P, Ruggiero ED, Frohlich KL, et al. *Taking account of context in population health intervention research: guidance for producers, users and funders of research*. Canadian Institutes of Health Research (CIHR)–National Institute for Health Research (NIHR) Context Guidance Authors Group. Southampton: National Institute for Health Research. 2018. <https://doi.org/10.3310/cihr-nihr-01>. Accessed Aug 27, 2020.
9. Moore GF, Evans RE, Hawkins J, et al. From complex social interventions to interventions in complex social systems: future directions and unresolved questions for intervention development and evaluation. *Evaluation*. 2019;25:23–45.
10. Smit LC, Schuurmans MJ, Blom JW, et al. Unravelling complex primary-care programs to maintain independent living in older people: a systematic overview. *J Clin Epidemiol*. 2018;96:110–19.
11. Leischow SJ, Milstein B. Systems thinking and modeling for public health practice. *Am J Public Health*. 2006;96:403–05.
12. Benton DC, Perez-Raya F, Fernandez-Fernandez MP, González-Jurado MA. A systematic review of nurse-related social network analysis studies. *Int Nurs Rev*. 2015;62:321–39.
13. Scott J. *Social Network Analysis*. Thousand Oaks, CA: Sage; 2017.
14. Pow J, Gayen K, Elliott L, Raeside R. Understanding complex interactions using social network analysis. *J Clin Nurs*. 2012;21:2772–79.

15. Parnell JM, Robinson JC. Social network analysis: presenting an underused method for nursing research. *J Adv Nurs*. 2018;74:1310–18.
16. Hawe P. Lessons from complex interventions to improve health. *Annu Rev Public Health*. 2015;36:307–23.
17. Keogh F, Pierce M, Neylon K, Fleming P. Intensive home care packages for people with dementia: a realist evaluation protocol. *BMC Health Serv Res*. 2018;18:829.
18. Loutfi D, Andersson N, Law S, et al. Reaching marginalized young women for HIV prevention in Botswana: a pilot social network analysis. *Glob Health Promot*. 2020;27:74–81.
19. Rosas S, Knight E. Evaluating a complex health promotion intervention: case application of three systems methods. *Crit Public Health*. 2019;29:337–52.
20. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8:19–32.
21. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci*. 2010;5:69.
22. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169:467–73.
23. Bauermeister JA, Tross S, Ehrhardt AA. A review of HIV/AIDS system-level interventions. *AIDS Behav*. 2009;13(3):430–448.24
24. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev*. 2016;5:210.
25. Johnson N, Phillips M. Rayyan for systematic reviews. *J Electron Resour Librariansh*. 2018;30:46–48.
26. Lewin S, Hendry M, Chandler J, et al. Assessing the complexity of interventions within systematic reviews: development, content and use of a new tool (iCAT\_SR). *BMC Med Res Methodol*. 2017;17(1):76.
27. Benton DC, Fernández MPF. Social network analysis: a tool for the identification of next generation trainers. *Collegian*. 2014;21(4):311–318.28
28. Rice E, Tulbert E, Cederbaum J, Adhikari AB, Milburn NG. Mobilizing homeless youth for HIV prevention: a social network analysis of the acceptability of a face-to-face and online social networking intervention. *Health Educ Res*. 2012;27:226–36.
29. Bliuc AM, Best D, Iqbal M, Upton K. Building addiction recovery capital through online participation in a recovery community. *Soc Sci Med*. 2017;193:110–17.
30. Ramanadhan S, Wiecha JL, Gortmaker SL, Emmons KM, Viswanath K. Informal training in staff networks to support dissemination of health promotion programs. *Am J Health Promot*. 2010;25:12–18.
31. Moses AS, Skinner DH, Hicks E, O'Sullivan P. Developing an educator network: the effect of a teaching scholars program in the health professions on networking and productivity. *Teach Learn Med*. 2009;21:175–9.



32. Campbell N, Schiffer E, Buxbaum A, McLean E, Perry C, Sullivan TM. Taking knowledge for health the extra mile: participatory evaluation of a mobile phone intervention for community health workers in Malawi. *Glob Health Sci Pract*. 2014;2:23–34.
33. Katz ML, Pennell ML, Dignan MB, Pasket ED. Assessment of cancer education seminars for Appalachian populations. *J Cancer Educ*. 2012;27:287–93.
34. Elreda LM, Coatsworth JD, Gest SD, Ram N, Bamberger K. Understanding process in group-based intervention delivery: social network analysis and intra-entity variability methods as windows into the “black box”. *Prev Sci*. 2016;17:925–36.
35. Millery M, Aguirre AN, Kukafka R. Does a community-engaged health informatics platform facilitate resource connectivity? An evaluation framework. *AMIA Annu Symp Proc*. 2017;2017:1292–301.
36. Spitzer-Shohat S, Goldfracht M, Key C, Hoshen M, Balicer RD, Shadmi E. Primary care networks and team effectiveness: the case of a large-scale quality improvement disparity reduction program. *J Interprof Care*. 2018;33:472–80.
37. Banbury A, Chamberlain D, Nancarrow S, Dart J, Gray L, Parkinson L. Can videoconferencing affect older people’s engagement and perception of their social support in long-term conditions management: a social network analysis from the Telehealth Literacy Project. *Health Soc Care Community*. 2017;25:938–50.
38. Yang L, Chou Y, Hsu P, Yang HH. Evaluation of on-job training in a ward: nurses job satisfaction and professional commitment. Latest advances in educational technologies. In: *Proceedings of the 11th WSEAS International Conference on Education and Educational Technology*. Singapore: World Scientific and Engineering Academy and Society Press; 2012.
39. Owen JE, Curran M, Bantum EO, Hanneman R. Characterizing social networks and communication channels in a web-based peer support intervention. *Cyberpsychol Behav Soc Netw*. 2016;19:388–96.
40. Masumoto K, Yaguchi T, Matsuda H, et al. Measurement and visualization of face-to-face interaction among community-dwelling older adults using wearable sensors. *Geriatr Gerontol Int*. 2017;17:1752–58.
41. Gesell SB, Barkin SL, Sommer EC, Thompson JR, Valente TW. Increases in network ties are associated with increased cohesion among intervention participants. *Health Educ Behav*. 2016;43:208–16.
42. Yousefi-Nooraie R, Dobbins M, Marin A, Hanneman R, Lohfeld L. The evolution of social networks through the implementation of evidence-informed decision-making interventions: a longitudinal analysis of three public health units in Canada. *Implement Sci*. 2015;10:166.
43. Held FP, Roberts C, Daly M, Brunero C. Learning relationships in community-based service-learning: a social network analysis. *BMC Med Educ*. 2019;19:113.
44. Li J, Weeks MR, Borgatti SP, Clair S, Dickson-Gomez J. A social network approach to demonstrate the diffusion and change process of intervention from peer health advocates to the drug using community. *Subst Use Misuse*. 2012;47:474–90.

45. Phillips CB, Hall S, Irving M. Impact of interprofessional education about psychological and medical comorbidities on practitioners' knowledge and collaborative practice: mixed method evaluation of a national program. *BMC Health Serv Res.* 2016;16:465.
46. Marquez-Serrano M, Gonzalez-Juarez X, Castillo-Castillo LE, González-González L, Idrovo AJ. Social network analysis to evaluate nursing interventions to improve self-care. *Public Health Nurs.* 2012;29:361–9.
47. Gesell SB, Barkin SL, Valente TW. Social network diagnostics: a tool for monitoring group interventions. *Implement Sci.* 2013;8:116.
48. McGlashan J, Nichols M, Korn A, et al. Social network analysis of stakeholder networks from two community-based obesity prevention interventions. *PLoS One.* 2018;13:e0196211.
49. Ramanadhan S, Minsky S, Martinez-Dominguez V, Viswanath K. Building practitioner networks to support dissemination and implementation of evidence-based programs in community settings. *Transl Behav Med.* 2017;7:532–41.
50. Jippes E, Achterkamp MC, Brand PL, Kiewiet DJ, Pols J, Van Engelen JML. Disseminating educational innovations in health care practice: training versus social networks. *Soc Sci Med.* 2010;70:1509–17.
51. Shelton RC, Lee M, Brotzman LE, et al. Use of social network analysis in the development, dissemination, implementation, and sustainability of health behavior interventions for adults: a systematic review. *Soc Sci Med.* 2019;220:81–101.
52. Scott J. Social network analysis: developments, advances, and prospects. *Soc Netw Anal Min.* 2011;1:21–26.
53. Serrat O. Social network analysis. In: *Knowledge Solutions Tools, Methods, and Approaches to Drive Organizational Performance.* Singapore: Springer 2017:39–43.
54. Grol R, Wensing M, Eccles M. *Improving Patient Care: The Implementation of Change in Clinical Practice.* Edinburgh, Scotland: Elsevier Butterworth Heinemann; 2005.
55. Glasgow RE, McKay HG, Piette JD, Reynolds KD. The RE-AIM framework for evaluating interventions: what can it tell us about approaches to chronic illness management? *Patient Educ Couns.* 2001;44:119–27.
56. Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health Psychol.* 2008;27:379–87.
57. Bartholomew L, Parcel G, Kok G, Gotlieb NH. *Intervention Mapping: Designing Theory and Evidence-Based Health Promotion Programs.* Mountain View, CA: Mayfield; 2001.
58. Van Meijel B, Gamel C, Van Swieten-Duijfjes B, Grypdonck MHF. The development of evidence-based nursing interventions: methodological considerations. *J Adv Nurs.* 2004;48:84–92.
59. Bleijenberg N, De Man-Van Ginkel JM, Trappenburg JCA, et al. Increasing value and reducing waste by optimizing the development of complex interventions: Enriching the development phase of the Medical Research Council (MRC) Framework. *Int J Nurs Stud.* 2018;79:86–93.

60. Valente TW, Palinkas LA, Czaja S, Chu K, Brown CH. Social network analysis for program implementation. *PLoS One*. 2015;10:e0131712.
61. Latkin CA, Knowlton AR. Social network assessments and interventions for health behavior change: a critical review. *Behav Med*. 2015;41:90–7.
62. Perkins JM, Subramanian SV, Christakis NA. Social networks and health: a systematic review of sociocentric network studies in low- and middle-income countries. *Soc Sci Med*. 2015;125:60–78.
63. Bolívar M. Macro, meso, micro: broadening the ‘social’ of social network analysis with a mixed methods approach. *Qual Quant*. 2016;50:2217–36.
64. Domínguez S, Hollstein B. *Mixed Methods Social Networks Research: Design and Applications*. New York, NY: Cambridge University Press; 2014.
65. Rienties B, Johan N, Jindal-Snape D. Bridge building potential in cross-cultural learning: a mixed method study. *Asia Pacific Educ Rev*. 2015;16:37–48.
66. Schoonenboom J. Designing mixed methods research by mixing and merging methodologies: A 13-step model. *Am Behav Sci*. 2018;62(7):998-1015.
67. Schoonenboom J, Johnson R, Fröhlich D. Combining multiple purposes of mixing within a mixed methods research design. *Int J Multiple Res Approaches*. 2018;10:271–82.
68. Subirana M, Sola I, Garcia JM, Gich I, Urrútia G. A nursing qualitative systematic review required MEDLINE and CINAHL for study identification. *J Clin Epidemiol*. 2005;58:20–5.
69. Hand C, Letts L. *Occupational Therapy Research and Practice Involving Adults with Chronic Diseases: A Scoping Review and Internet Scan*. Ottawa: Canadian Association of Occupational Therapists; 2009.
70. Brien SE, Lorenzetti DL, Lewis S, Kennedy J, Ghali WA. Overview of a formal scoping review on health system report cards. *Implement Sci*. 2010;5:2.
71. Njelesani J, Couto S, Cameron D. Disability and rehabilitation in Tanzania: a review of the literature. *Disabil Rehabil*. 2011;33:2196–207.
72. McColl MA, Shortt S, Godwin M, Smith K, Rowe K, O’Brien P, et al. Models for integrating rehabilitation and primary care: a scoping study. *Arch Phys Med Rehabil*. 2009;90:1523–31.

## Appendix A. Dimensions, assessment and criteria to extract complexity of the health care interventions based on the Complexity Assessment Tool for Systematic Reviews (iCAT\_SR).

Core dimensions	Assessment and criteria
Active components included in the intervention, in relation to the comparison	<p>More than one component and delivered as a bundle = The intervention includes more than one component and some or all of these components need to be delivered as a bundle.</p> <p>More than one component= The intervention includes more than one component. These components may be integrated into a package.</p> <p>One component= The intervention includes one component only.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p>
Behaviour or actions of intervention recipients or participants to which the intervention is directed	<p>Multi-target= Intervention directed at three or more behaviours or actions.</p> <p>Dual target= Intervention directed at two behaviours or actions.</p> <p>Single target= Intervention directed at one behaviour or action only.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p>
The degree of tailoring intended or flexibility permitted across sites or individuals in applying or implementing the intervention	<p>Highly tailored/flexible= High degree of variation in implementation from site to site permitted and/or intervention designed to tailor to individuals or specific implementation settings.</p> <p>Moderately tailored/flexible = Some variation in implementation from site to site permitted (i.e. some components of the intervention are tailored/flexible while others are not).</p> <p>Inflexible Intervention= implementation highly standardised with minimal variation from site to site.</p> <p>Varies= Varies across interventions to be considered for/ included in the review</p>
The level of skill required by those delivering the intervention in order to meet the intervention objectives	<p>High level skills= Extensive specialised skills required, i.e. new skills in addition to expected existing skills AND/OR the extension of existing skills to a highly specialised area AND/OR skills requiring extensive additional training.</p> <p>Intermediate level skills = Some specialised skills required, i.e. a small extension to the expected existing skills of professionals, decision makers or consumers.</p> <p>Basic skills= No specialised skills required.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p>

---

The level of skill required for the targeted behaviour when entering the included studies by those receiving the intervention, in order to meet the intervention objectives	<p>High level skills= Extensive specialised skills required.</p> <p>Intermediate level skills= Some specialised skills required.</p> <p>Basic skills = No specialised skills required.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p>
---	---

---

Organisational levels and categories targeted by the intervention	<p>Multi-level = Intervention directed at two or more levels.</p> <p>Multi-category= Intervention directed at two or more categories of individuals within the individual level (e.g. primary care professionals and primary care patients).</p> <p>Single category= Intervention directed only at single category of individuals within the individual level (e.g. professionals or patients or policy makers).</p>
---	--

---

**Optional dimensions**

---

The nature of the causal pathway between the intervention and the outcome it is intended to effect	<p>Pathway variable, long= The causal pathway includes three or more steps between intervention and outcome or occurs over a long time period; is not linear, or is variable; and/or more than one causal pathway has been proposed.</p> <p>Pathway linear, long= The causal pathway is linear but there are three or more steps between intervention and outcome.</p> <p>Pathway linear, short= The causal pathway is clear, short (only one or two steps), direct, linear.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p> <p>Unclear or unable to asses</p>
--	---

---

The degree to which the effects of the intervention are dependent on the context or setting in which it is implemented	<p>Highly dependent on individual-level Factors= The effects of the intervention are modified by both recipient and provider factors.</p> <p>Moderately dependent on individual-level factors= The effects of the intervention are modified by one of recipient or provider factors.</p> <p>Largely independent of individual level Factors= The effects of the intervention are not modified substantially by recipient or provider factors.</p> <p>Varies= Varies across interventions to be considered for/ included in the review.</p> <p>Unclear or unable to assess</p>
--	---

---

## Appendix B. Extended study characteristics of the included studies.

Authors/year	Study Objective	Population/sample	Type of intervention	Intervention description
Banbury, 2017 <sup>37</sup>	This study examined the relationship between changes in social support networks for older people living in a regional area following weekly videoconference groups delivered to the home.	Coffs Harbour, New South Wales, Australia. Participants were recruited via community events and health professional referrals, aged 50 years and over with at least one LTC and the cognitive ability and the physical ability to use the videoconference equipment. A total of 44 videoconference meetings with 9 groups took place lasting between 45 minutes to 1.5 hours each. The mean number of participants in each meeting was 4.2	Tele health intervention	Telehealth Literacy Project was nested within a non-randomized, non-controlled vital signs remote monitoring project, My Health Clinic at Home. The THLP study consisted of five weekly group meetings by videoconference followed by a further week for feedback and evaluation. At the aged care provider premises, one facilitator, who is an experienced health promotion professional, ran the group meetings with support from an IT specialist who was also in the room. Participants were situated in their homes and once connected to a virtual room by the IT specialist, they could see and hear other group members and the facilitator in real time. Meetings started with introductions and the facilitator highlighting videoconference etiquette and confidentiality. Health information using slides and videos was provided. However, and more importantly, didactic teaching was minimal, and a facilitation method was employed whereby participants were highly encouraged to share anecdotes about their week and discuss their experiences, knowledge and opinions on health issues.
Benton et al., 2015 <sup>27</sup>	To explore whether social network analysis metrics may be useful in identifying candidates for the LFC train the trainers' programme. Instead of individuals identified by the traditional expert-opinion approach to train the trainer selection	A country in the Middle East. Participants in the study consisted of the inaugural Leadership for Change cohort. 32 participants were enrolled in the SNA	Educational	The Leadership For Change Programme utilizes five major elements; workshops that deliver core knowledge and provide opportunities for skills development; mentoring that offers students a means of addressing particular gaps in the leadership competencies; a team project that requires sub-cohorts to work together on a major policy or change issue; the completion and pursuit of individual development plans; and the opportunity to participate in learning activities such as visits to television or radio studios and media centers. The LFC programme uses an action learning methodology and from the initial cohort of thirty students trained by either the programme director, one of the regional trainers or the ICN chief executive approximately one third of the group go on to become in-country trainers
Bliuc, 2016 <sup>29</sup>	This study examines how online participation in a community of recovery contributes to personal journeys of recovery. It investigates whether recovery capital building as indicated by increased levels and quality of online social interactions and markers of positive identity development predict retention in a recovery program designed around fostering community involvement for early stage recovery addicts.	The study population (total N 609) consisted of all participants in the online JFH Facebook community. This community includes JFH program participants (N ¼ 23), JFH staff (N ¼ 5), and community members (N ¼ 581) who contributed to the online discussions over a period of eight months since the establishment of the JFH Facebook page	Network intervention	Jobs, Friends and Houses (JFH), a social enterprise that engages addicts in early recovery in apprenticeships in building professions while working on the renovation and construction of recovery housing in the north of England town of Blackpool. Participants in the program are actively involved in employment and training and are provided with recovery housing; as a part of a lifestyle change program, many of them also attend recovery mutual aid group meetings. As part of the building of the recovery community, JFH introduced a Facebook page to perform two primary functions: (1) to provide a recovery-supportive online community for participants; and (2) to allow the outside world (including a range of community stakeholders) to engage with JFH.

Campbell, 2014 <sup>32</sup>	Describes the mobile health intervention of the K4Health Malawi project and explores the effects of the intervention on knowledge exchange, focusing particularly on the qualitative and quantitative data collected through a participatory action research methodology called Net-Map.	Malawi, Nkhotakota and Salima Districts. In total 638 community health workers (CHWs) were included by given them phones etc. Participants were selected based on their membership in key stakeholder groups related to the technical focus of their work in HIV/AIDS and family planning/reproductive health in Malawi, A limit of 15 participants per workshop was necessary to ensure substantive discussions and output.	M health intervention	The project trained and provided mobile phones, solar chargers, and airtime to 253 CHWs in Nkhotakota and Salima Districts—30% of all CHWs in the 2 districts combined. An additional 385 CHWs received phones, chargers, and training during a second distribution in November 2010, bringing SMS coverage to 77% of health workers in both districts, targeting those whose homes were farthest away from health centers. In addition to providing new channels for communication (mobile phones and the SMS Hub), the system also filled these channels with essential technical information. The communication flow encompassed requests from health workers as well as prompt replies from district supervisors and coordinators. When clients approached health workers with urgent questions, or when workers needed to restock contraceptives, the workers could use their mobile phones to send a text message to the Hub, where a district coordinator or supervisor would be assigned to read and respond to messages. Alternately, a worker could reach a specific supervisor directly by using defined keywords, which the Hub would recognize and forward to the phone of the supervisor. The CHW could also use the system to contact a fellow worker within the network to ask a question or make a request. One of the reasons that the project chose this mHealth intervention was because of its low cost. NET-MAP intervention was included as evaluation method. Consisting of 5 steps: 1) Identifying the actors in the network. 2) Linking the actors 3) Mapping the influence 4) Facilitating the discussion. 5) Comparing the maps.
Elreda, 2016 <sup>34</sup>	The present study examines group process among parents and early adolescents in an efficacy trial of a mindfulness-based adaptation of the Strengthening Families Program (MSFP)	Central Pennsylvania. In total, participants for this study were 120 parents	Group based intervention	MSFP; in which participants were assigned to either SFP or the MSFP adaptation. SFP is a universal, evidence-based behavioral intervention for parents and youth ages 10–14 delivered in seven weekly sessions to groups of families, targeting a range of outcomes related to parenting, quality of the parent-youth relationship, and various parent and youth behavioral and psychological functioning outcomes. Each session begins with a one-hour parenting skills course and an adolescence life skills course (for which parents and teens are separated). MSFP followed an identical delivery structure, but integrated mindfulness activities into the parent skills portion. Group process within the separate parent and teen groups is the focus of the present study. We integrate SNA and IFV methods to provide for precise tracking of group structural features and individuals' positions in the groups, their change over time, and their associations with between-person differences in program benefits accrued to members.

Gesell, 2013 <sup>47</sup>	We hypothesized (H1) that by week twelve, after weekly 90-minute group skills-building group sessions, we will observe a moderate increase in network structure and perceived cohesion among participants.	Eleven pilot study participants enrolled in a twelve week intervention designed to teach healthy lifestyles in a group format.	Network intervention	GROW is an ongoing group-level behavioral intervention to prevent childhood obesity. It occurs at public community recreation centers for high-risk parent preschool child (ages three to five years) dyads. GROW is based on a conceptual model that childhood growth patterns are affected over time at sensitive windows of development by both micro- and macro-level systems. The micro-level system includes personal characteristics ranging from genetic profiles to individual attitudes and behaviors; whereas the macro-level system ranges from social networks to public policies. The GROW intervention focuses on the family, recruiting an index parent-child dyad, and connecting that dyad to the larger built environment. This built environment serves as a community-centered location to build healthy lifestyle skills (both routine physical activity and nutritional habits). During the first (intensive) phase of the intervention, families attend skills-building sessions together in small groups for twelve weeks.
Gesell, 2016 <sup>41</sup>	This article examined the relationship between social network ties and group cohesion in a group-based intervention to prevent obesity in children.	<b>Davidson County Tennessee.</b> Six-hundred and eleven adult-child pairs were enrolled in the GROW trial. Of those, 305 pairs were assigned to the intervention designed to teach healthy lifestyles in a group format. Social network data were collected from 304 intervention group adults (in 30 groups) and included in the analysis.	Group intervention	GROW is an ongoing group-level behavioral intervention to prevent childhood obesity. It occurs at public community recreation centers for high-risk parent-preschool child (ages 3-6 years) dyads. GROW is based on a conceptual model that childhood growth patterns are affected over time at sensitive windows of development by both micro- and macro-level systems. The micro-level system includes personal characteristics ranging from genetic profiles to individual attitudes and behaviors, whereas the macro-level system ranges from social networks to public policies. The GROW intervention focuses on the family, recruiting an index parent-child dyad, and connecting that dyad to the larger built environment. This built environment serves as a community-centered location to build healthy lifestyle skills (both routine physical activity and nutritional habits). During the first (intensive) phase of the intervention, families attended skills-building sessions together in small groups for 12 weeks. Parents met in consistent groups of approximately 8 to 10 parents for 2 hours each week for group sessions. Transportation and child care for siblings was offered to all study participants to overcome the most frequently cited barriers to study participation (Eakin et al., 2007). Participants did not receive remuneration for attending sessions. All sessions for each group were conducted in English or Spanish by the same group leader, who was trained to facilitate group discussion rather than lecture. All sessions involved a parent only skills building component and a parent-child applied learning component to build healthy lifestyle skills (nutrition, physical activity). Integrated within the intervention was the intentional building of new social networks described in detail elsewhere (Gesell, Barkin, & Valente, 2013). By design, participants who could not attend group sessions were given the opportunity to receive the intervention via phone call coaching depending on their weekly circumstances.



<p>Held, 2019 <sup>43</sup></p> <p>In this study we use the novel methodology of social network analysis to explore important aspects of learning of allied health professional (AHP) students in a rural community-based program.</p> <p>Australia, Broken Hill.</p> <p>An entire cohort of ten students (6 speech therapy and 4 OT students) was invited to participate during the final week of their placement. They had spent 6–8 weeks at Broken Hill University Department of Rural Health (BHUDRH). They came from the same university and were in the final year of their undergraduate degrees. Nine were female, one was male.</p>	<p>Educational</p> <p>For the cohort of AHP students in our study (occupational therapy (OT) and Speech therapy) the program included regular classes and workshops at BHUDRH, and the students' main role was to conduct lessons in local primary schools and kindergartens to further the children's lingual and motor development. In teams of two or three students had to plan, prepare, conduct and evaluate classes. Team membership was fixed for each school for the duration of the placement, but different combinations of students teamed up in different schools. School teachers were present during each of their classes. Students lived in shared housing facilities with students of other disciplines during their placement. In this context, we asked the research question "What are the important social relations of AHP students within a community-based rural clinical placement regarding what and from whom the students learn?"</p>
<p>Jippes, 2010 <sup>50</sup></p> <p>We examined the effect that following an intensive Teach-the-Teacher training had on the dissemination of a new structured competency-based feedback technique of assessing clinical competencies among medical specialists in the Netherlands.</p>	<p>Organizational</p> <p>Many medical specialists in our sample had followed a Teach-the-Teacher course which was aimed at improving the didactic skills or teaching abilities of the participants. The training consisted of three sequential two-day courses. Registration for the second and third courses was dependent upon successful completion of the first course. The introductory course comprised training in structured feedback, training in the Mini-CEX, and the basics of adult learning. The second course comprised training in daily educational practice, which includes organizing day-to-day training for residents and adapting the training to the learning styles of the residents. The third course included training in periodic interviews for the formative and summative assessment of residents. Participants in the courses were medical specialists from different specialties and hospitals in the Netherlands; among these participants were the gynecologists and pediatricians in our sample.</p>
<p>Katz, 2012 <sup>35</sup></p> <p>Cancer education seminars for Appalachian populations were conducted to: (1) increase knowledge of existing cancer disparities, (2) disseminate findings from Appalachian community based participatory research (CBPR) projects, and (3) foster CBPR capacity building among community members by promoting social networking.</p>	<p>Educational</p> <p>The seminar series consisted of three regional and one national seminar. The educational objectives of the seminars were to increase knowledge of existing cancer disparities in Appalachia and to disseminate research findings from CBPR projects conducted in Appalachia. An additional objective of the national seminar was to foster capacity building among Appalachian community members for CBPR by promoting networking at the seminars. The seminars were designed to draw attention to the cancer disparities that exist in Appalachia and to highlight the CBPR projects and evidence-based educational programs being conducted by academic and community partnerships in Appalachia. Each seminar used a common agenda format including speakers who were academic researchers, junior investigators, and community members from local cancer coalitions. Panel discussions were featured to facilitate sharing ideas with the members of the audience. In addition to presentations directed at cancer disparities and interventions to reduce cancer, the seminars also addressed Appalachian identity, the impact of culture and heritage on cancer disparities in Appalachia, and the importance of storytelling in Appalachia. Although the content of all seminars was comparable, the regional seminars featured local researchers and community members compared to the national seminar which featured researchers, community members, and cancer-related issues associated with the entire Appalachian region.</p>

<p>Li, 2012<sup>44</sup></p>	<p>We conducted a study called the Risk Avoidance Partnership (RAP) in which we tracked network relationships and dynamics in the course of implementing an innovative peer intervention to measure efficacy of this program to change group behavior. This paper uses ego and sociometric network analysis to test the RAP intervention diffusion process and effect based on diffusion theory, in order to illustrate the key processes of social change driven by drug users as community change agents within the networks of their peers.</p>	<p>The survey sample includes two primary participant groups related to peer intervention diffusion. The first was 112 PHAs who completed 5 or more of the 10-session training curriculum. The second participant group was 411 contacts, comprising primarily contact referrals the trained PHAs brought into the study for the baseline and 6-month surveys, plus PHA candidates who did not finish the training and their network referrals.</p>	<p>Peer intervention</p>	<p>The RAP PHA Curriculum was a 10-session, theoretically driven interactive training program modeled after a similar one tested in Baltimore, Maryland, adding a significant staff-PHA partnered community component based on community empowerment theory to emphasize advocacy action. Content of the training and intervention was modified on the basis of local ethnography (Weeks, et al., 2001) and PHA input during the pilot (Weeks, et al., 2006). The first 5 training sessions were conducted in-office for two hours each on consecutive days, using both didactic and interactive methods to provide information, model peer intervention activities, and role play delivery of the RAP Peer Intervention to other drug users in the community. The RAP Peer intervention was a harm reduction approach to reducing risky drug use and sexual practices and promoting general prevention and health enhancement. Up to 5 additional staff-accompanied field sessions were conducted in the community over the next 10 weeks at the convenience of the PHA and his or her staff partner in a variety of community locations chosen by the PHA, including in some of the PHAs' drug-use sites. Field sessions allowed PHAs to practice effective communication and demonstration of prevention strategies in community situations where they could be expected to continue to apply them in the absence of project staff. Ongoing support for PHAs included monthly Community Advocacy Group (CAG) meetings to plan, organize, and implement activities to advocate for and promote drug users' health and well-being at the community level, and to reinforce their new role as interventionists for peer and community change. PHAs received monetary compensation of \$20 for participation in each of the 2-hour training sessions, and also received \$10 for each CAG meeting they attended. However, they received no monetary incentives to deliver intervention to their peers.</p>
------------------------------	--	---	--------------------------	---

<p>Márquez-Serrano, 2012<sup>46</sup></p>	<p>To explore the impact of an educational intervention for self-care of elders on their knowledge of acute respiratory infections and its incidence within their social networks.</p>	<p>Mexico.</p>	<p>10 older people included in intervention. 94 people including participants and family (their social network) included in SNA.</p>	<p>Educational</p>	<p>The educational strategy was based on the meaningful learning principles by Ausubel, which indicate that learning should be based on prior knowledge. The experience included the following four stages: (1) activation of knowledge, (2) acquisition of knowledge, (3) practice of knowledge, and (4) application and evaluation of knowledge. Thus, the participating elders first indicated what they knew about acute respiratory infections. Second, they acquired new knowledge during seven sessions. They then modified some of their hygienic habits, including washing their hands with the correct technique before each meal, covering their mouths when coughing or sneezing, and, finally, producing the liquid soap, handkerchief, and towel that they used for the prevention of acute respiratory infections. The sessions combined information to acquire the knowledge needed for self-care and the development of skills—such as making low-cost liquid soap, correctly using a thermometer and masks—and to participate in recreational activities such as making a handkerchief and a towel. A central theme of all the sessions was the strengthening of self-esteem so that the elders could change from being receivers of care to being promoters of their own health and that of their families. Seven educational sessions were held for approximately 70 min each, from September to December 2009. The first two sessions corresponded to the first stage in the Ausubel learning cycle, with the objective of activating the elders' prior knowledge of acute respiratory infections. The method used was discussion among the participants. The second stage in the learning cycle was conducted during Sessions 3, 4, and 5, with the objective of broadening the elders' knowledge of acute respiratory infections. The method used in these sessions was the presentation of recreational activities by the facilitator. The objective of the third stage (Sessions 6 and 7) was for the elders to expand and modify their practices. This was accomplished using the active method, in which each elder applied and adapted the knowledge that he or she had learned and maintained. The objective of the last stage in the learning cycle was for the elders to self-discover their own knowledge, making it personal and replicating it with events and/or activities within their social networks.</p>
<p>Masumoto, 2017<sup>40</sup></p>	<p>The present study was designed to quantitatively measure and visualize face-to-face interactions among elderly participants in an exercise program. We also examined relationships among interactional variables, personality and interest in community involvement, including interactions with the local community.</p>	<p>Kobe City, Japan.</p>	<p>27 participants (10 men and 17 women; mean age 73.41 years) were recruited on the condition that they were expected to participate in all four sessions of the exercise program. However, just eight could participate in all the sessions as a result of ill health or unexpected schedule changes. Of the remaining 19 participants, 11 attended three sessions, five attended two sessions and three attended one session.</p>	<p>Exercise intervention</p>	<p>In this study, participants were led in the DK Elder System (Daichikoshō, Tokyo, Japan) by professional instructors. The DK Elder System consists of a program combining exercise, music and video images, aiming at preventive care and health maintenance. The programs are delivered using the karaoke-on-demand system. In the present study, images were projected on a screen (H180 cm × W240 cm) set in front of the participants. Two instructors demonstrated exercises on both sides of the screen, and another instructor accordingly gave advice while observing the condition of the participants. The programs included exercises using rubber bands and dumbbells for preventing falls, stretching exercises and rhythmic exercises, by moving the body to music. Each session of the exercise program lasted 90 min, and four sessions were carried out with the same participants over a 2-month period.</p>

<p>McGlashan, 2017<sup>48</sup></p>	<p>This paper presents a quantitative analysis of the interpersonal network structures within a sub-sample of stakeholders from two past successful childhood obesity prevention interventions.</p>	<p>USA &amp; Australia</p>	<p>Community-based environmental change intervention &amp; community capacity building approach</p>	<p>Two interventions: the Shape Up Somerville (SUS) and Romp &amp; Chomp (R&amp;C) CBIs resulted in significant reduction in BMI z-score for children in the intervention areas. Both SUS and R&amp;C investigators retrospectively hypothesized that the SC networks comprising strong partnerships and engagement of community stakeholders were key contributors to the interventions' results. SUS (2003-2005) was a community-based environmental change intervention in Somerville, MA, USA that targeted the school, home and community settings of early elementary school children. The SC included individuals from schools, food service, community organizations, academia and local health leaders. The 'on-going group cohesion and consistent leadership' were regarded as the most critical factors of the intervention for the effectiveness of the intervention. R&amp;C (2004-2008) used a community capacity building approach to improve healthy eating and active play among 12,000 children aged 0 to 5 years in Geelong, Australia. The intervention consisted of multiple changes to environments in early-childhood care and educational settings. It was led by a SC with representation from local government, early childhood settings, health services and academia. R&amp;C stakeholders documented their perceptions of what contributed to the intervention's positive results, reporting that partnerships and relationships were a critical factor of success; for example, engagement of major community stakeholders</p>
<p>Millary, 2017<sup>35</sup></p>	<p>This study present a framework for evaluating the process and outcomes of a CEHI platform designed to improve connectivity among community health resources.</p>	<p>New York City 28 organizations; with a 61% response rate</p>	<p>Network intervention</p>	<p>GetHealthyHeights.org CEHI platform (GHH). The mission of GHH was collectively defined by the GHH Steering Committee as "an online community that engages people and organizations in Washington Heights-Inwood to discover, connect, and share resources to get healthy". The platform include a community calendar, a local service directory, posting of multiple types of content (e.g., articles, videos, and links), the ability to comment and rate content, integration of social media for content sharing, use of Google Translate (especially for Spanish translation of content), creation of pages for local organizations and the ability to form groups that other users can join. Community organizations have an essential role in creating and disseminating content through GHH.</p>

<p>Moses, 2009 <sup>31</sup></p>	<p>The purpose of this study was threefold. First, we wanted to determine if participation in the Teaching Scholars Program (TSP), a longitudinal faculty development program at our institution, resulted in a larger network of colleagues interested in education. If so, we also wanted to determine what types of colleagues—departmental, campus-wide, administrators, national contacts—were involved. Second, we wanted to identify themes related to building this network through TSP. Finally, we wanted to determine if an increase in participants' educational networks was associated with increased productivity as measured with a curriculum vita (CV) analysis</p>	<p>Arkansas. Interviews with individuals who completed the TSP at the University of Arkansas for Medical Sciences from 1998 to 2004. Thirty-six of the 43 (88%) eligible TSP graduates completed interviews.</p>	<p>Educational</p>	<p>The TSP sought to improve the teaching skills of faculty in five health professions colleges and to nurture the development of a group of faculty who actively engage in the scholarship of teaching. The format included three components: nine monthly 3-hr workshops on topics related to teaching and educational research; approximately four annual lectures by nationally known health professions educators; and completion of a project in the subsequent two years. During the 1st year, the program was available to College of Medicine faculty only; since then, the program has also included participants from the Colleges of Nursing, Pharmacy, Health-Related Professions, and Public Health.</p>
----------------------------------	---	--	--------------------	--

<p>Nooraie, 2015<sup>42</sup></p>	<p>We studied the evolution of information-seeking networks over a 2-year period during which an organization-wide intervention was implemented to promote evidence-informed decision-making (EIDM). We tested whether engagement of staff in the intervention and their EIDM behavior were associated with being chosen as information source and how the trend of inter-divisional communications and the dominance of experts evolved over time</p>	<p>Canada</p> <p>The three public health units enrolled in the study differed. Unit A served a large urban population (&gt;1.5 million). At the time the study commenced, unit A had in place many trained project specialists assigned to practice-based teams, with responsibility for conducting literature reviews to address practice issues. Also, more than 100 staff members, mainly managers and project specialists, had attended a weeklong workshop on EIDM. The “highly engaged” staff frequently met at progress meetings and critical appraisal clubs to share their problems and progress with other review teams. At the end of the project, completed reviews were presented in department-wide research events and other local meetings. Unit B was the largest health unit in the study, serving a large urban population area (&gt;1.5 million). Thirteen staff members (1.2 % of 1068) were highly engaged in the intervention. Unit C served a smaller mixed urban-rural community (~600,000 population). At unit C, public health nurses had the responsibility for searching and applying evidence to practice, along with carrying out their daily public health duties under the supervision of program managers. Much similar to unit B, a few divisions of unit C participated in the intervention, and nurses were assigned to small groups to conduct summary evidence reviews. There were 18 highly engaged staff members (9 % of 202).</p>	<p>Organizational</p>	<p>Three public health units in Ontario, Canada, participated in a 22-month multifaceted and site-tailored intervention to promote EIDM among public health professionals. Senior management from each health unit helped in tailoring the intervention to their unit’s goals for EIDM and available resources. The intervention consisted of an introductory workshop introducing the study and the concept of EIDM, and face-to-face mentoring of small groups of staff through the EIDM process by a professional knowledge broker (KB). More details about the capabilities and responsibilities of the KB are provided elsewhere. In each public health unit, a group of staff was recruited by local managers to get engaged in the development of summary evidence reviews to address local public health problems, while the majority of their peers had very limited contact with the intervention. Local managers chose these individuals because their roles were already (or were planning to be) associated with EIDM. The KB interacted with this “highly engaged” staff either one-on-one (through consultations) or as members of project-specific teams to develop summary evidence reviews. During and after the intervention, “highly engaged” staff continually communicated with their peers, through which they had the opportunity to share their experience and accomplishment and get recognized by the staff as EIDM experts.</p>
-----------------------------------	--	---	-----------------------	---

<p>Owen, 2016 <sup>39</sup></p>	<p>This study (a) evaluates social network characteristics of four distinct communication channels (discussion board, chat, e-mail, and blog) in a large social networking intervention, (b) predicts membership in online communities, and (c) evaluates whether community membership impacts engagement.</p>	<p>Southern California Participants were 299 cancer survivors with significant distress using the 12-week health-space.net intervention. Participants (n = 299) were derived from a larger study of the effect of a web-based social networking intervention for cancer survivors experiencing significant distress (healthspace.net). Eligibility criteria included having a previous diagnosis of cancer, reporting distress q4 on the Distress Thermometer,<sup>29</sup> having reliable access to the Internet, and being willing to complete baseline and follow up surveys.</p>	<p>Health-space net intervention</p>	<p>The health-space intervention included access to a confidential community of other cancer survivor participants and professional facilitators and a structured, 12-week coping skills training intervention. The intervention provided opportunities for participants to interact in four distinct social networking channels: asynchronous discussion board, personal pages and blogs, confidential web-based mail messages, and a real-time, 90-minute weekly chat (Fig. 1). Additional details about each social networking channel and engagement with each of the channels are provided by Owen et al.<sup>30</sup> All dyadic interactions between participants (i.e., “actors” in the social networking analysis) were recorded by time stamp and activity on the study server. Participants’ identities were held in strict confidence, so participants did not have any opportunity to interact with one another outside the health-space study Web site.</p>
<p>Phillips et al., 2016 <sup>45</sup></p>	<p>This study evaluates the impact of “Mind the Gap”, an Australian interprofessional continuing education program about management of dual illnesses, on practitioners’ knowledge, use of psychological strategies and collaborative practice.</p>	<p>Of the 837 workshop participants, 645 enrolled in the evaluation (54 % GPs, 16 % nurses, 14 % mental health professionals, response rate 77 %). Other allied health practitioners who attended were occupational therapists, pharmacists, physiotherapists, podiatrists and social workers.</p>	<p>Educational</p>	<p>Mind the Gap was an advanced learning module which aimed to develop participants’ skills and knowledge to work singly or interprofessionally with patients with comorbid psychological and physical illnesses. Aims, content and educational strategies are summarised in Table 1. The module was delivered in one six-hour workshop, or two three-hour workshops, facilitated by a local clinician with expertise in psychological care. All facilitators received a facilitator’s guide and a presentation, with speaking notes. The program was delivered through the Medicare Locals, primary care support organisations, which at the time of the study had 61 regional offices across Australia. As this program was funded by the Department of Veterans’ Affairs, one of the referral pathways covered was to the Veterans and Veterans Families Counselling Service (VVCS), an Australian Government funded service providing counselling and support for war and defence service-related mental health conditions.</p>

<p>Ramanadhan, 2010 <sup>30</sup></p>	<p>This study was interested in ways that a staff network might serve as a resource for informal training to strengthen practitioner skills and, ultimately, the implementation of a health promotion program. We had three goals: (1) to describe the network of staff implementing a health promotion program; (2) to describe perceived skill transfer within the staff network; and (3) to examine the relationship between staff-program-related connections and perceived skill transfer.</p>	<p>USA. All 91 staff members at program sites who participated directly in childcare and who were on the staff roster on November 1, 2007 were eligible to participate in the study. A total of 80 staff members took the survey, which yielded a response rate of 88%.</p>	<p>Health promotion intervention</p>	<p>The iPLAY program helped staff create environmental changes that support child health in four areas: physical activity, nutrition, time spent with television and videos, and staff connections with children and parents/guardians. Staff members were also encouraged to use data-driven decision making and experimentation to improve program offerings as part of the learning organization movement. The program placed explicit emphasis on peer knowledge sharing as a means of enhancing implementation. To this end, coordinators (i.e., staff members responsible for spearheading implementation) received mandatory quarterly training sessions and were expected to share information informally (i.e., no formal training mandated) with colleagues at their sites. Technical assistance was provided by the program director, an individual hired to support this program.</p>
<p>Ramanadhan, 2017 <sup>49</sup></p>	<p>This study brings together a unique focus on CBO-based practitioners; a goal of creating sustainable, community-based networks; and the use of a participatory approach to create a viable solution. We sought to answer the following question: Is network engagement associated with EBP use among trainees in a capacity-building program for CBO staff members?</p>	<p>USA. 125 trainees from diverse organizations, ranging from health-focused nonprofits to housing authorities to schools.</p>	<p>Capacity building programs</p>	<p>PLANET MassCONNECT, a project that used participatory approaches to build capacity for systematic program planning among a diverse range of CBOs working with the underserved in three Massachusetts communities. The intervention included a number of components to support the goal of repeated engagement with trainees over time. These components included the following: (1) a skill-building workshop, typically delivered over two half-days, which focused on using data, finding partners, exploring intervention approaches, selecting/adapting an EBP, and evaluating the EBP; (2) a tool kit including a customized web portal, a training manual with handouts, and case studies; (3) networking events for additional training and to support the development of a network of dissemination specialists; (4) mini-grants to provide opportunities to apply the systematic approach to program planning; and (5) technical assistance provided by staff members. The training emphasized the use of key national resources, including the CDC community guide, which provides systematic reviews related to health promotion intervention strategies and the NCI Cancer Control PL.A.N.E.T., a web-based resource that supports the data and EBPs for cancer control. Trainees were enrolled on a rolling basis to allow for small class sizes (15–20 trainees per session) and to support interaction among trainees and between trainees and trainers. Additional details about the intervention are provided elsewhere</p>



Rice et al., 2012 <sup>28</sup>	<p>The objective of the study is to use social network analysis to examine the acceptability of a youth-led, hybrid face-to-face and online social networking HIV prevention program for homeless youth</p>	<p>Three different categories of participants were included in the pilot study: peer leaders (PL) (n = 7), face-to-face youth (F2F) (n = 53) and online youth (OY) (n = 103).</p>	<p>Social networking intervention</p>	<p>The intervention included psychosocial training and skill building for PL, as is typical of most effective HIV prevention interventions. For PL and F2F, engagement in the creation of youth-conceptualized and youth-produced digital media was based on theories of community mobilization and empowerment via participatory community theater models. For all participants, dissemination of online media and the accompanying HIV prevention dialog utilized the Diffusion of Innovations, which has successfully been employed in face-to-face HIV prevention strategies.</p>
Rosas and Knight, 2019 <sup>19</sup>	<p>This study described an evaluation that embraced systems thinking and complexity science to examine a complex intervention designed to promote the healthy development of adolescents. In doing so, we apply several systems principles and concepts, and describe how multiple systems methods enabled us to address systems-oriented evaluation questions and draw conclusions about the intervention.</p>	<p>USA            IM40 targeted approximately 45,000 youth ages 12–15 across the state; however, the council decided that the initiative should start in three communities and gradually spread statewide. Using social, economic, and health data, planners identified communities with particularly high levels of poverty and indicators of disadvantage, such as low high school graduation rates and high percentages of single parent households, as well as other factors associated with youth risk. One community in each of DE's three counties was identified, resulting in a total of 7200 youth ages 12–15, who comprised the initial target population.</p>	<p>Health promotion intervention</p>	<p>IM40 sought to increase or strengthen youth developmental assets according to the Search Institute's 40 Developmental Assets® framework, enabling youth to foster greater resilience to negative influences and engage in healthier behaviors.</p>

<p>Spitzer-Shohat, 2018 <sup>36</sup></p>	<p>This study investigated how the organizational structure and social relations among primary-care-clinic team members were associated with their perceptions of effectiveness in leading and implementing disparity reduction interventions to improve the care of disadvantaged populations they serve</p>	<p>Israel Participants were members of the interdisciplinary managerial teams (medical, nursing, and administrative directors) of 26 clinics of 4 of the organization's regions. Additionally, the clinics' associated managerial levels (sub regional management for each 2-4 clinics and each region's headquarters) were included. Clinic teams comprised 26 physicians, 26 nurses, 20 administrative heads, five pharmacists and one clinic quality-improvement coordinator (n = 78). The 10 mid-level management, sub regional managerial teams included 10 medical directors, seven nursing directors and two administrative directors (n = 19). The four regional management teams included four medical directors, four nursing directors, and two quality-improvement coordinators (n = 10).</p>	<p>large-scale disparity reduction intervention</p>	<p>An organization-wide QI program aimed at reducing gaps between low-performing clinics serving mostly low socioeconomic and minority populations and the general Clalit member population, in a composite measure of seven health and health care indicators: diabetes, hypertension, and lipid control; anemia prevention in infants; and performance of mammography and occult blood tests and of influenza immunizations for the chronically ill. The program targeted 55 primary care clinics serving approximately 400,000 people (10% of Clalit's population), of mainly economically disadvantaged and minority groups, who were identified as performing poorly on the composite indicators measure. Although the overall organizational goals for disparity reduction and the measurement scheme were set by the central Clalit management, the interventions formulated and their implementation strategy were developed locally at the regional, sub regional, and primary-care clinic levels.</p>
<p>Yang 2012 <sup>38</sup></p>	<p>This study described the training effect in a single ward.</p>	<p>Taiwan En Chu Kong Hospital. The total bed number is 44 with 80% occupancy rate. All of the 20 nurses working in the 13th ward were voluntary to participate in this study</p>	<p>Theoretical based intervention program</p>	<p>Theoretical based intervention program was applied from May to October in 2010. First a needs assessment was carried out. Then, key persons were interviewed and group discussions were held. Subsequently, the results were translated into specific objectives and used in intervention development for the 13th ward's staff. Strengthening professional commitment and harmonic interaction was defined as objectives. And 16-hour training sessions were designed. The training sessions included courses, conferences and workshops. According to Frans' themes, the content of sessions included facilitation skills, standards of service, developing self-esteem and assertiveness, realize your potential, discovering the secrets of self-confidence, smart thinking and smarter working, effective communication, and essentials of personal development.</p>

## Appendix C. Application SNA in included studies

Author/Year	Single, Multi-, or mixed method*	SNA purpose	Target Intervention research	SNA metrics
Banbury, 2017 <sup>37</sup>	A mixed methods design combining a social network analysis tool, semi-structured interviews, focus groups and a course journal was used. The course journal was maintained by the facilitator throughout the programme and recorded details of meeting attendance, IT difficulties, group dynamics, processes and other observations.	The social network analysis focused on mapping egocentric networks, using a single 'name generator' Tool. Participants were asked pre and post-intervention 'Who do you think is most important to you in managing your condition/s?'	Effectiveness	Outdegree
Benton et al., 2015 <sup>27</sup>	Single method.	To explore whether social network analysis metrics may be useful in identifying candidates for the LFC train the trainers' programme.	Identifying interventionists	Indegree, outdegree, degree connectedness, closeness centrality, betweenness
Bliuc, 2016 <sup>29</sup>	A mixed methods design combining a social network analysis (to map how participants interact online), computerised linguistic analyses that evaluated sentiment of the textual data (to capture social identity markers), and in-depth interviews with participants to explore personal experiences of engagement in the online community of group members who have undergone the most significant changes since joining the community.	To measure the quality of participation in the online community, as centrality network coefficients derived from conducting social network analysis (SNA) by mapping the linkages between members of the online network through their online interactions.	Effectiveness	Degree-centrality, betweenness-centrality.

Campbell, 2014 <sup>32</sup>	Qualitative and quantitative methodologies, including Net-Map research, Lot Quality Assurance Sampling (LQAS), and focus group discussions were used. The study did not specify their design by name as being a mixed methods.	To explore the effects of the intervention on knowledge exchange of the K4Health Malawi project	Effectiveness	Indegree, outdegree, degree centrality	
Elreda, 2016 <sup>34</sup>	A multi-methods design was used. The study integrated SNA and “intra-entity variability” methods which are both quantitative in nature.	To provide for precise tracking of group structural features and individuals’ positions in the groups, their change over time, and their associations with between-person differences in program benefits accrued to members.	Process Evaluation	Indegree -centrality, outdegree centrality, connectedness	
Gesell, 2013 <sup>47</sup>	Single method.	A social network survey was developed to assess change in social relationships (specifically, advice networks and discussion networks) over the course of the study period by capturing the presence and absence of ties at mid-point and completion of the intervention	Effectiveness	Isolates, degree, reciprocity, sub-groups, density, centralization, transitivity, and cohesion	
Gesell, 2016 <sup>41</sup>	Single method.	A social network survey was developed to assess change in social relationships (specifically, advice networks and discussion networks) over the course of the three weeks by capturing the presence and absence of ties at various stages of the intervention	Effectiveness	Outdegree, cohesion	

<p>Held, 2019 <sup>43</sup></p>	<p>Single method.</p>	<p>We conducted a social learning network survey in four domains of learning (clinical knowledge, procedural skills, professional development, and complex determinants of health) to explore learning relationships (ties) with other people (alters) that students (egos) formed during their placement. We quantified how different roles (supervisors, health professionals, administrators, peers, schoolteachers, and clients) contributed to the students' learning in each of the four domains. We used exponential random graph models (ERGMs) to test which relational processes contributed to the structure of the observed learning networks.</p>	<p>Effectiveness</p>	<p>Density</p>
<p>Jippes, 2010 <sup>50</sup></p>	<p>Single method.</p>	<p>In this paper we will examine the effects of an intensive Teach-the-Teacher training course versus the effect that the structure of the social network has on the adoptive behavior of medical health care professionals. More specifically, we will look at the effect of network tie strength on the dissemination of a new structured feedback technique among medical specialists.</p>	<p>Effectiveness</p>	<p>Degree centrality betweenness centrality closeness centrality</p>
<p>Katz, 2012 <sup>33</sup></p>	<p>A multi-methods design was used. Pre-post surveys were added with a social network component.</p>	<p>A social network analysis was conducted among the participants prior to and at the end of the meeting to evaluate potentially new patterns of collaboration for future community-based participatory research (CBPR).</p>	<p>Effectiveness</p>	<p>Out degree</p>

Li, 2012 <sup>44</sup>	Single method.	Was it the RAP intervention or something else that caused the risk behavior norm change? To answer this question, methods other than over time risk assessment comparisons are needed in order to reveal the RAP intervention diffusion process, and to determine the relationship between RAP intervention diffusion and its possible effects on risk behavior change.	Process evaluation	Indegree, outdegree, degree centrality,
Márquez-Serrano, 2012 <sup>46</sup>	Single method.	To evaluate the impact of an educational strategy focused on the self-care of elders. Especially in the dissemination of knowledge from the intervention into the social network of participants.	Effectiveness	Density Out degree
Masumoto, 2017 <sup>40</sup>	A multi-methods design was used. A device with wearable sensor technology was used to measure face-to-face interactions. Psychological variables and interest in interacting with local community residents and community involvement were asked.	The aim of the program was to quantitatively assess participants' communication networks and changes in these networks by using wearable sensors that automatically collected face-to-face interactional data of participants.	Effectiveness	Network density, outdegree.
McGlashan, 2017 <sup>48</sup>	Single method.	The objective of this study was to use social network analysis to retrospectively analyse the structure of the networks present within the SCs of two successful childhood obesity CBIs	Process evaluation	degree; (out-degree); EI index, network density, reciprocity, clustering, coefficients, and centralization

<p>Millary, 2017 <sup>35</sup></p>	<p>Single method.</p> <p>Context information at baseline of community bases organizations. The baseline results of the social network survey of CBOs, using the PARTNERtool, demonstrate that the survey methodology produces a rich set of network metrics for describing the state of the CBO network at baseline. They used an adapted version of the validated PARTNERtool. The PARTNERtool was designed to collect network interaction data from public health collaborations.</p>	<p>Process evaluation</p>	<p>Density, degree centrality, trust</p>
<p>Moses, 2009 <sup>31</sup></p>	<p>Single method.</p> <p>We wanted to determine if participation in the Teaching Scholars Program (TSP), a longitudinal faculty development program at our institution, resulted in a larger network of colleagues interested in education. If so, we also wanted to determine what types of colleagues—departmental, campus-wide, administrators, national contacts—were involved.</p>	<p>Effectiveness</p>	<p>Outdegree isolated members and cut points.</p>
<p>Nooraie, 2015 <sup>42</sup></p>	<p>Single method.</p> <p>The study tested whether engagement of staff in the intervention and their EIDM behavior were associated with being chosen as information source and how the trend of inter-divisional communications and the dominance of experts evolved over time</p>	<p>Effectiveness</p>	<p>Measures of network connectivity (density, reciprocity, E-I index, and Krackhardt's hierarchy index) in-degree centrality of actors, and Freeman's centralization.</p>

Owen, 2016 <sup>39</sup>	Single method.	This study (a) evaluates social network characteristics of four distinct communication channels (discussion board, chat, e-mail, and blog) in a large social networking intervention, (b) predicts membership in online communities, and (c) evaluates whether community membership impacts engagement	Effectiveness	Density, clustering, path length, average degree, and connectedness
Phillips et al., 2016 <sup>45</sup>	A mixed methods design combining a social network analysis, observations and surveys were used.	Exploring the size and structure of the individual's networks with other health professionals before and after the program.	Effectiveness	Defined as network characteristics
Ramanadhan, 2010 <sup>30</sup>	Single method.	To describe the network of staff implementing a health promotion program; and to examine the relationship between staff program-related connections and perceived skill transfer.	Implementation context	Network Density, In/Out Degree, out degree
Ramanadhan, 2017 <sup>49</sup>	A multi-methods design was used. Post-test surveys were added by a social network analysis.	Is network engagement associated with EBP use among trainees in a capacity-building program for CBO staff members?	Implementation context	Network density, Network centralization
Rice et al., 2012 <sup>28</sup>	Single method.	The objective of the study is to use social network analysis to examine the acceptability of a youth-led, hybrid face-to-face and online social networking HIV prevention program for homeless youth	Examine acceptability	Density, centralization, between-centrality, eigen-centrality, degree-centrality, homophily



Rosas and Knight, 2019 <sup>19</sup>	A multi-methods design was defined by the authors as being used. The study however used qualitative methods, observations and social network survey	How were the collaborative <i>relationships</i> among IM40 stakeholders manifest – we employed network analysis to examine shifts in the relationships among organizational actors in the IM40 system.	Process evaluation	Average degree Average weighted degree Density Modularity Communities Average path length
Spitzer-Shohat, 2018 <sup>36</sup>	A mixed-methods design was used combining qualitative and quantitative methods in a convergent design. Semi-structured in-depth interviews, self-rated questionnaires and SNA.	To investigate the implementation of Clalit's disparity reduction program in which the types and strength of ties between network members were characterized.	Implementation context	Density, network centralization, group centrality, and group betweenness centrality
Yang 2012 <sup>38</sup>	Single method.	A quasi-experimental design was used in which one pre-intervention survey and one post-intervention survey was used to collect data from the participants. The most important parameters of the overall data collection were the change in the job satisfaction, professional commitment, and social networks. The collected data was analysed in both individual and organizational levels.	Effectiveness	Outdegree, indegree.

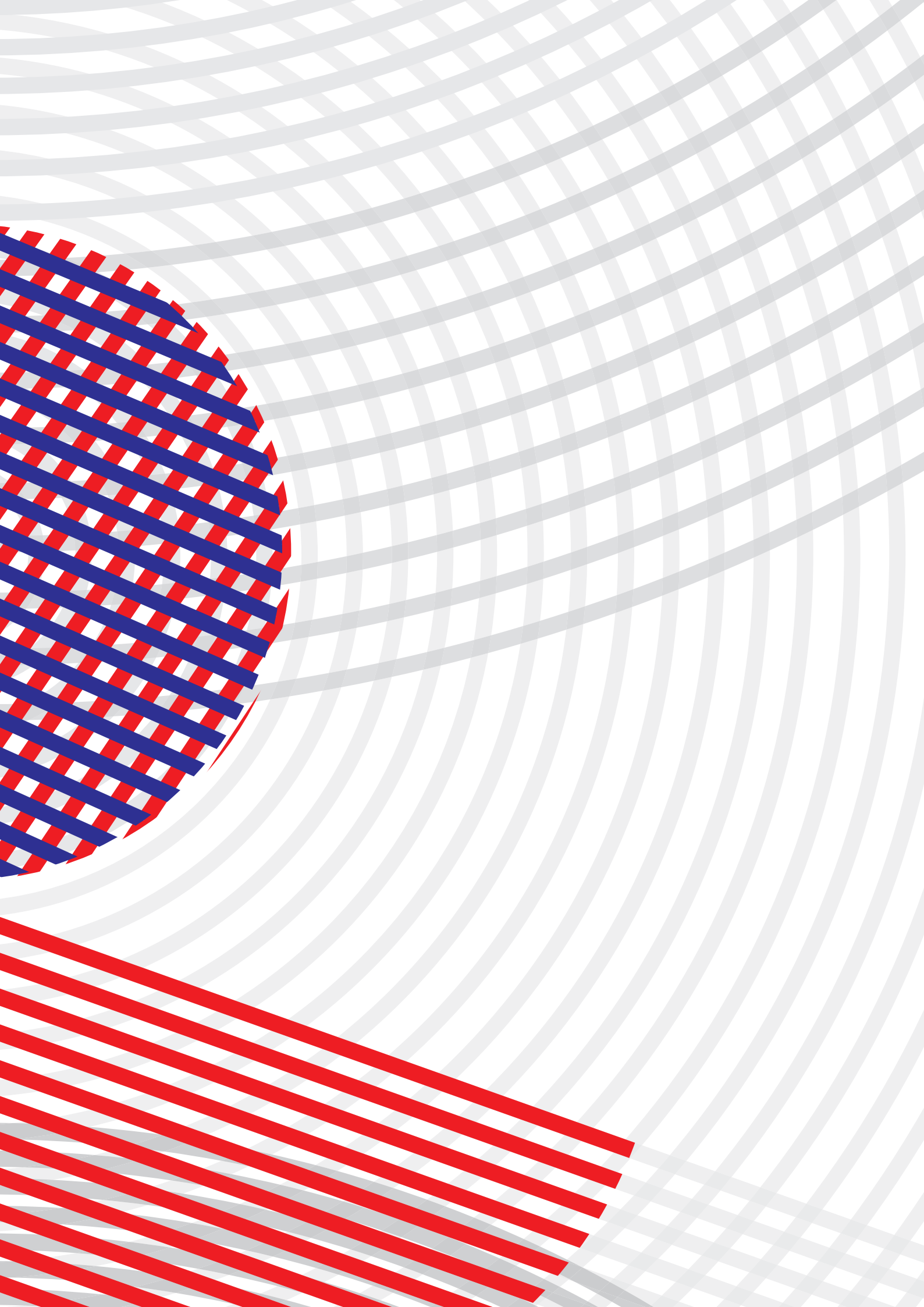
**Notes:** Multi-method studies collect and analyse multiple types of qualitative or quantitative data , mixed-methods studies collect and analyse both qualitative and quantitative data as quoted in Creswell's chapter in the 2nd edition of the Handbook of Mixed Methods Research.





# **Part 2**

**Improving the  
interprofessional collaboration  
between professionals involved  
in proactive care programs  
for older people**



# 5

## **The Methodological Development of an Interprofessional Educational Program to Provide Proactive Integrated Care for Elders**

5

*Development process of an IPCP program*

Smit LC, Dikken J, Van Wijk M, Pool IA, Schuurmans MJ, De Wit NJ and  
Bleijenberg N.

*Journal of Research in Interprofessional Practice and Education. 2020: 9(2),1-2.*

## ABSTRACT

**Background:** Interprofessional collaboration in practice (IPCP) between professionals from the medical and social domain within primary care is desirable; however, it is also challenging due to fragmented healthcare. Little is known about the development of IPCP in primary care to fit the implementation context. This article describes the methodological development and the final content of an IPCP program.

**Methods and findings:** The development process started with the identification of IPCP competencies in a literature review and a qualitative needs analysis with semi-structured interviews among eight elders and four health care professionals. The results were discussed during a first consultation with an expert team, which consisted of ten health care professionals. Consensus was reached on the themes role identity, communication, and shared vision development to form the basis of the program. A second consultation with the experts discussed the first version of the program. Then, consensus was reached on the final version of the program, which included a blended learning approach consisting of two face-to-face meetings, online learning, and on-the-job learning with a sixteen-hour time investment over a six-week period.

**Conclusions:** The IPCP program was developed based on educational strategies and evidence, and with the support and knowledge of practice experts to fit the implementation context.

## INTRODUCTION

Globally, the population is ageing. In the Netherlands, the population aged 65 years and older will double by 2040, of which two thirds will experience multimorbidity.<sup>1</sup> The impact of chronic conditions on care needs and the growing constraints on partners and family members increases the need for psychosocial care alongside medical care.<sup>2</sup> Often, the complex care needs of elders cannot be addressed by only one profession. The complex care needs of elders requires that different health and social care professionals be involved in the delivery of such care in interprofessional collaborative care practice (IPCP).

Interprofessional collaborative care practice in health care occurs when multiple health workers from different professional backgrounds provide comprehensive services by working with patients and their families, caregivers, and communities to deliver the highest quality of care.<sup>3</sup> To create an interprofessional collaborative person-centred practice (IPCPCP) in which a participatory, collaborative, and coordinated approach leads to shared decision-making, a collaborative practice that involves a partnership between a team of health and social care professionals and patients, clients, families, and communities is needed.<sup>3,4</sup> Interprofessional education (IPE) is a necessary prerequisite for a collaborative practice. The definition of interprofessional education developed by the Centre for the Advancement of Interprofessional Education (CAIPE) in the UK is now globally accepted, i.e. professionals learn with, from, and about each other to improve collaboration and the quality of care and services.<sup>5</sup> Whilst most IPE occurs in academic settings and acute and long-term care sectors, little is known about IPCP in the context of fragmented community care for older adults.<sup>6</sup>

A study by Oeseburg et al evaluated the feasibility of an IPE program in primary care but did not describe the development process, which limited replication.<sup>7,8</sup> During this program, tasks and responsibilities shifted from the general practitioner to the practice nurse, and the participants' attitude toward elderly care changed. Throughout the development of complex interventions such as IPCP programs, a consideration for the context of implementation is recommended.<sup>9-12</sup> A misalignment between the intervention and the implementation context often results in suboptimal treatment success.<sup>11</sup> This article describes the methodological development and final content version of an IPCP program for health professionals working with elders living in primary care community settings.



## METHODS

The IPCP program was developed by a team of five nurse educators and researchers with a background in nursing, geriatrics, and education. An organization offering educational training and guidance on collaboration in health care practices at the district level joined the development team and shared their experience and expertise. Furthermore, an interprofessional expert team of primary care professionals was consulted twice by the development team on the content of the IPCP program. The expert team consisted of eight health care professionals: one general practitioner (specialized in geriatric care), one district nurse (associate degree), one advanced nurse practitioner in general practice (master's degree), two practice nurses (bachelor's and master's degree), and three social workers (bachelor's degree). Each of the professionals had more than 10 years of experience working with an elderly population. Furthermore, we invited one representative elder (aged 70) to participate in the expert team to include the wishes and perspective of elders. The development of the IPCP program consisted of the following steps: 1) the identification of competencies for IPCP; 2) a needs analysis among health care professionals and elders; and 3) the design of the IPCP program and proposed evaluation (Figure 1).



Figure 1. Development phases of the IPCP program.

## Identifying competencies for IPCP

The development team searched in PubMed for relevant competencies regarding IPCP with the following search string: “interprofessional education” OR “interprofessional learning” AND competencies. The search was limited to studies published between January 2010 and June 2017. The results were discussed with the expert team as described in Design of the IPCP program below.

## Needs analysis

A needs analysis involving semi-structured interviews was conducted by the development team to investigate the (care) needs and perceptions of health care professionals and elders regarding the identified problem with respect to care delivery, as well as their preferences and capacities with regard to the IPCP program.

### *Needs analysis: participants and setting*

The development team provided a purposive sample of six Dutch health care professionals who were approached to participate during September–December 2016. One professional did not respond to the invitation and one was unable to attend the interview. In total, four professionals, of which three were female, signed up to participate: one practice nurse, one community district nurse, one nurse specialist, and one social worker. A purposive sample of eight Dutch community dwelling elders aged 60 years and older receiving home care was also approached to participate during the same period. All eight elders—six females and two males—signed up to participate. The average age of the elders was 79 years. All eight respondents received some form of home care, varying from specialist care such as wound care to physiotherapy.

### *Needs analysis: data collection*

Semi-structured interviews were conducted to investigate barriers, facilitators, and needs in delivering and receiving care in an elderly population. Each respondent was interviewed once. A topic list was used as a framework for formulating open questions. The topics for interviewing professionals included collaboration (with internal and external locations), communication between different professionals, knowledge level, and caseload. Each respondent was interviewed once. The topics for interviewing elders included communication, continuity, and social network.

The interviews were conducted by a health scientist with a nursing degree (MvW) and eight bachelor of nursing students. Interviews were held in patients’ homes (n = 8) or at professionals’ places of work (n = 4). The duration of the interviews ranged from 45 to 90 minutes. All interviews were audiotaped.

### ***Needs analysis: data analysis***

Data were analysed by two independent researchers using thematic analysis (MvW and two bachelor's students per interview) and were discussed with a third researcher (LS).<sup>13</sup> All interviews were transcribed verbatim and a member check was conducted. Through selective coding, the categories were refined and connections between the categories were integrated to identify barriers, facilitators, and needs in delivering and receiving care in an elderly population. The potential for bias in the needs analysis was diminished through the transcription of interviews and the use of researcher triangulation in all phases of the study.<sup>14</sup> To further enhance the credibility of the study, the process of data analysis and interpretation was systematically discussed in by development team.

### ***Needs analysis: ethical considerations***

Ethical considerations regarding the needs analysis were that all the respondents were informed about the purpose of the research by means of an information letter. All respondents participated on a voluntary basis and signed a physical consent form. All data were encoded and analysed anonymously. Permission for the study was granted by the Medical Ethical Committee of the University Medical Center Utrecht.

### **Design of the IPCP program**

The design of the IPCP program was based on two consultations with the expert team. The first consultation related to the competences of IPCP identified in the literature search and the barriers, facilitators, and needs in delivering and receiving care identified in the needs analysis. The purpose of this consultation was to define themes that could serve as a basis for the IPCP program. The themes identified in this consultation were expanded by the development team to define learning objectives, and subsequently functioned as the first version of the IPCP program. A second consultation with the expert team was then held to discuss this first version of the program, with the objective of creating a joint final version and a framework for evaluating the program. To ensure consultations were constructive, the development team briefly presented the results (needed for the specific purpose of the consultation). One member of the development team was a chairman and one member a secretary. During both consultations, the secretary created memos to describe observations and reflections on the discussions. The guideline for evidence-based practice educational interventions and teaching (GREET) was used to report the content of the IPCP program with the aim of enabling replication (Appendix A).<sup>15</sup>

## RESULTS

### Identifying competences of IPCP

The literature search identified 206 relevant studies. However, one study was most notable because the study defines a single set of interprofessional learning competency statements with relevance to all health professions.<sup>16</sup> The study reviewed and combined six national and international interprofessional competency frameworks, previously identified in a comprehensive report as “important and influential” by the Interprofessional Curriculum Renewal Consortium in 2013, followed by a process of mapping and grouping into common content areas.<sup>17</sup> The principle of interprofessional learning by disciplines working in interprofessional practice defined by O’Keefe et al<sup>16</sup> includes understanding, appreciation, and respect for individual discipline roles in health care. Interprofessional collaboration in practice places the interests of patients at the heart of the delivery of care. An important part of IPCP is recognition and the use of skills from other disciplines in providing care. This is supported by interactions that clarify perspectives and allow insights and teachings from other disciplines.<sup>16</sup> The principles were summarized in eight IPCP competences (Box 1). These competencies correspond to the competences defined by the Interprofessional Educational Collaborative (IPEC) in 2016, which states that the integrated enactment of knowledge, skills, values, and attitudes that enables successful collaboration across the professions and with patients is central to improving the health outcomes in specific care contexts. The IPEC outlines that families and communities should also be integrated.<sup>18</sup> However, the inclusion of families and communities was not the focus of this methodological development.

#### BOX 1. IPCP competences

1. *Clarify the interprofessional practice in which you work on patients, family and other disciplines.*
2. *Describe the work and tasks of other disciplines.*
3. *Express professional opinions, competent, confident and respectful, avoiding discipline specific language.*
4. *Plan the patient's goals and priorities with involvement in other disciplines.*
5. *Identify the possibilities of improving patient care by involving other disciplines.*
6. *Recognize and resolve disagreements arising from different disciplinary perspectives in relation to patient care.*
7. *Evaluate critical protocols and assignments in relation to interprofessional practice.*
8. *Provide timely, empathetic and instructive feedback to other disciplines and respond responsibly to your feedback.*

## **Needs analysis**

### ***Health care professionals***

Five themes emerged from the qualitative analysis: 1) no task coordination, 2) no cooperation, 3) communication problems, 4) knowledge level, and 5) high caseload.

### ***No task coordination***

In the context of task coordination, the four respondents indicated that they were not clear what each other's professional role was. They had difficulty locating each other and had no procedure for informing each other. The district nurse said: "What is sometimes difficult is to frame who has which tasks. There is often a[n] overlap in tasks. Who will do the task or who will continue?" The practice nurse indicated: "Making each other professional roles and tasks more clear for different disciplines during a course would be valuable. What do professionals contribute to each other and how can they continue to function efficiently and effectively?"

### ***No cooperation***

Respondents indicated that there was not enough consultation and consensus among professionals due to lack of time and money. They found it difficult to get in touch with each other, even when working in the same practice. They also identified issues when working with different files because information was not transferred. The practice nurse indicated: "Sitting together in a building does not mean that you are working together" and "Agreements in work were made often personal. With staff turnover many of the agreements disappeared as well." The practice nurse also said: "You must have confidence in the other caregivers. Have faith that quality is delivered and that agreements are met. Because the practice assistant's office and home care are located next to each other, there are short lines, easier contact, which certainly adds value."

### ***Communication problems***

Communication problems stemmed from poor task coordination and cooperation. This also indicated a lack of time and money as an impeding factor. The disciplines appear to be reluctant to address each other when stagnation occurs.

### ***Level of knowledge***

Both the practice assistant and the district nurse indicated that there was often a lack of knowledge among some professionals. Professionals with lower levels of education were less proactive than others. For example, new problems faced by home care patients were not signaled and communicated with the practice nurse.

The practice nurse indicated: “More nurses should enter the home care teams. Because the level of knowledge is currently too low. A higher knowledge level for the nurse assistants would also help, so that they can signal problems much sooner.”

### ***High caseload***

Three respondents indicated that they did not have enough time to complete their work. The number of patients receiving home care is growing exceptionally, but there is not enough staff available to handle this. The practice nurse said “I work fewer days, but the caseload has not decreased. Work stays on hold.”

### ***Elders***

Four themes emerged from the qualitative analysis: lack of communication, the need to sustain personal relationships, insufficient coordination, and the need to sustain social network.

### ***Lack of communication***

Of the respondents, two elders indicated that communication between disciplines and between professionals and patients was not optimal. One elder stated: “The mutual communication, sometimes I have to tell someone three times a week that I have had an accident.” Two respondents indicated that they could view the report via a tablet. The other six respondents said they had no idea how the reporting of care was being conducted. The youngest respondent could use a tablet and indicated that she could email her physiotherapist with questions: “I am very happy that I can send an email to a physiotherapist if I have any questions. The feeling of a short line makes me more certain.” For other elders, a lack of technology skills was a barrier to efficient communication and management. Furthermore, it was indicated that technology may make healthcare even more businesslike than it already sometimes is: “A good conversation is sometimes omitted due to the internet and all telephones.”

### ***Sustain personal relationships***

Technology may supplement health care, but should not replace personal contact. Respondents indicated a need for a personal relationship with care professionals. Elders communicated a desire to be seen as people and not as numbers. They need a listening ear, not a health care professional who always comes up with solutions immediately. They also expressed a need to trust the care professional. One respondent said: “I am happy that I can still live at home at the age of 93. Maybe professionals can give me a little more time when they come. I often hear this on daycare as well from other elders. That professionals sometimes leave quickly while

sometimes you just want to tell your story.” This suggest that professionals should manage their time in a way that allows them to stay for a cup of coffee and a chat after they complete their care tasks.

### ***Insufficient coordination***

Concerning the continuity of care, almost every respondent reported discomfort with having so many different professionals providing their care. “I would rather see the same faces often than always a new face. It doesn’t feel nice to keep telling my story over and over again.”

The elders also experienced insufficient care plans that lacked goals, and a lack of overview of their care processes. Furthermore, the care delivered was occasionally experienced as impersonal and businesslike. Some patients felt that the fact they had to perform care independently was overlooked. Most respondents would like to see a fixed group of care professionals who know their stories and needs with a common care plan.

### ***Sustain social network***

All respondents had a social network including their own children, neighbours, and friends of the church. However, even though all respondents reported a small social network, they did not indicate that this was a problem. All respondents indicated that they still feel relatively autonomous and can therefore maintain social network themselves. Having a social network gave the respondents a sense of security: “I have the feeling that people always think of me and that I can always call in case of an emergency.” This shows that a social network has a positive effect on patients’ well-being, but also offers social control.

## **Design of the IPCP program**

### ***Results of the first expert team consultation***

Of the four themes defined in the expert team consultation on needs analysis, it was decided that for three of the themes, the expert team could not make any significant short-term improvements (i.e. a joint IT platform for communication, reducing high caseload, sustaining personal relationships). A joint information and communication technology platform would allow all professionals, elders, and family member to read the patient’s file and report, thus reducing professional’s high caseload and sustaining the patient’s social network. However, it was decided that such a platform could not be effectuated by an IPCP program. Sustaining personal relationships despite the use of care technology was discussed but not resolved due to the fact that the IPCP program did not introduce new technology. All other themes such as no task coordination, no cooperation, communication

problems, discordant knowledge levels, and insufficient coordination reached consensus as improvable by an IPCP program. As a result, the competences were categorized into three main themes:

1. Role identity (which covers IPCP competences 1, 3, and 6)
2. Shared vision development (which covers competences 2, 4, 5, 6, and 7)
3. Communication (which covers competences 3, 6, and 8)<sup>15</sup>

The expert team's rationale was that these three themes capture all the elements considered improvable in the needs analysis. The first theme, role identity, implies the ability to work together. When working together, it is essential that professionals know their own role and each other's role.<sup>16,19,20</sup> Professionals need to know what others can contribute, that everyone's work is valued, what the boundaries of each discipline are, and where the disciplines align. Collaborative practice can be hindered if people have stereotypical preconceptions about each other's profession. Furthermore, professionals should respect each other's role, expertise, knowledge, and skills.<sup>21</sup>

The second theme, shared vision development, implies that care is provided from a common vision and should have an interprofessional approach.<sup>21</sup> It is important for professionals to formulate common objectives and to compile a care plan that focuses on the wishes of the patient and their family. The third theme, communication, is crucial for providing comprehensive proactive care for elders.<sup>19,20</sup> Professionals should be able to communicate effectively and respectfully with colleagues from other professions.<sup>19</sup> It is also necessary for professionals to adapt their professional language to communicate effectively with other members of the interprofessional team.<sup>16</sup> Based on the themes role identity, shared vision development, and communication, learning objectives were formulated by the development team (Box 2).

### ***Results from the second expert team consultation***

Blended learning was chosen by the expert team and development team as the IPCP program format. This format was chosen because it suited the inter-disciplinary and multi-location characteristics of the group. Blended learning is defined as when two or more learning or training methods are imperceptibly merged.<sup>22</sup> Blended learning appears to have a consistently positive effect, and is more effective than or at least as effective as non-blended instruction (e.g. in- class learning) for knowledge and skills acquisition in health professions.<sup>23</sup> The expert team stated that professionals face high caseloads these days, and that the educational approach should support the participants' and their commitment to the program, not hinder them. Blended



learning allows students to read materials within an online environment as often as necessary and at their own pace, which likely enhances learning performance and follow-up on agreements.<sup>24,25</sup> The blended learning in this study included an online learning environment, face-to-face meetings, and on-the-job-learning (explained in Section 3.4.).

### **BOX 2. Learning objectives IPCP program**

- *Can tell what his / her function is, what the boundaries of this function are and how he / she completes this function.*
- *Can tell what the other functions do in the area around the care / guidance of the client.*
- *Can tell which other professional in the community district you can ask a specific question.*
- *Makes active contact with colleagues and client.*
- *Can formulate a shared vision with the colleague professionals about how the client is involved in treatment and counseling.*
- *Asks a clear help question to a colleague professional from the community district about a mutual client.*
- *Is aware of the importance of discussing if the collaboration is not successful.*
- *Can make appointments with colleague professionals and identify who does what by the mutual client.*
- *At the right time, can use the right form of collaboration.*

The duration of the program, including the study hours, was identified by the expert team as “too much.” The expert team referred to professionals’ high caseloads, and suggested that the program should be applicable in practice. As a result, the online learning environment was limited to one study hour per week instead of three hours. Furthermore, the first face-to-face meeting was moved to the second week of the program instead of the first week. The expert team stated that more emphasis should be placed on the themes and the exchange of knowledge in the face-to-face meetings. The first week of the program only included one online assignment in which participants made a personal profile that each could access.

### **Final content of the IPCP program**

The IPCP program included sixteen study hours in a six-week period. The program consisted of a blended learning approach that alternated between online learning, face-to-face meetings, and on-the-job learning. Figure 2 illustrates the format and content of the program. For detailed information of the content

of the IPCP program, see Appendix A (based on GREET guidelines). The target group of professionals included primary care professionals such as general practitioners, (practice and community) nurses, social workers, physiotherapists, and pharmacists.

CONTENT IPCP PROGRAM			
Online learning environment	Face-to-face meeting	On-the-job learning Forum-online learning environment	Face-to-face meeting
Exploring electronic learning environment	Introduction	Shadow assignment: Observe another professional during their work in proactive elderly care	Discuss assignments
Getting acquainted with each other	Role clarification ▪ Pitch function ▪ Social Network Analysis	Online discussion casuality: Prioritize and vision formulation while discussing a recognizable IPCP case	Role play communication Discuss casuality
Job imaging assignment	Discuss casuality		Evaluation IPCP
Week 1	Week 2	Week 3	Week 4
Week 5	Week 6	▶	
1 hour	4 hour	7 hour time investment	4 hour

Figure 2. Overview of IPCP form and content.

### On-the-job learning and online learning

On-the-job learning involved shadowing, which is a learning activity wherein a professional closely follows (shadows) another professional over a period of time.<sup>26</sup> Shadowing provides insights into the role of the shadowed professional.<sup>27</sup> Following the shadowing period, the professional wrote a reflection, which was discussed in the second meeting. Between the meetings, online learning was used to enhance communication and teambuilding.<sup>23,28</sup>

The online learning environment was designed based on four important features.<sup>29</sup> The first feature, *customized training*, was imbedded by matching the learning content to the knowledge and needs of the professionals. This environment offered a place to communicate (ask questions, exchange experiences, make appointments, etc.) with each other, ideally forming a group that continues to engage long after the training day or period. The second feature, *engagement in learning*, proposes that learning can only take place when a participant is actively involved in the learning process, after the information is processed and then appropriately applied. Achieving engagement in learning was possible in the online environment by adding assignments such as a discussion board for the case discussions. Feedback from the teacher played an important role in achieving this engagement.<sup>29</sup> The third feature,

*scenario training*, offered extensive practice opportunities in a realistic way. Case studies were used as scenario training with the goal of developing a shared vision of a case. The final feature, *multimedia*, made information processing more effective. The online learning environment offered the possibility to add multimedia. The investigators added videos, texts, and illustrations to provide professionals with appropriate and useful information.

### ***Face-to-face meetings and assignments***

The first meeting focused on the theme *role identity*. Prior to the meeting, the participants were asked how they think other professionals perceive their profession, i.e. job image prejudices. These prejudices were discussed during the first meeting. Professionals then presented their own profession in order to clarify their role in the care of elders. For group discussion, and also for evaluation purposes, participants were asked to map the social network that they work with in the delivery of care for elders. One patient case discussion was introduced during the first meeting that addressed the theme *vision development*. A participant introduced an individual patient case in which IPCP was essential. Participants discussed the complexity of the case and proposed a first step in formulating a common vision on the care that the patient needs and who should coordinate the (delivery of) care. The 4-domain (4D) model—inspired by the International Classification of Functioning, Disability, and Health model, the biopsychosocial model, and the 4D framework—was used as a tool to inform the discussion.<sup>30-32</sup> The participants (and, in practice, also the patients) completed the 4D model, a holistic template that includes the physical, societal, spiritual, and social domains, which are a starting point for discussing a common vision for care of the patient. Case discussions using the 4D model took place in both the meetings and in the online learning. During the second meeting, the importance of collaboration was discussed, and the theme *communication* was addressed. Participants used the Situation Background Assessment and Recommendation (SBAR) communication tool to communicate effectively with each other in a structured way.<sup>33</sup> Participants practiced using the SBAR tool in pairs with a patient transfer case. Individual patient case discussions that addressed the theme *vision development* were also part of this second face-to-face meeting.

### ***Evaluation of the IPCP program***

The expert team stated that the content of the IPCP should not be lacking at the expense of research purposes. The development team was therefore discouraged from including validated (multiple) questionnaires to measure Level 1, 2, and 3 of the adapted framework of Kirkpatrick for interprofessional education.<sup>34</sup> Therefore, this study evaluated 1) the quality of the content of the program, using a participant

questionnaire, and 2) the impact of the program on the community's ability to collaborate, including non-participating health care professionals, using a social network analysis.

### **Questionnaire**

The quality of the content of the program was measured based on the results from a questionnaire (administrated at the end of the IPCP program) developed by the Expertise Centre for Education and Training located at the Utrecht Medical Centre (the Netherlands), which evaluates educational programs. This questionnaire was adapted to the context of IPCP. The questionnaire involved two concepts based on the adapted framework of Kirkpatrick for interprofessional education.<sup>34</sup> First, participants' satisfaction with the program was assessed by capturing their perceptions of the content, organization, teaching, materials, and online environment. Second, the applicability of the content of the IPCP was assessed by capturing participants' perceptions of interacting with fellow professionals and applying the knowledge and skills gained from the program. In total, the questionnaire involved 20 questions. Several measuring scales were used including 1-10 scales (4 questions; a higher score indicates a high appreciation), *yes-a little-no* scales (11 questions), and *insufficient-sufficient-more than sufficient-good-very good* scales (5 questions).

### **Social network analysis**

To elaborate on the third level of the adapted framework of Kirkpatrick for interprofessional education, the investigators focused on a method that enhanced the content of the program.<sup>35</sup> During the first meeting of the IPCP program and 5.5 months after the IPCP program, we posed the following social network question to assess interprofessional collaboration: "With which professionals of all primary health care workers in the community district do you collaborate regarding care for community living older people?" The purpose of this question was to gather important data about participating and non-participating professionals. These data points were used to generate anonymized whole-network data. Changes in IPCP were measured by generating the community collaboration networks of the three community districts. To compare the networks across community districts, first, network measures such as average degree of contacts, density, and E-I index were calculated. Second, the reciprocity of contacts was calculated as professionals who shared a mutual network connection. Third, the diversity of contacts was calculated as the extent to which contacts in the community district transcend the different backgrounds in disciplines. At last, the average of the value that each professional

placed on each network contact was calculated. The data was analysed and visualized with UCINET 6.6, a network analysis program used for descriptive and inferential network statistics.<sup>36</sup>

## DISCUSSION

The IPCP program was developed with qualified teachers, an educationalist, and practice and research professionals in order to make the best choices in the development process. The investigators believe that they succeeded in building an IPCP program that is based on the latest educational strategies, evidence, and the support and input of the expert team consultations to represent current practice and, subsequently, reaching a high degree of acceptability and feasibility in terms of implementation. The IPCP program can be seen as a complex intervention containing several interacting components.<sup>8</sup> Complex interventions are frequently criticized for being a black box; not knowing the contents of the black box makes it difficult to understand why an intervention succeeds and what elements work and for whom.<sup>8</sup> Several frameworks and articles indicate the importance of considering the implementation context—in our case, the current primary care practice—during the development phase of designing a complex intervention before moving on to the pilot or feasibility phase.<sup>9-12</sup> Optimizing the development of a complex intervention will enhance the intervention design, increase value, and minimize the risk of subjects being exposed to ineffective interventions. Misalignments between the intervention and the implementation context often results in suboptimal treatment success.<sup>11</sup>

The extent to which the current practice participated in the development process can be explained by the well-known participation ladder of Arnstein.<sup>37</sup> The development team included an organization that offered educational training and guidance on collaboration in health care practices. This organization not only shared its experience and expertise during the development process, but also delegated power.<sup>37</sup> The delegated power resulted in a high level of participation within the methodological development. The expert team was consulted twice, reducing the degree of participation and increasing the risk of tokenism.<sup>37</sup> Tokenism refers to the concept that, although the development team requested the involvement of the expert team, they may not take the discussions and advices seriously.<sup>38</sup> However, in this study, the final version of the IPCP program showed that the development team took all of the expert team's advice seriously and that without their participation, the investigators could not have fit the implementation context. The development team gave the expert team equal weight during the development of the IPCP program.

Although many different types of professionals from the medical and social domain were involved, within the expert team, the involvement of other professionals and care workers, such as household workers and (informal) care givers, must be acknowledged. The early identification of elders at risk could also be introduced by, for example, household workers or other professionals who deliver care to elders. Furthermore, it might be valuable to involve elders (and caregivers) in the delivery of the IPCP.<sup>4</sup>

In the final version of the IPCP, the blended learning design runs the risk of overloading the professionals with information, assignments, and on-the-job learning, which requires a significant time investment. Keeping in mind that the professionals are graduates working in practice, the necessary time investment and the content of the educational intervention should be balanced to reduce aversion and dropout rates.<sup>39</sup> Due to the involved expert team, well-informed decisions could be made to find the right balance in the blended design. Furthermore, the teacher-as-facilitator aspect also poses risks. First, a teacher should have the skills to facilitate and be sensitive to signals from the professionals.<sup>40</sup> If not, no optimal dialogue will occur, which influences interprofessional learning. Second, hierarchal patterns within each profession can start to emerge. For example, university graduates often have the floor while less educated professionals remain in the background. The latter issue certainly needs the teacher's attention to ensure proper group dynamics.

## CONCLUSION

This paper described the methodological development and final content of an IPCP program. The IPCP program was developed based on the latest educational strategies, evidence, and the support and input of expert team consultations to reach the highest level of agreement with the implementation context. The program consists of a blended learning approach that alternates online learning, face-to-face meetings, and on-the-job learning based around the themes of role identity, shared vision development, and communication.

## REFERENCES

1. Hilderink HBM, Verschuuren M. *Volksgezondheid Toekomst Verkenning 2018: Een gezond vooruitzicht*. Synthese. 2018. Available from: <https://www.rivm.nl/publicaties/volksgezondheid-toekomst-verkenning-2018-gezond-vooruitzicht-synthese>. Accessed Aug 11, 2019.
2. Morgan S, Pullon S, McKinlay E. Observation of interprofessional collaborative practice in primary care teams: An integrative literature review. *Int J Nurs Stud*. 2015;(52):1217–1230.
3. World Health Organization. *Framework for action on interprofessional education and collaborative practice*. Geneva: World Health Organization; 2010.
4. Bookey-Bassett S, Markle-Reid M, Mckey C, Akhtar-Danesh N. Understanding interprofessional collaboration in the context of chronic disease management for older adults living in communities: a concept analysis. *J Adv Nurs*. 2017;73(1): 71–84.
5. Centre for the Advancement of Interprofessional Education. *Definition*. 2016. Available from: <https://www.caipe.org/> Accessed March 25, 2020.
6. Ploeg J, Markle-Reid M, Fisher A, et al. An exploration of experts' perceptions on the use of interprofessional education to support collaborative practice in the care of community-living older adults. *J Interprof Care*. 2017;31(5):638–647.
7. Oeseburg B, Hilberts R, Luten TA, Van Etten AV, Slaets JP, Roodbol PF. Interprofessional education in primary care for the elderly: a pilot study. *BMC Med Educ*. 2013;13(1): 161.
8. Craig P, Dieppe P, Macintyre S, et al. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008;337:a1655.
9. Pinnock H, Barwick M, Carpenter CR, et al. Standards for reporting implementation studies (StaRI) statement. *BMJ*. 2017;356:i6795.
10. Smit LC, Schuurmans MJ, Blom JW, et al. Unravelling complex primary-care programs to maintain independent living in older people: a systematic overview. *J Clin Epidemiol*. 2018;96:110–119.
11. Bleijenberg N, De Man-Van Ginkel JM, Trappenburg JC, et al. Increasing value and reducing waste by optimizing the development of complex interventions: Enriching the development phase of the Medical Research Council (MRC) Framework. *Int J Nurs Stud*. 2018;79:86– 93.
12. Moore GF, Evans RE, Hawkins J, et al. From complex social interventions to interventions in complex social systems: future directions and unresolved questions for intervention development and evaluation. *Evaluation*. 2019;25(1):23–45.
13. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3:77–101.
14. Lincoln YS, Guba EG. *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications; 1985.
15. Phillips AC, Lewis LK, McEvoy MP, et al. Development and validation of the guideline for reporting evidence-based practice educational interventions and teaching (GREET). *BMC Medical Education*. 2016;16(1):237.

16. O’Keefe M, Henderson A, Chick R. Defining a set of common interprofessional learning competencies for health profession students. *Med Teach*. 2017;39(5):463–468.
17. Interprofessional Curriculum Renewal Consortium. *Curriculum renewal for interprofessional education in health*. Sydney: Centre for Research in Learning and Change, University of Technology; 2013.
18. Interprofessional Educational Collaborative. *Core competencies for interprofessional collaborate practice: 2016 update*. 2016. Available from: <https://hsc.unm.edu/ipe/resources/ipec-2016-core-competencies.pdf> Accessed March 25, 2020.
19. Suter E, Arndt J, Arthur N, Parboosingh J, Taylor E, Deutschlander S. Role understanding and effective communication as core competencies for collaborative practice. *J Interprof Care*. 2009;23(1):41–51.
20. Rogers GD, Thistlethwaite JE, Anderson ES, et al. International consensus statement on the assessment of interprofessional learning outcomes. *Med Teach*. 2017;39(4):347–359.
21. Van Royen P. Interprofessionele samenwerking, transmurale en interdisciplinaire zorg [Interprofessional collaboration, transmural and interdisciplinary care]. *Bijblijven*. 2009;25(3):31–36.
22. Bonk CJ, Graham CE. *The Handbook of Blended Learning: Global Perspectives, Local Designs*. San Francisco, CA: Pfeiffer; 2006.
23. Liu Q, Peng W, Zhang F, Hu R, Li Y, Yan W. The effectiveness of blended learning in health professions: systematic review and meta-analysis. *J Med Internet Res*. 2016;18(1), e2.
24. Wu J, Tennyson RD, Hsia T. A study of student satisfaction in a blended e-learning system environment. *Comput Educ*. 2010;55(1):155–164.
25. Makhdoom N, Khoshhal KI, Algaidi S, Heissam K, Zolaly MA. ‘Blended learning’ as an effective teaching and learning strategy in clinical medicine: a comparative cross-sectional university-based study. *J Taibah Univ Medical Sci*. 2013;8(1):12–17.
26. Czarniawska-Joerges B. *Shadowing: and Other Techniques for Doing Fieldwork in Modern Societies*. Copenhagen, DK: Copenhagen Business School Press; 2007.
27. McDonald S. Studying actions in context: a qualitative shadowing method for organizational research. *Qual Res*. 2005;5(4):455–473.
28. Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin PJ, Montori VM. Internet-based learning in the health professions, a meta-analysis. *JAMA*. 2008;300(10):1181–1196.
29. Clark RC, Mayer RE. *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. San Francisco, CA: Pfeiffer; 2008.
30. Rosenbaum P, Stewart D. The World Health Organization International Classification of Functioning, Disability, and Health: a model to guide clinical thinking, practice and research in the field of cerebral palsy. *Semin Pediatr Neurol*. 2004;11(1):5–10.
31. Engel GL. The biopsychosocial model and the education of health professionals. *Ann N Y Acad Sci*. 1978;310(1):169–181.
32. Coppenhagen R. *Creatieregie, visie en verbinding bij verandering*. Schiedam, NL: Scriptum; 2002.



## Chapter 5

33. Leonard M, Graham S, Bonacum D. The human factor: the critical importance of effective teamwork and communication in providing safe care. *BMJ Qual Saf.* 2004;13:85–90.
34. Reeves S, Barr H. Twelve steps to evaluating interprofessional education. *J Taibah Univ Medical Sci.* 2016;11(6):601–605.
35. Otte E, Rousseau R. Social network analysis: a powerful strategy, also for the information sciences. *J Inf Sci.* 2002;28(6):441–453.
36. Borgatti SP, Everett MG, Freeman LC. *UCINET for Windows: Software for Social Network Analysis.* Harvard, MA, Analytic Technologies;2002.
37. Arnstein SR. A ladder of citizen participation. *J Am Plann Assoc.* 1969;35(4):216–224.
38. Ocloo J, Matthews R. From tokenism to empowerment: progressing patient and public involvement in healthcare improvement. *BMJ Qual Saf.* 2016;25(8):626–632.
39. Tekane R, Pilcher LA, Potgieter M. Blended learning in a second year organic chemistry class: students' perceptions and preferences of the learning support. *Chem Educ Res and Pract.* 2020;21:24–36.
40. Howkins E, Bray J. *Preparing for Interprofessional Teaching.* Oxford, UK: Radcliffe Publishing; 2008.

APPENDIX A.

Reporting of the IPCP program based on the reporting guideline for evidence-based practice educational interventions and teaching (GREET).

BRIEF NAME			
<p><b>1. INTERVENTION: Provide a brief description of the educational intervention for all groups involved (e.g. control and comparators).</b></p> <p>An interprofessional collaboration in practice intervention (IPCP) was developed to enhance interprofessional collaboration in practice for health professionals working with elders living in primary care community settings. The IPCP program included sixteen study hours and covered six weeks and consisted of a blended learning design where online learning, face-to-face meetings and on-the job learning alternated. The program assignments and content were based on three themes e.g. role identity, shared vision development and communication. See figure 1 for the form and content of the IPCP program (for detailed information see paragraph “educational strategies”).</p>			
<b>CONTENT IPCP PROGRAM</b>			
Online learning environment	Face-to-face meeting	On-the-job learning Forum-online learning environment	Face-to-face meeting
Exploring electronic learning environment	Introduction	Shadow assignment: Observe another professional during their work in proactive elderly care	Discuss assignments
Getting acquainted with each other	Role clarification • Pitch function • Social Network Analysis	Online discussion casualty: Prioritize and vision formulation while discussing a recognizable IPCP case	Role play communication
Job imaging assignment	Discuss casualty		Discuss casualty Evaluation IPCP
Week 1	Week 2	Week 3	Week 4
1 hour	4 hour	7 hour time investment	
		Week 5	Week 6
			4 hour
WHY –this educational process			
<p><b>2. THEORY: Describe the educational theory (ies), concept or approach used in the intervention.</b></p> <p>IPCP in health-care occurs when multiple health workers from different professional backgrounds provide comprehensive services by working with patients, their families, caregivers and communities to deliver the highest quality of care across settings. To create an interprofessional collaborative person-centred practice (IPCPCP) in which a participatory, collaborative and coordinated approach leads to shared decision-making, a collaborative practice that involves a partnership between a team of health, and social care professionals and patients, clients, families, and communities is needed.</p>			

Figure 1. Form and content IPCP

Interprofessional education (IPE) is a necessary prerequisite for a collaborative practice. The definition of interprofessional education developed by the Centre for the Advancement of Interprofessional Education (CAIPE) in the UK, is now globally accepted, i.e. professions learn with, from and about each other, to improve collaboration, and the quality of care and services. The educational approach of the IPCP was based on eight competences that, disciplines working in interprofessional practice, should be able to achieve.

- 1) Clarify the interprofessional practice in which you work on patients, family and other disciplines.
- 2) Describe the work and tasks of other disciplines.
- 3) Express professional opinions, competent, confident and respectful, avoiding discipline specific language.
- 4) Plan the patient's goals and priorities with involvement in other disciplines.
- 5) Identify the possibilities of improving patient care by involving other disciplines.
- 6) Recognize and resolve disagreements arising from different disciplinary perspectives in relation to patient care.
- 7) Evaluate critical protocols and assignments in relation to interprofessional practice.
- 8) Provide timely, empathetic and instructive feedback to other disciplines and respond responsibly to your feedback

These competencies correspond to the competences defined by the Interprofessional Educational Collaborative (IPEC) in 2016, stated as the integrated enactment of knowledge, skills, values, and attitudes that enable working together successfully across the professions and with patients are central to improve health outcomes in specific care contexts. IPEC complements that also families and communities should be integrated. The inclusion of families and communities was however not yet the focus in this IPCP program.

The developing team discussed the competences of IPCP and the results of the needs analysis how they could form a basis for the program. Resulting in three main themes:

- 1) Role identity (competences 1,3,6),
- 2) Shared vision development (competences 2,4,5,6,7),
- 3) Good communication (competences 3,6,8).

### **3. LEARNING OBJECTIVES: Describe the learning objectives for all groups involved in the educational intervention.**

Based on the themes 'role identity', 'shared vision development' and 'communication', learning objectives were formulated for the program by the development team.

- 1) Can tell what his / her function is, what the boundaries of this function are and how he / she completes this function.
- 2) Can tell what the other functions do in the area around the care / guidance of the client.
- 3) Can tell which other professional in the community district you can ask a specific question.
- 4) Makes active contact with colleagues and client.

- 5) Can formulate a common vision with the colleague professionals about how the client is involved in treatment and counseling.
- 6) Asks a clear help question to a colleague professional from the community district about a common client.
- 7) Is aware of the importance of discussing if the collaboration is not successful.
- 8) Can make appointments with colleague professionals and identify who does what the common client is doing.
- 9) At the right time, can use the right form of collaboration.

**4. EBP CONTENT: List the foundation steps of EBP (ask, acquire, appraise, apply, assess) included in the educational intervention.**

The study of Oeseburg et al. (2013) evaluated the feasibility of an IPE program in primary care but did not described the development process. Throughout the development of complex interventions such as IPCP programs is the consideration of the implementation context recommended. Because, a misfit between the intervention and the implementation context often results in suboptimal treatment success. Therefore, this paper describes the methodological development and final version of an IPCP program for health professionals working with elders living in primary care community settings.

The IPCP program was developed by a team consisting of five nurse educators and researchers with a background in nursing, geriatrics, and education. An organization offering educational training and guidance on collaboration in health care practices at district level, joined the development team and shared their experience and expertise. Furthermore, an expert team of primary care professionals was consulted twice by the development team on the content of the IPCP program. The expert team consisted of eight health care professionals; one general practitioner (specialized in geriatric care); two district nurse (associate and master degree), two practice nurses (bachelor and master degree), three social workers (bachelor degree). All professionals had more than 10 years of experience working with an elder population. Furthermore, we included one representative elder (age of 70) of an organization for elders in the expert team to give insight in the perspective of elders. The steps followed in the development of the IPCP program were as follows: 1) the identification of competencies for IPCP; 2) a needs analysis among healthcare professionals and elders; and 3) the design of the IPCP program and proposed evaluation.

The development process started with the identification of IPCP competences in literature and a qualitative needs analysis with semi-structured interviews among eight elders and four health care professionals. The results were discussed during a first consultation with an expert team which consisted of ten health care professionals. Consensus was reached on the themes “role identity”, “communication” and “shared vision development” to form the basis of the IPCP program. A second consultation with the experts discussed the first version of the program. Then consensus was reached on the final version of the program which included a blended learning approach consisted of face-to-face meetings, online learning, and on-the-job learning with a sixteen hours’ time investment in six week time.

The evaluation of the IPCP program involved a questionnaire (based on the adapted framework of Kirkpatrick for interprofessional education) measuring 1) the satisfaction of participants regarding the content, organization, teaching, materials, and online environment of the program, and 2) the applicability of the content of the IPCP in practice. In total, the questionnaire involved 20 questions. In addition, change in IPCP was measured by generating community's collaboration networks of the three participating community districts. During the first face-to-face meeting and 5,5 months after the program, we posed the following social network question to assess interprofessional collaboration: "*with which professionals of all primary health care workers in the community district do you collaborate regarding care for community living older people?*" Data was collected among participating and non-participating professionals. To compare the networks across community districts, first, network measures such as *average degree of contacts, density, and E-I index* were calculated. Second, the *reciprocity* of contacts was calculated as professionals who shared a mutual network connection. Third, the *diversity* of contacts was calculated as the extent to which contacts in the community district transcend the different backgrounds in disciplines. At last, for each professional, the average of the value that s/he placed on each network contact was calculated. The data was analyzed and visualized with UCINET 6.6, a network analysis program used for descriptive and inferential network statistics .

## WHAT

### **5. MATERIALS: Describe the specific educational materials used in the educational intervention. Include materials provided to the learners and those used in the training of educational intervention providers.**

- The "Situation Background Assessment and Recommendation" (SBAR) communication tool was used to communicate effectively with each other in a structured way
- The 4 D model used for case discussion is available at <https://www.omuutrecht.nl/>

### **6. EDUCATIONAL STRATEGIES: Describe the teaching/learning strategies (e.g. tutorials, lecturers, online modules) used in the educational intervention.**

#### ***Design IPCP program***

The IPCP program included sixteen study hours and covered six weeks, where face-to-face meetings will be alternated with online learning and on-the-job learning (e.g. blended learning). Blended learning was chosen by the expert team and development team to be the form of the IPCP program for its fit with the characteristics of the group having different disciplines from more locations working together in the same area. Blended learning is defined as learning from which two or more learning or training methods imperceptibly merge into each other. Blended learning appears to have a consistently positive effect, and is more effective than or at least as effective as non-blended instruction (e.g. in class learning) for knowledge and skills acquisition in health professions. The expert team stated that professionals facing a high case load these days and that the educational approach should support the commitment of participants to the program and should not hinder them. Blended learning allows students to read materials within an online environment as often as necessary

and at their own pace, which likely enhances learning performance and follow-up on agreements.

### ***On-the-job learning***

On-the-job learning involved shadowing which is a learning activity wherein a professional closely follows (shadows) another professional over a period of time. Shadowing provides insights into the role of a shadowed professional. Following the shadowing, a professional will write a reflection, which will be discussed in the second meeting.

Between the meetings, online learning was used to enhance communication and teambuilding.

### ***Online learning environment***

The design of the online learning environment was based on four important features. The first feature, *customized training*, was imbedded by matching the learning content to the knowledge and needs of the professionals. Online learning offers the possibility for customized content and self-guidance by the professional (moment and time investment of learning, choice of content, order, tempo). Furthermore, this environment offers a place to communicate (ask questions, exchange experiences, make appointments etc.) with each other, ideally forming a group that lasts longer than the training day or period. The second feature, *engagement in learning* proposes that learning can only take place when a professional is actively involved in the learning process, that the information is processed and then appropriately applied. Achieving engagement in learning is possible in an online environment by adding assignments such as a discussion board for case discussions. Feedback from the teacher played an important role in achievement of this active engagement. The third feature, *scenario training*, offers extensive practice opportunities in a realistic way. In this IPCP program case studies were used as scenario training with the goal of developing a shared vision of a case. The final feature, *multimedia* can make information processing more effective. An online learning environment offers the possibility to add multimedia. In this IPCP program videos, texts and illustrations were used to provide professionals with appropriate useful information.

### ***Face-to-face meetings***

The first meeting focuses on the theme “*role identity*”. Prior to the meeting, the professionals were asked how they think other professionals perceive their profession (e.g. job image prejudices). These “job image prejudices” was discussed during the first meeting. Professionals then present his/her own profession in order to clarify her/his role in the care of elders. For group discussion, and also for evaluation purposes, professionals were asked to map the social network with whom they work with in the delivery of care for elders. One patient case discussion was introduced during the first meeting that addressed the theme, “vision development”. A professional introduced an individual patient case in which IPCP was essential. Professionals discussed the complexity of the case and propose a first step in formulating a common vision on the care that the patient need and who should coordinate the (delivery of) care. The 4 domain (4D) model, inspired by the International Classification of Functioning, Disability and Health model, the biopsychosocial model and the 4D framework was used as tool to inform the discussion. The professionals (and in practice also the patient) completed the 4D model, a holistic template which includes the physical, societal, spiritual and social domains which are a starting point for discussing a common vision for care of the

patient. Case discussions using the 4D model took place in both the meetings and in the online learning. During the second meeting, the importance of collaboration was discussed, and the theme “communication” addressed. The “Situation Background Assessment and Recommendation” (SBAR) communication tool was used to communicate effectively with each other in a structured way. The SBAR was practiced in pairs on the case of a patient transfer. Individual patient case discussions that address the theme “vision development” was also part of this second face-to-face meeting.

**Teachers role**

The teacher had a role as an e-moderator in the online learning environment during the entire IPCP program. As e-moderator, the teacher actively contributes, to the activities on the online forum with the aim to focus and deepen the discussion and answering questions of the participating professionals. Because the participating professionals determined the direction of the IPCP program, specific skills from the teachers were required. The teachers should not lead the IPCP program but should act as a facilitator and stimulate professionals to connect with each other in dialogue. The role of facilitator is also important in the online and face-to-face case discussions of the IPCP program. The facilitator related, among other things, to suspending judgments, making differences fruitful, removing irritations and disturbances and strengthening joint dialogue.

**7. INCENTIVES: Describe any incentives or reimbursements provided to the learners**

None

**WHO PROVIDED**

**8. INSTRUCTORS: For each instructor(s) involved in the educational intervention describe their professional discipline, teaching experience/expertise. Include any specific training related to the educational intervention provided for the instructor(s).**

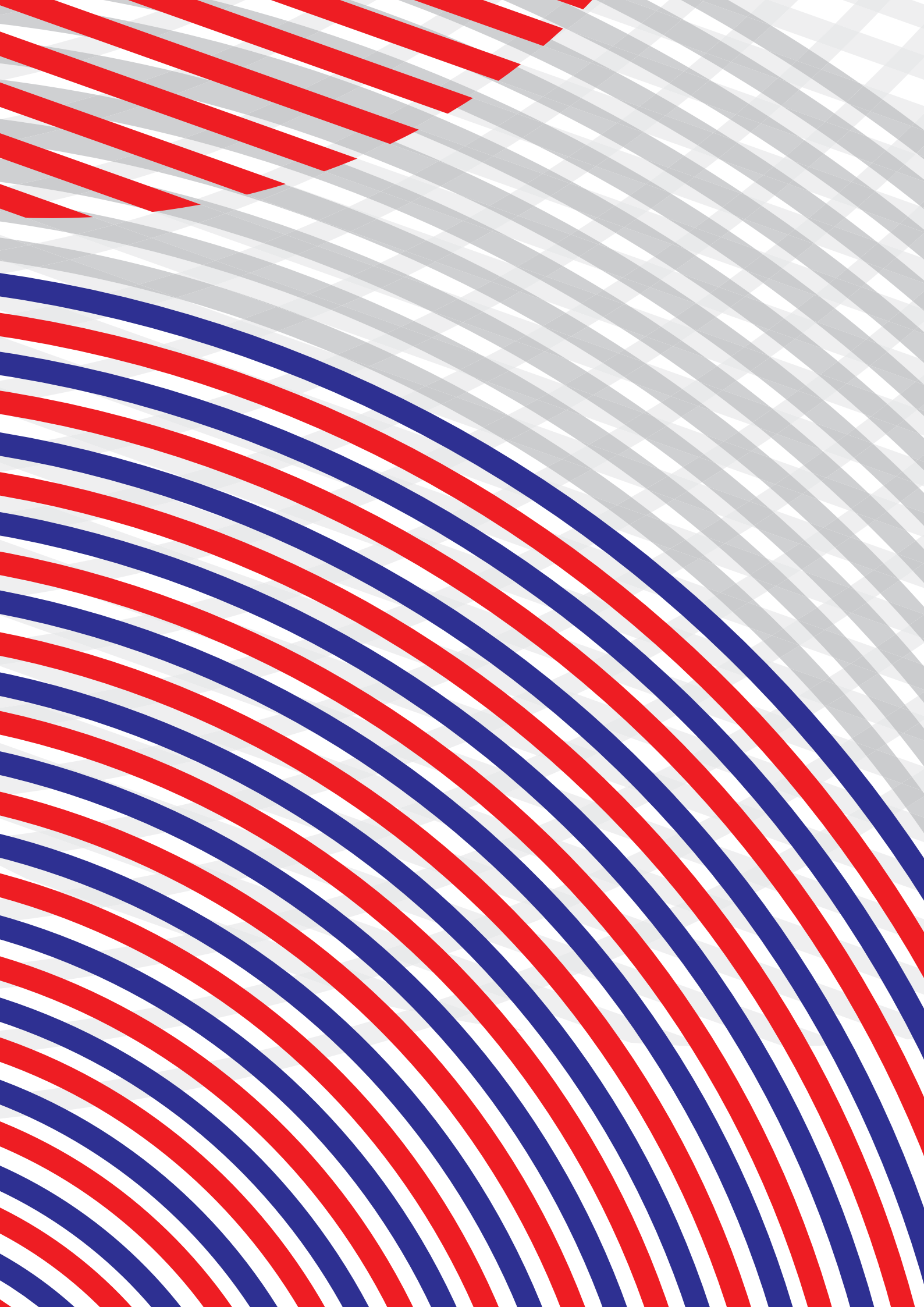
Two teachers and two experienced co-teachers from the clinical practice were involved in the delivery of the IPCP program. One teacher is a lecturer at bachelor of nursing, the other teacher is advisor and coach of the organization that took part in the development team. Both co-teachers worked as a registered professional in a district making discussion subjects easily recognized. Based on their expertise, questions were asked in the discussions, which made it possible to deepen and take essential steps to uncover problems surrounding interprofessional collaboration. In the face-to-face meetings, the teacher and a co-teacher worked together as a duo. As a result, they were complementary to each other and a large amount of expertise was available. The teachers had considerable experience with training and knew the district setting well to match the needs of the group and also to keep an eye on the interprofessional character to learn with, from and about each other. The teacher was responsible for the content of the program, creating interim discussions and for monitoring the duration

<b>HOW</b>
<p><b>9. DELIVERY: Describe the modes of delivery (e.g. face-to-face, internet or independent study package) of the educational intervention. Include whether the intervention was provided individually or in a group and the ratio of learners to instructors.</b></p> <p>Face-to-face meetings were alternated with online learning and on-the-job learning. The program was provided in three groups. Per group, 7-8 participants were included from three community districts. Each group had one instructor and one co-instructor (see for more details item 8). The online learning was e-moderated by one teacher and each group had his own online learning environment.</p>
<b>WHERE</b>
<p><b>10. ENVIRONMENT: Describe the relevant physical learning spaces (e.g. conference, university lecture theatre, hospital ward, community) where the teaching/learning occurred.</b></p> <p>The learning spaces where the IPCP took place were in the community districts. Specific the district in which the participants (per group) was working. Furthermore, a meeting room with smartboard was arranged to achieve an optimal face-to-face meeting with the participants.</p>
<b>WHEN and HOW MUCH</b>
<p><b>11. SCHEDULE: Describe the scheduling of the educational intervention including the number of sessions, their frequency, timing and duration.</b></p> <p>The program included sixteen study hours and covered six week. Two face-to-face meetings were alternated with online learning and on-the-job learning (see Figure 1).</p> <p><b>12. Described the amount of time learners spent in face to face contact with instructors and any designated time spent in self-directed learning activities.</b></p> <p>The participants spent 4 hours per face to face meeting with teachers and 8 hours with the online learning activities and on the job-learning (see Figure 1).</p>
<b>PLANNED CHANGES</b>
<p><b>13. Did the educational intervention require specific adaptation for the learners? If yes, please describe the adaptations made for the learner(s) or group(s).</b></p> <p>The IPCP program did not required specific adaptations for the participants. The teacher's manual offered a defined program with a time schedule in which the various parts of the program were described. However, the group and the teachers were free to match the program to their own needs. In case of any changes to the program, the teacher focussed on the interprofessional characteristic of the program.</p>



<b>UNPLANNED CHANGES</b>
<p><b>14. Was the educational intervention modified during the course of the study? If yes, describe the changes (what, why, when and how).</b></p> <p>The IPCP program is not yet modified over time.</p>
<b>HOW WELL</b>
<p><b>15. ATTENDANCE: Describe the learner attendance, including how this was assessed and by whom. Describe any strategies that were used facilitate attendance.</b></p> <p>Accreditation credits were obtained when professionals were present at both face to face meetings. Due to the small groups (7-8 participants) the instructors registered if a participant did not attended the meeting.</p>
<p><b>16. Describe any processes used to determine whether the materials (item 5) and the educational strategies (item 6) used in the educational intervention were delivered as originally planned.</b></p> <p>No process was used to determine whether the materials and the educational strategies used in the program were delivered as originally planned. However, the two teachers of the program were also involved during the development process. Therefore, they knew if materials and educational strategies were not delivered as originally planned.</p>
<p><b>17. Describe the extent to which the number of sessions, their frequency, timing and duration for the educational intervention were delivered as scheduled (item 11).</b></p> <p>The number of sessions, frequency, timing and duration for the educational intervention were all delivered as scheduled in figure 1.</p>





# 6

## **Implementation of an interprofessional collaboration in practice program: a feasibility study using social network analysis**

6

Smit LC, Dikken J, Moolenaar NM, Schuurmans MJ, De Wit NJ and Bleijenberg N.

*Pilot and Feasibility Studies. 2021: 7(1).*

## ABSTRACT

**Background:** Due to multimorbidity and geriatric problems, older people often require both psychosocial and medical care. Collaboration between medical and social professionals is a prerequisite to deliver high quality care for community-living older people. Effective, safe, and person-centred care relies on skilled interprofessional collaboration and practice. Little is known about interprofessional education to increase interprofessional collaboration in practice (IPCP) in the context of community care for older people. This study examines the feasibility of the implementation of an IPCP program in three community districts and determine its potential to increase interprofessional collaboration between primary healthcare professionals caring for older people.

**Methods:** A feasibility study was conducted to determine the acceptability and feasibility of data collection and analysis regarding interprofessional collaboration in network development. A questionnaire was used to measure the learning experience, and the acquisition of knowledge and skills regarding the program. Network development was assessed by distributing a social network survey among professionals attending the program as well as professionals not attending the program at baseline and 5.5 months after. Network development was determined by calculating the number, reciprocity, value, and diversity of contacts between professionals using social network analysis.

**Results:** The IPCP program was found to be instructive and the knowledge and skills gained were applicable in practice. Social network analysis was feasible to conduct and revealed a spill-over effect regarding network development. Program participants, as well as non-program participants, had larger, more reciprocal, and more diverse interprofessional networks than they did before the program.

**Conclusions:** This study showed the feasibility of implementing an IPCP program in terms of acceptability, feasibility of data collection and social network analysis to measure network development, and indicated potential to increase interprofessional collaboration between primary healthcare professionals. Both program participants and non-program participants developed a larger, more collaborative, and diverse interprofessional network.

## INTRODUCTION

With rapid population ageing, the provision of care to older people with complex health issues resulting from multimorbidity and geriatric problems is a major challenge.<sup>1</sup> In the Netherlands, two thirds of people aged 65 years and older are experiencing multimorbidity and geriatric problems. It is estimated that by 2050, 33.2% of the population will be aged 60 years and older.<sup>2</sup> Currently, 94% of older people in The Netherlands live at home, and their complex conditions need medical- and social- care solutions. For these solutions, interprofessional collaboration in practice (IPCP) between healthcare professionals is essential.<sup>3,4</sup>

Interprofessional collaboration has been defined as follows: *an evolving interpersonal process, involving a diverse team of healthcare and other community providers who interdependently engage in frequent communication and shared decision making, for the purposes of providing optimal health and social care services to community living older adults and their families.*<sup>5</sup> IPCP in health care occurs when multiple health workers from different professional backgrounds provide comprehensive services by working with patients, their families, caregivers and communities to deliver the highest quality of care across settings.<sup>1</sup> Community care, however, is often provided by a heterogeneous workforce consisting of professionals by different levels of education working in different organizational structures that may hamper the ability to collaborate effectively.<sup>6,7</sup>

Interprofessional education (IPE) can support healthcare teams by utilizing the individual skills of their members, sharing case management, providing better health services to patients and the community, and improving patient outcomes.<sup>1,8,9</sup> IPE occurs when two or more professionals learn with, from, and about each other to improve collaboration and quality care.<sup>10</sup> Most IPE focuses on academic settings, and acute, and long-term care sectors.<sup>11</sup> Little is known about IPE to enhance interprofessional collaboration in practice for community-living older people.<sup>6,12</sup> A pilot IPE program for general practitioners (GPs) and practice nurses from different community districts evaluated the effect of the IPE program for these professionals and reported that an IPE for professionals with different educational backgrounds (GPs and practice nurses) is feasible and adds value to the redefining of tasks and responsibilities among GPs and practice nurses.<sup>13</sup> However, studies examine the implementation of an IPCP program for primary care healthcare professionals from the medical and social domains are lacking. Therefore, a feasibility study was initiated to examine the implementation of an IPCP program<sup>14</sup> for healthcare professionals from the medical and social domains to enhance interprofessional collaboration. The aim of this study is to examine the feasibility of

the implementation of an IPCP program in three community districts to determine its potential to increase interprofessional collaboration between primary healthcare professionals caring for older people. The feasibility objectives were as follows: 1) to determine the acceptability of the IPCP program, 2) to determine whether data can be collected during the implementation of an IPCP program to construct networks in a meaningful way, and 3) to examine the possibility of measuring network development in terms of the number, reciprocity, value, and diversity of contacts between healthcare professionals in three community districts.

## METHODS

### Study design

We performed a pre-post study to examine the feasibility of implementing a previously developed IPCP program in three community districts. Figure 1 provides an overview of the study design and elements of the IPCP program.

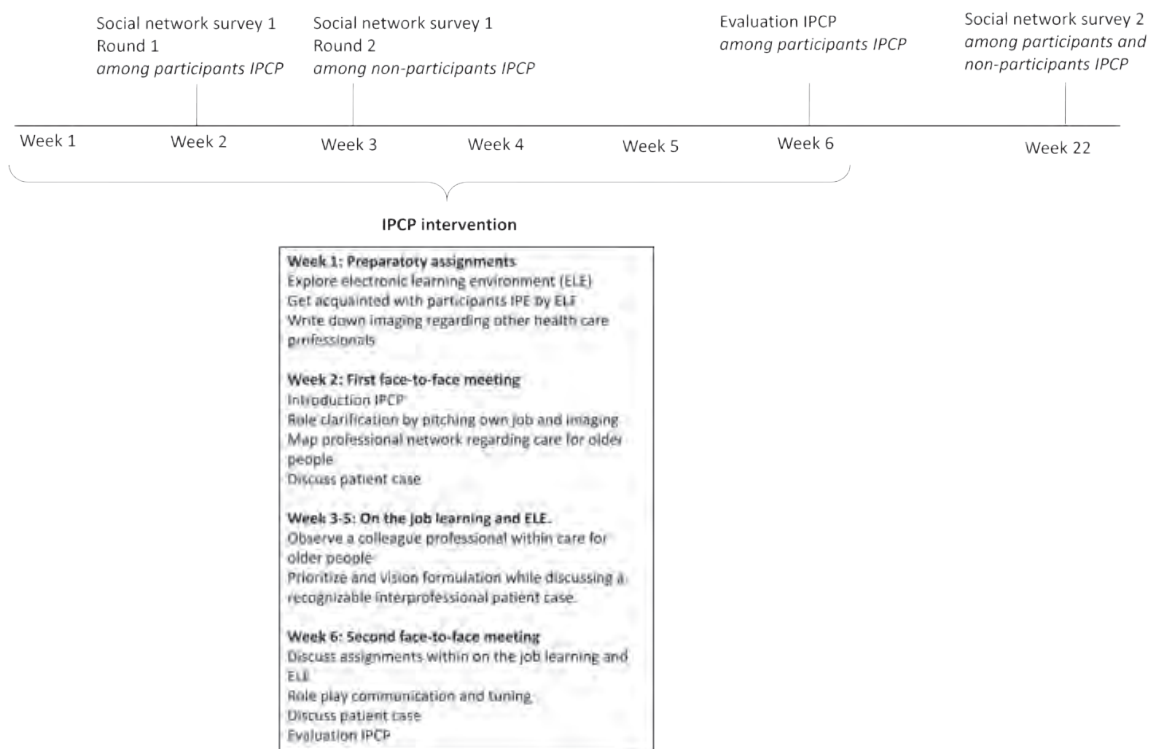


Figure 1. Study design and overview of IPCP program

## Participants and setting

Participants who were attending the IPCP program (“program participants”) were primary healthcare professionals delivering care to community-living older people in three community districts in the city of Utrecht (350.000 inhabitants), the Netherlands. Participants included GPs, practice nurses, district nurses, social workers, physiotherapists and pharmacists. In addition, “non-program participants” were included. Non-program participants were professionals who did not participate in the IPCP program but only participated with consent in the social network data collection.

## IPCP program

The IPCP program was developed to enhance interprofessional collaboration among primary healthcare providers and was co-created by professionals from clinical practice, education, and research. The developmental process of the IPCP program has been described elsewhere.<sup>14</sup> A development team discussed the competencies of interprofessional collaboration,<sup>15</sup> resulting in three main themes as the basis for the IPCP program, namely, role identity, shared vision, and communication. Based on these themes, learning objectives and activities were developed. The IPCP program included sixteen study hours and covered six weeks, and consisted of face-to-face meetings, online learning, and on-the-job learning (see Figure 1). This blended learning approach was chosen to fit the diverse target group and for its positive effect on knowledge acquisition among health professionals.<sup>16</sup> A partner in developing the IPCP program, (as described elsewhere)<sup>15</sup>, which is also the organization that offers the educational training and guidance on collaboration in healthcare practices in the community, acted as independent coordinator in recruiting participants. Information leaflets were provided by the organization to the medical and social healthcare professionals as well as the regional coordinators. Professionals in the IPCP program participated voluntarily and free of costs because of the nature of the IPCP program as a feasibility study.

## Feasibility outcomes

The acceptability of the IPCP program was defined as 1) the views on the learning experience and its interprofessional nature, and 2) the acquisition of knowledge and skills linked to interprofessional collaboration indicated by the program participants.<sup>17</sup>

The feasibility of data collection and analysis was determined by collecting and measuring network development regarding the interprofessional collaboration between professionals working in the same district. To compare the community’s



collaboration networks, we assessed network development by the number of contacts with other professionals, the extent to which contacts are reciprocal, the diversity of contacts, and the perceived value of contacts.

### Data collection and measurement

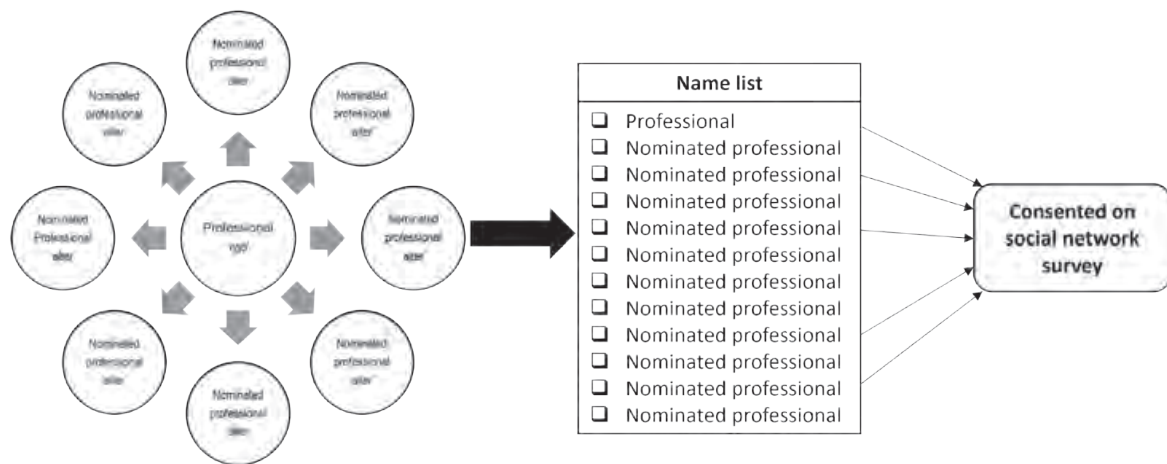
The acceptability of the IPCP program was, after delivery, evaluated among 22 program participants using a self-reported questionnaire. The questionnaire, originally developed by the Expertise Centre for Education and Training located at the Utrecht Medical Centre (The Netherlands), was adapted to the context of IPCP and included two concepts based on the adapted framework of Kirkpatrick for interprofessional education.<sup>17</sup> First, participants' satisfaction with the program was assessed by asking about perceptions of the content, organization, teaching, materials, and online environment of the IPCP program. Second, the applicability of the IPCP content was evaluated by asking about perceptions in acting towards fellow professionals and in applying knowledge and skills gained from the program. In total, the questionnaire involved 20 questions in which several measurement scales were used including 1-10 scales (4 questions, with a higher score indicating a higher appreciation), yes–a little–no scales (11 questions), and insufficient, sufficient, more-than-sufficient, good, very-good scales (5 questions).

Interprofessional collaboration was measured among program participants (N=22) and non-program participants (N=33; N<sub>total</sub>=55) using a social network survey. The IPCP program was delivered to a maximum of ten professionals in each district. The nature of the IPCP program was to enhance interprofessional collaboration in which we expect a spill-over effect of the IPCP program. To capture this spill-over effect, non-program participants were also included. A social network survey was administered at two time points (see Figure 1). At both time points, we posed the following network question: “*out of all the primary healthcare professionals in the community, with whom do you collaborate regarding care for community-living older people?*”<sup>18</sup> At time point 1, data were collected in two rounds.

#### **Round 1 – Collecting data from IPCP program participants (ring 1)**

The professionals who participated in the IPCP program (called ‘the first ring’ of network members) were asked to provide a list of all primary healthcare professionals with whom they collaborate with about care for community-living older people.<sup>18</sup> In addition, we asked the program participants to indicate the value of these contacts on a scale of 1-10. Using these data, we visualized ego-networks for each participant (the so-called ‘ego’) and his/her contacts (the so-called ‘alters’).

These contacts formed ‘the second ring’ of network members surrounding each ego.<sup>19,20</sup> Figure 2 provides a diagrammatic representation of the network theory and data collection.



**Figure 2. Diagrammatic representation of the network theory and data collection.**

*Notes:* Nominated professionals received an email with the social network survey; returning the survey was considered to indicate consent to participate in the study.

### **Round 2 – Collecting data from the program participants’ contacts in the district (ring 2)**

Using the data collected in the first round, a list of names including all program participants (egos) and their nominations (alters) was created, resulting in a single, comprehensive list of potential health-care professionals who may collaborate with each other in each community district. Subsequently, all professionals from this list were invited to complete, and thereby gave their consent for, the survey (see Figure 2). We asked the participants to indicate with whom they collaborated in regard to care for community-living older people and how they value each of their contacts on a scale (1-10).

At the second time point, we again used this comprehensive list of names to delineate the community’s collaboration networks.

In each community district between 27% and 40% of all nominated healthcare professionals responded and consented to the social network survey during round 2 of the data collection. The response rate also indicates the unit non-response, which is defined as completely missing for healthcare professional for whom all outgoing contacts of the professional are missing but not the incoming contacts. This is because professionals who did respond also nominated the non-responding

professionals as professionals with whom they work.<sup>21</sup> The collected data, therefore, were divided into three data categories: 1) program participants, 2) non-program participants and 3) non-consented professionals, further described as rings 1, 2 and 3.

### ***Network development***

#### *Number of contacts*

The number of contacts was calculated for each professional as the number of professionals with whom the participant indicated as collaborating with regarding care for older people (*out-degree*).<sup>19</sup> A social network diagram was used to visualize the number of contacts between professionals. The professionals were visualized as colored squares of which the color indicates the ring 1, 2 or 3, in which the professionals were categorized. To compare the networks across community districts, we also calculated the network measures *average degree of contacts*, *density*, and *E-I index*.<sup>19</sup> The *average degree of contacts* was calculated as the average out-degree for each community district. The network's *density* was calculated as the proportion of existing relationships out of the maximum number of relationships possible in the network. The denser the network, the more professionals collaborate with one another. The value of density varied between 0 (*no relations in the network*) and 1 (*all actors are connected to each other*). Finally, the *E-I index* was calculated for each network to determine whether ring 1 and ring 2 differed in their choice of alters. For instance, did ring 1 mainly increase collaboration with other ring 1 participants, or did they also increase collaboration with ring 2 members? And did ring 2 members also increase interprofessional collaboration, even though they did not participate directly in the IPCP program? The *E-I index* ranges from -1 (*all contacts are internal to the group*) to +1 (*all contacts are external to the group*).

#### *Reciprocity of contacts*

Reciprocity of contacts was calculated as the ratio of the number of pairs who shared a reciprocal network connection, (i.e., they both chose the other to collaborate with) relative to the number of pairs within any given contact. A high level of reciprocity reflects a high level of reciprocal collaboration between professionals in a district.<sup>19</sup> Reciprocal contacts of the professionals were visualized in a social network diagram displaying reciprocal and one-sided contacts between professionals for each district.

#### *Diversity of contacts*

Diversity of contacts was calculated as the extent to which contacts in the community district transcend the different backgrounds in disciplines (see box 1).<sup>18,19</sup> The score for diversity in relationships can vary between 0 and 1. A high score indicates that the healthcare professional collaborates with healthcare professionals

from a wide variety of disciplines (heterogeneity) while a low score indicates that the healthcare professional mainly chooses to collaborate with others from the same discipline (homogeneity).

### Box 1. Definition and formula for diversity of contacts

Heterogeneity indicates, per healthcare professional,  $i$ , the degree of the number of relationships outside their own discipline in relation to the number of all possible different disciplines with which they are in contact. The number of times healthcare professional,  $i$ , has been chosen by the other healthcare professionals is considered (indegree), because this parameter has a higher reliability with reality than the relationships indicated by the healthcare professional themselves (outdegree). Diversity is thus determined on the basis of two components:  $P_{iR}$ , the proportion of healthcare professions  $i$ 's relationships with members of other disciplines,  $R_{divi}$ , regarding all relationships of healthcare professions  $i$   $R_i$ ; and  $D_{iD}$ , the number of diverse disciplines with which healthcare professions,  $i$ , has contact outside of his own discipline,  $D_{divi}$ , regarding all disciplines within the network minus the own discipline of healthcare professions,  $i$   $D_i$ :

$$P_{iR} = (R_i - R_{divi}) / R_i$$

$$D_{iD} = D_{divi} / D_i$$

For every healthcare professional within the network, diversity is defined as:

$$H_i = \Sigma P_{iR} * D_{iD}$$

When a healthcare professional has relationships within all professionals, and as many professionals speak outside their own professionals as within their own professional, then  $P_{iR} = 0.5$  and  $D_{iD} = 1$ . The diversity of relationships for this healthcare professional,  $H_i$ , is  $0.5/1 = 0.5$ . The score for diversity in relationships can vary between 0 and 1.

### *Value of contacts*

For each professional, we calculated the average of the value that s/he placed on each network contact. The score for value of contact can vary between 1 and 10. A high score indicated that healthcare professionals highly appreciated their collaboration with that specific professional while a low score indicated a low appreciation for the collaboration.

### **Sample size**

During the development process of the IPCP program, it was decided to include seven to ten program participants per community district to achieve a high degree of interaction between professionals during the implementation of the program. The interaction between professionals was important to address the three main themes of the program, role identity, shared vision, and communication. A convenience sample of 22 program participants participated and consented to participate in this study. Non-program participants were included as well in determining network development of each community district. Due to scattered healthcare organizations in the districts it was very difficult to generate a name roster of all professionals per community district. By combining the snowball method (using the program participants) and a fixed-list selection of names, we obtained access to each whole community of healthcare professionals of which 33 non-program participants consented to participate in our study.<sup>19</sup>

### **Social network analysis**

All social network measures were calculated and analysed using UCINET 6.6, a network analysis program used for descriptive and inferential network statistics.<sup>21</sup> To determine a significant increase in the value and diversity of contacts, a paired T test was performed using SPSS software version 24 for Windows (IBM SPSS Statistics, IBM Corporation, Armonk, NY).

## **RESULTS**

Twenty-two participants participated in the IPCP program, and a total of 55 program and non-program participants were included in the data analysis (see Table 1).

**Table 1.** Healthcare professionals included in the study (N=55).

	<b>Total</b>		<b>District 1</b>		<b>District 2</b>		<b>District 3</b>	
<b>Program participants</b>	<b>N=22</b>		<b>N=7</b>		<b>N=8</b>		<b>N=7</b>	
General practitioner, n (%)	3	13.6	1	14.3	1	12.5	1	14.3
Practice nurse, n (%)	1	4.6	1	14.3	0	0.0	0	0.0
Physiotherapist, n (%)	1	4.6	0	0	1	12.5	0	0.0
Social care worker, n (%)	5	22.7	1	14.3	2	25.0	2	28.6
Social care prescriber, n (%)	4	18.2	2	28.6	1	12.5	1	14.3
District nurse, n (%)	6	27.3	2	28.6	2	25.0	2	28.6
Pharmacist, n (%)	2	9.1	0	0	1	12.5	1	14.3
<b>Non-program participants</b>	<b>N=33</b>		<b>N=9</b>		<b>N=11</b>		<b>N=13</b>	
General practitioner, n (%)	5	15.2	1	11.1	1	9.1	3	23.1
Practice nurse, n (%)	5	15.2	2	22.2	1	9.1	2	15.4
Physiotherapist, n (%)	1	3.0	0	0.0	0	0.0	1	7.7
Social care worker, n (%)	10	30.3	2	22.2	5	45.5	3	23.1
Social care prescriber, n (%)	3	9.1	1	11.1	1	9.1	1	7.7
District nurse, n (%)	4	12.1	1	11.1	1	9.1	2	15.4
Pharmacist, n (%)	2	6.1	0	0.0	1	9.1	1	7.7
Specialist geriatric medicine, n (%)	1	3.0	1	11.1	0	0.0	0	0.0
Dietician, n (%)	1	3.0	1	11.1	0	0.0	0	0.0



### Acceptability of the IPCP program

The content of the IPCP program was experienced as instructive in 81% of the program participants and contributed to an enhanced interprofessional collaboration with an average score of 7.7 out of 10 (sd 1.0). Approximately 86% of the program participants indicated to act differently towards fellow professionals after attending the program, and 95% of the program participants indicated that they were able to apply the knowledge and skills of the program in practice. The participants valued the IPCP program with an average of 7.6 out of 10 (sd 1.0). For detailed information regarding the results of the questionnaire (see Appendix 1).

### The number of contacts between professionals

The community's collaboration networks before and after the IPCP program suggested that collaboration networks developed in each community district (see Table 2). In all districts, an increase in the number of contacts among the program participants was observed (ring 1). In district 1, ring 1 reported on average 4.8 contacts before and 7.5 contacts after the IPCP program. In addition, the results

suggest increased collaboration between IPCP participants and other professionals in the district that did not participate in the IPCP program (rings 2 and 3). Figure 3 visualizes the increase in contacts over time for rings 1, 2 and 3.

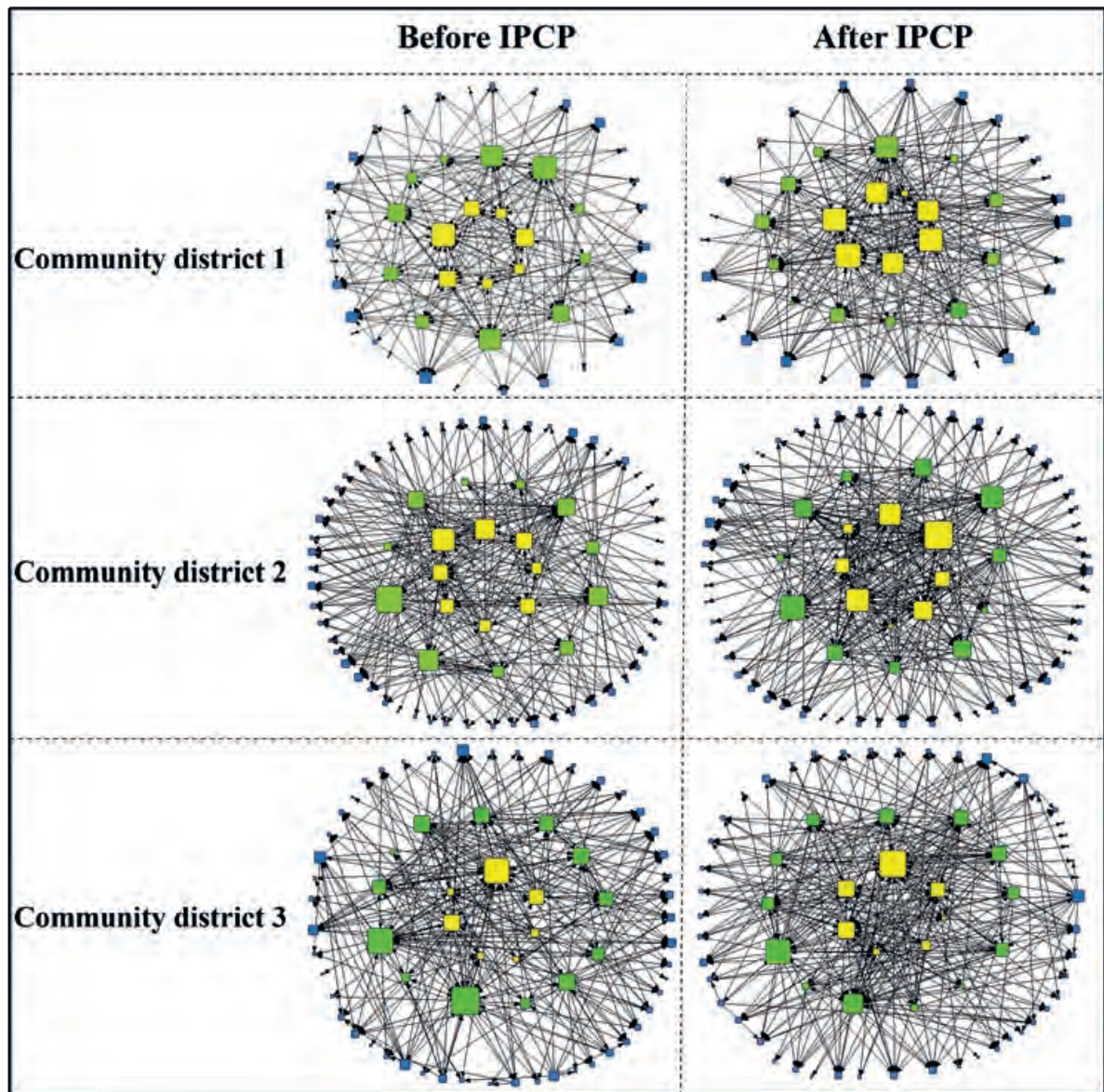
In district 1, program participants reported an increase in contacts to non-program participants (from an average of 4.0 contacts before to 5.5 contacts after the IPCP program). An examination of the change in network density before and after the IPCP program suggests that in all three districts, the network density increased after the IPCP program. For example, for district 1, density increased from 34% to 51%. Before the program roughly a third of all potential connections among the healthcare professionals was actually present within a district, which increased to about half of all connections after the program. In other words, after the program, the professionals in the district tended to collaborate with more and other professionals across the district. This increase in collaboration not only held for participants in the IPCP program, but also extended to non-program participants, as expressed by an increased E-I index for all districts.

### **Reciprocity of contacts**

Program participants and non-program participants had more reciprocal contacts after the IPCP program than before, which is shown in Figure 4. The reciprocity increased over time with 15% in district 1, 2% in district 2 and 13% in district 3. In district 1, for example, before the IPCP program, 49% of all potential reciprocal relationships are actually reciprocal. This number increased to almost two-thirds (64%) after the IPCP program, indicating that the IPCP program also contributed to more sustained reciprocal collaborative efforts among the professionals.

### **Diversity of contacts**

The diversity of contacts increased over time, with almost 10% (CI -0.14 to 0.05, p value <.001) in district 1 and 6% in district 2 (CI -0.13 to -0.002, p value .055) and district 3 (CI -0.08 to 0.03, p value .371). For example, district 1 showed that of all possible diverse contacts, 32% of these were used before the IPCP program. The diversity of contacts, thus the interprofessional collaboration between professionals, increased to 42% after the IPCP program. This finding suggests that the IPCP program contributed to a more diverse network of healthcare professionals, for both program participants as well as non-program participants.



**Figure 3.** Community district collaboration networks before and after the IPCP program

*Notes:* Yellow squares: healthcare professionals in ring 1, green squares: healthcare professionals in ring 2, blue squares: healthcare professionals in ring 3. The larger the square the higher the number of professionals with whom the participant indicated as collaborating with regarding care for older people (based on the out-degree of contacts) The black lines reflects a contact between professionals.



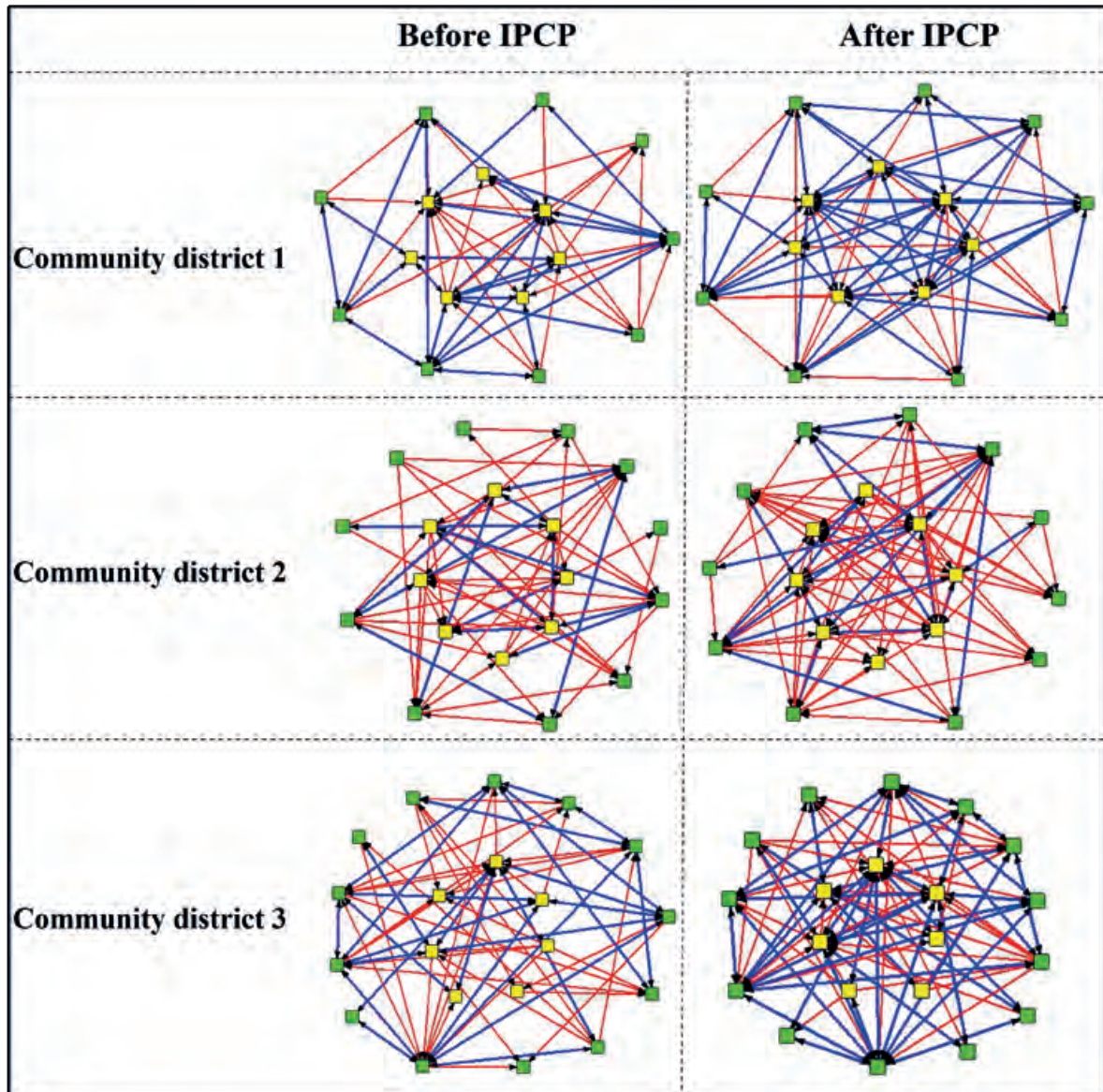


Figure 4. Community districts' collaboration networks of reciprocal contacts

Notes: Blue lines = reciprocal contact. Red lines = one-sided contact. Yellow squares: healthcare professionals in ring 1; green squares: healthcare professionals in ring 2.

Table 2. Descriptive statistics

	District 1 Rings 1 and 2 N=16		District 1 Rings 1, 2 and 3 N=49		District 2 Rings 1 and 2 N=19		District 2 Rings 1, 2 and 3 N=75		District 3 Rings 1 and 2 N=20		District 3 Rings 1, 2 and 3 N=69	
	T0	T1	T0	T1	T0	T1	T0	T1	T0	T1	T0	T1
<b>Number of contacts</b>												
Avg. degree	5.13	7.56	5.79	7.00	4.00	5.53	4.25	4.31	4.81	6.20	4.68	5.26
Density (%)	34	51	12	15	22	31	6	6	19	33	7	8
<b>E-I index</b>												
<b>Ring 1</b>												
Internal avg. degree	4.8	7.5			3.6	5.1			2.0	3.8		
Internal contacts	26	38			42	56			8	14		
External contacts	32	44			28	43			38	51		
<b>Ring 2</b>												
External avg. degree	4.0	5.5			2.4	3.7			2.3	3.2		
Internal contacts	20	22			24	24			102	98		
External contacts	32	44			28	43			38	51		
<b>E-I index</b>												
E-I index ring 1	.10	.07			-.20	-.13			.65	.57		
E-I index ring 2	.23	.33			.08	.28			-.46	-.32		
<b>Collaboration</b>												
Reciprocity (%)	49	64			25	27			40	53		
<b>Diversity of contacts</b>												
Mean	.32	.42			.36	.42			.26	.32		
(SD)	(.17)	(.14)			(.15)	(.19)			(.17)	(.14)		
Paired T test												
t	-4.39	<.001			2.05	.055			.91	.371		
<b>Value of contacts</b>												
Mean			7.3	7.7			7.6	7.8			7.5	7.5
(SD)			(.67)	(.47)			(.61)	(.65)			(.64)	(.58)
Paired T test												
t			-1.28	.209			-2.35	.022			-1.12	.267

**Notes:** T0: Before IPCP program, T1: after IPCP programme. Ring 1: participating professionals IPCP, Ring 2: Non-participating professionals who respond on the network survey, Ring 3: Non-participating professionals who did not respond on the network survey. Internal contacts: contacts that remain within the ring. External contacts: contacts that cross over to the other ring. SD: standard deviation, avg.: average, significance at p value < .05.

### The value of contacts

Participants from district 2 valued their collaboration with other professionals significantly more after the IPCP program ( $t$  -2.35, CI -0.33 to -0.03,  $p$  value .022). However, this significant increase could not be confirmed for districts 1 ( $t$  -1.28, CI -0.28 to 0.06,  $p$  value .209) and 3 ( $t$  -1.12, CI -0.19 to 0.05,  $p$  value .267).

## DISCUSSION

This study examined the feasibility of implementation of the IPCP program in three districts and evaluated its potential to increase interprofessional collaboration in caring for older people. First, our results indicate a high acceptability of the IPCP program as determined by the program participants. Second, the data collection as described in the methods section showed potential to reach the healthcare professionals who were not participating the program. Third, the social network analysis showed that it was possible to measure network development for each community district in which a spill-over effect was revealed. Compared with before the IPCP program, after the program, participants had larger, more reciprocal, and more diverse interprofessional networks.

Our study showed that the IPCP program was found to be acceptable by the program participants. A more in depth understanding could be obtained when using validated questionnaires measuring levels 1, 2 and 3 of the adapted framework of Kirkpatrick for interprofessional education.<sup>22</sup> However, during the development process of the IPCP program an expert team was involved to discuss the final content of the program, as previously described elsewhere.<sup>14</sup> The expert team did not have the scientific background to discuss the methodological rigor of the proposed evaluation but rather whether this evaluation seemed feasible for the program participants. The expert team stated that the content of the IPCP should not be at the expense of research purposes. The development team was therefore discouraged from including validated (multiple) questionnaires and therefore combined elements from the framework of Kirkpatrick for interprofessional education to one single questionnaire to examine the acceptability.<sup>22</sup>

This study showed that it was feasible to collect social network data despite the lack of a clear network boundary. Because of scattered healthcare organizations in the districts it was very difficult to generate a name roster of all professionals per district. These so called “hidden”, fluid networks are difficult to reach,<sup>23</sup> and it may mean that we did not include all potential professionals in the districts. However, by combining the snowball method and a fixed-list selection of names,<sup>19,24</sup> we

sufficiently captured this “hidden” network to assess what we were interested in, namely, the feasibility of implementing an IPCP program to improve community collaboration networks.

This study showed that the interprofessional network of the participants of the IPCP program increased in size after the program. A larger network increases the likelihood of encountering actionable knowledge.<sup>25</sup> Moreover, not only did the program participants develop their interprofessional network but, the non-program participants did as well. This spill-over phenomenon reflects findings in other fields, e.g., educational science,<sup>26,27</sup> and can be explained by the theory of ‘three degrees of influence’.<sup>28</sup> Social influence, or the effect that the words and actions of others have on our thoughts, feelings, attitudes or behavior, has the largest effect between people who are directly connected in a network (called ‘1 degree of separation’).<sup>28</sup> Nonetheless, the theory of ‘three degrees of influence’ asserts that social influence tends to ripple through our network to measurably influence others by up to three degrees of separation (colleague from a colleague of a colleague). While this may promote the adage “the bigger the network, the better”, this saying should be interpreted carefully. The likelihood of encountering actionable knowledge by increasing one’s network may be counteracted by the cost of maintaining a large network. In addition, the phrase ignores variety in the content and diversity of the network. Depending on what professionals need in caring for community-dwelling older people, some may benefit from increased network diversity while others may prefer a larger network. As such, in future work, network characteristics need to be studied in interaction. In addition, further research is necessary to understand how professionals with a large network versus those with a small network perceived the availability of actionable knowledge in their care for community-living older people.

The reciprocity in the district collaboration networks increased after the IPCP program. In other words, health and social care professionals tended to engage in more reciprocal connections after the IPCP program than before. Districts 1 and 3 showed a high increase in the reciprocity of contacts, and district 2 showed a low increase. District 2 also differed from the other districts with a lower reciprocity before the IPCP program. This study did not examine the underlying aspects for these changes. However, collaboration is a process that takes time and energy.<sup>11,29</sup> Furthermore, it is a process in which several factors play a role, such as personal skills and attitudinal aspects, but just as important is the context in which professionals work together, that it is clear and balanced.<sup>29</sup> In addition, after the IPCP program, healthcare professionals in all three districts showed an increase in network diversity, as their networks consisted of multi-disciplinary professionals

from the IPCP as well as outside the IPCP program. Network diversity is linked to opportunities for improvement as one can tap into different sources of expertise and experiences when framing complex care needs for community-living older people.<sup>30</sup> Although there was an increase in diversity, after the IPCP the three community districts still only utilized 32-42% of the potential diversity in their network. One explanation, could be that collaboration between professionals is still based on disorders that require specialist care instead of more integral and wellness-oriented care.<sup>31,32</sup>

In this study, the terms ‘collaboration’ and ‘value’ were not explicitly defined. The researchers have consciously made this choice because how professionals perceive and define collaboration can differ. For example, some professionals can value another professional because of their accessibility while for others, the fruitfulness of their contacts, regarding care for older people, is more important. This is in line with a concept analysis of interprofessional collaboration that demonstrates that IPC is a complex concept, which continues to evolve.<sup>5</sup> IPC has been studied as an outcome of IPE and as an antecedent to patient and provider outcomes. WHO stated that IPE have been proven to be essential in improving dynamics in local healthcare services.<sup>33</sup> Furthermore, coordinated home-based care by interprofessional teams is associated with lower consumption of care.<sup>34</sup> However, a Cochrane review from 2017 stated that there is not sufficient evidence to draw clear conclusions on the effects of IPC interventions for interprofessional practice and health outcomes, because of the certainty of evidence from the included studies, which was judged as low to very low.<sup>35</sup> Despite these inconclusive results regarding interprofessional practice and health outcomes, healthcare professionals are still in need of interprofessional educational program to guide them to overcome the difficulties encountered by health professionals when collaborating in clinical practice to provide care to older people with complex care needs.<sup>35</sup> The outcomes of this feasibility study provided insights to expand this program on a larger scale. Following the Medical Research Council Framework, as this program can be seen as a complex intervention that contains several interacting components,<sup>36</sup> the next step is to evaluate the IPCP program in regard to its (cost) effectiveness. A clear conceptualization of IPC, regarding antecedents, attributes and outcomes of IPC in the context of primary care, is therefore first necessary for understanding interprofessional collaboration within different networks and how it may be strengthened.<sup>5</sup>

### **Strengths and limitations**

This study is among the first that uses SNA to enrich common research methods to examine the feasibility of implementing an IPCP program. While SNA is an underused method within healthcare education and intervention design, it is a

useful technique for examining how social relationships among professionals are established and evolved.<sup>37-41</sup> Another strength of this study is its use of different data sources (i.e., IPCP program participants as well as non- program participants) to examine the feasibility of implementing the IPCP program. This triangulation results in a low same-source and same-measurement-context (SS/SMC) bias, thereby increasing the validity of our study results.<sup>24,39</sup>

This study also has some limitations. First, the presence of a Hawthorne effect, the effect of an intervention that is solely due to intervention participation, cannot completely be excluded.<sup>42</sup> However, the non-program participants received no intervention, and a strong increase in contacts was also observed within this group indicating that the risk of the Hawthorne effect is limited. Moreover, the nature of this study was to examine the feasibility of implementation which is commonly done in uncontrolled settings.<sup>42</sup> Second, the small number of participants limits generalisability. However, a large body of research has found that SNA techniques provide a robust insight into actual social networks, as these techniques focus on relationships rather than individuals.<sup>43-47</sup> Third, this study observed unit non-response defined as missing healthcare professionals in which all outgoing contacts of a professional are missing but not the incoming contacts. Although non-response results in missed contacts for some actors, partial information on the network context of the incompletely observed professionals was available due to their responding colleagues.<sup>19</sup> This information was included in this study and expressed within the results section as ring 3 to provide a comprehensive understanding of the collaboration networks.

## CONCLUSION

This study showed that it was feasible to implement an IPCP program in terms of acceptability, feasibility of data collection and social network analysis, and to measure network development in order to see the potential of the IPCP program to increase interprofessional collaboration between primary healthcare professionals in caring for the older population. After the IPCP program, the program participants as well as non-program participants gained a larger more collaborative and diverse interprofessional network in primary care, suggesting a spill-over effect of networked interventions. Future studies are needed to determine the effects of interprofessional collaboration on continuity of care as well as its cost-savings.

## REFERENCES

1. World Health Organization. *Framework for action on interprofessional education and collaborative practice*. Geneva: World Health Organization; 2010. Available from: <http://www.who.int/iris/handle/10665/70185>. Accessed March 5, 2020.
2. NIVEL. *Zorgregistraties eerste lijn. Chronische ziekten en multimorbiditeit* [Chronic diseases and multimorbidity]. Utrecht, NL: NIVEL; 2016. Available from: <https://www.volksgezondheidenzorg.info/onderwerp/chronische-ziekten-en-multimorbiditeit/cijfers-context/huidige-situatie#node-prevalentie-multimorbiditeit-naar-aantal-chronische-ziekten>. Accessed March 5, 2020.
3. Van Kempen JA, Robben SH, Zuidema SU, Rikkert MGO, Melis RJ, Schers HJ. Home visits for frail older people: a qualitative study on the needs and preferences of frail older people and their informal caregivers. *Br J Gen Pract*. 2012;62(601):554-560.
4. NZa. Nederlandse Zorgautoriteit. *Monitor Zorg voor Ouderen* [Monitoring care for older people]. Utrecht: Nederlandse Zorgautoriteit. [Updated 2018] Available from: [https://puc.overheid.nl/nza/doc/PUC\\_234967\\_22/1/](https://puc.overheid.nl/nza/doc/PUC_234967_22/1/). Accessed March 5, 2020.
5. Bookey-Bassett S, Markle-Reid M, Mckey CA, Akhtar-Danesh N. Understanding interprofessional collaboration in the context of chronic disease management for older adults living in communities: a concept analysis. *J Adv Nurs*. 2017;73(1):71-84.
6. Sørensen M, Stenberg U, Garnweidner-Holme L. A Scoping Review of Facilitators of Multi-Professional Collaboration in Primary Care. *Int J Integr Care*. 2018;18(3):13.
7. Hofhuis J, Mensen M, Ten Den L, et al. *Succesfactoren voor Interprofessioneel Samenwerken in de Wijk: een kwantitatief onderzoek onder Nederlandse zorg- en welzijnsprofessionals* [Success factors for interprofessional collaboration in the community: a qualitative study among Dutch health- and social care workers]. Zwolle, NL: Hogeschool Windesheim; 2015.
8. Reeves S, Fletcher S, Barr H, et al. A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Med Teach*. 2016;38(7):656-668.
9. Reeves S, Palaganas J, Zierler B. An updated synthesis of review evidence of interprofessional education. *J Allied Health*. 2017;46(1):56-61.
10. CAIPE, Centre for the Advancement of Interprofessional Education. *Collaborative practice through learning together to work together*. 2016. Available from: <https://www.caipe.org/resource/CAIPE-Statement-of-Purpose-2016.pdf>. Accessed March 5, 2020.
11. American Geriatric Society. Position statement on interdisciplinary team training in geriatrics: An essential component of quality healthcare for older adults. *J Am Geriatr Soc*. 2014;62(5):961-965.
12. Ploeg J, Markle-Reid M, Fisher A, et al. An exploration of experts' perceptions on the use of interprofessional education to support collaborative practice in the care of community-living older adults. *J Interprof Care*. 2017;31(5):638-647.
13. Oeseburg B, Hilberts R, Luten TA, Van Etten AV, Slaets JP, Roodbol PF. Interprofessional education in primary care for the elderly: a pilot study. *BMC Med Educ*. 2013;13(1),161.

14. Smit LC, Dikken J, Van Wijk M, et al. The methodological development of an interprofessional educational program to provide proactive integrated care for elders. *J Res Interprof Pract Educ.* 2020;9(2):1-25.
15. O’Keefe M, Henderson A, Chick R. Defining a set of common interprofessional learning competencies for health profession students. *Med Teach.* 2017;39(5):463-468.
16. Liu Q, Peng W, Zhang F, Hu R, Li Y, Yan W. The effectiveness of blended learning in health professions: systematic review and meta-analysis. *J Med Internet Res.* 2016;18(1):2.
17. Barr H, Koppel I, Reeves S, Hammick M, Freeth D. *Effective interprofessional education. Argument, assumption & Evidence.* London: Blackwell Publishing; 2005.
18. Reagans R, Zuckerman EW. Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organ Sci.* 2001;12(4):502-517.
19. Borgatti SP, Everett MG, Johnson JC. *Analyzing social networks.* London: Sage Publications; 2013.
20. Borgatti SP, Everett MG, Freeman LC. UCINET. In: Alhajj R., Rokne J. (eds) *Encyclopedia of Social Network Analysis and Mining.* New York, NY: Springer; 2014.
21. Huisman M. Imputation of missing network data: Some simple procedures. *J Soc Struct.* 2009;10(1):1-29.
22. Reeves S, Barr H. Twelve steps to evaluating interprofessional education. *J Taibah Univ Medical Sci.* 2016;11(6):601-605.
23. Salganik M, Heckathorn DD. “Sampling and estimation in hidden populations using respondent-driven sampling”. *Sociol Methodol.* 2004;34:193-239.
24. Carolan BV. *Social Network Analysis and Education: Theory, Methods, and Applications.* Thousand Oaks, CA: Sage; 2014.
25. Cross R, Sproull L. More than an answer: Information relationships for actionable knowledge. *Organ Sci.* 2004;15(4):446-462.
26. Van Waes S, De Maeyer S, Moolenaar NM, Van Petegem P, Van Den Bossche P. Strengthening networks: A social network intervention among higher education teachers. *Learn Instr.* 2018;53:34-49.
27. Blume BD, Ford JK, Baldwin TT, Huang JL. Transfer of training: A meta-analytic review. *JOM.* 2010;36(4):1065-1105.
28. Christakis NA, Fowler JH. *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives.* Boston: Little, Brown and Company; 2009.
29. Kluft M. *Samenwerken in de wijk – tien vragen rondom de samenwerking tussen sociale wijkteams en andere professionals.* [Working together in the neighborhood - ten questions about the collaboration between social neighborhood teams and other professionals]. Utrecht, NL: Movisie; 2016 [https://www.movisie.nl/sites/default/files/alfresco\\_files/Samenwerken%20in%20de%20wijk,%2010%20vraagstukken%20\[MOV-11437021-1.0\].pdf](https://www.movisie.nl/sites/default/files/alfresco_files/Samenwerken%20in%20de%20wijk,%2010%20vraagstukken%20[MOV-11437021-1.0].pdf).
30. Kilduff M, Krackhardt D. Bringing the individual back in: A structural analysis of the internal market for reputation in organizations. *Acad Manage J.* 1994;37(1):87e108.



31. Baldwin DC. Territoriality and power in the health professions. *J Interprof Care*. 2007;21(1):97–107.
32. Supper I, Catala O, Lustman M, Chemla C, Bourgueil Y, Letrilliart L. Interprofessional collaboration in primary healthcare: a review of facilitators and barriers perceived by involved actors. *J Public Health*. 2015;37(4):716–727.
33. World Health Organization. *Interprofessional Collaborative Practice in Primary Healthcare: Nursing and Midwifery Perspectives*. Human Resources for Health Observer. Geneva: World Health Organization; 2013.
34. Stall N, Nowaczynski M, Sinha SK. Systematic review of outcomes from home-based primary care programs for homebound older adults. *J Am Geriatr Soc*. 2014;62:2243–51.
35. Reeves S, Pelone F, Harrison R, Goldman J, Zwarenstein M. Interprofessional collaboration to improve professional practice and healthcare outcomes. *Cochrane Database of Syst Rev*. 2017;(6).
36. Craig P, Dieppe P, Macintyre S, et al. Developing and evaluating complex interventions: the new medical research council guidance. *BMJ* 2008;337:a1655.
37. Parnell JM, Robinson JC. Social network analysis: Presenting an underused method for nursing research. *J Adv Nurs*. 2018;74:1310–1318.
38. Benítez-Andrades J, Rodríguez-González A, Benavides C, Sánchez-Valdeón L, García I. A Semantic Social Network Analysis Tool for Sensitivity Analysis and What-If Scenario Testing in Alcohol Consumption Studies. *Int J Environ Res Public Health*. 2018;15(11):2420.
39. Benton DC, Pérez-Raya F, Fernández-Fernández MP, González-Jurado MA. A systematic review of nurse-related social network analysis studies. *Int Nurs Rev*. 2015;62(3):321–339.
40. Pow J, Gayen K, Elliott L, Raeside R. Understanding complex interactions using social network analysis. *J Clin Nurs*. 2012;21(19pt20):2772–2779.
41. Smit LC, Dikken J, Schuurmans MJ, De Wit NJ, Bleijenberg N. The Value of Social Network Analysis for Developing and Evaluating Complex Health Care Interventions: A Scoping Review. *BMJ Open*; 2020.
42. Green L, Glasgow RE. Public health asks of systems science: to advance our evidence-based practice, can you help us get more practice based evidence? *Am J Public Health*. 2006;96:406–409.
43. Hommes J, Rienties B, De Grave W, Bos G, Schuwirth L, Scherpbier A. Visualising the invisible: a network approach to reveal the informal social side of student learning. *Adv Health Sci Educ*. 2012;17(5):743e757.
44. Curşeu PL, Janssen S, Raab J. Connecting the dots: social network structure, conflict, and group cognitive complexity. *High Educ*. 2012;63(5):621e629.
45. Daly AJ, Finnigan KS. A bridge between worlds: understanding network structure to understand change strategy. *J Educ Change*. 2010;11(2):111–138.
46. Daly AJ, Moolenaar NM, Bolivar JM, Burke P. Relationships in reform: the role of teachers' social networks. *J Educ Adm*. 2010;48(3):359e391.
47. Borgatti SP, Cross R. A relational view of information seeking and learning in social networks. *Manag Sci*. 2003;49(4):432e445.

## Appendix. Evaluation questions IPCP program

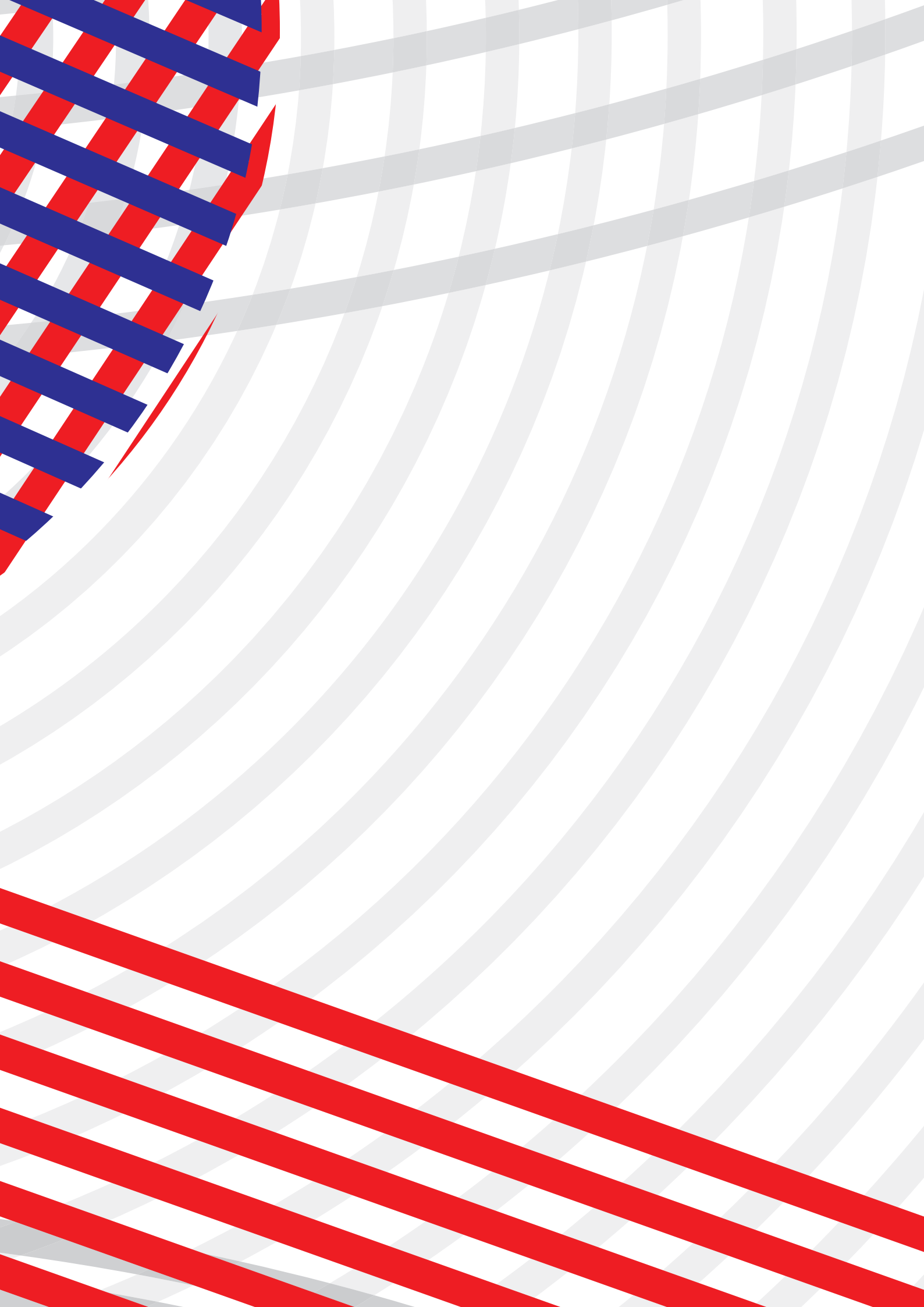
	Total (N=22) N (%)	District 1 (N=7) N (%)	District 2 (N=8) N (%)	District 3 (N=7) N (%)
1 Did you find the content of this IPCP program instructive				
<input type="checkbox"/> Yes	18 (81.8)	5 (71.4)	7 (87.5)	6 (85.7)
<input type="checkbox"/> A little	4 (18.2)	2 (28.6)	1 (12.5)	1 (14.3)
<input type="checkbox"/> No	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2 How do you score the content of the offered knowledge / skills in the IPCP program?				
Mean (sd)	7.69 (0.65)	7.79 (0.65)	7.69 (0.66)	7.58 (0.61)
3 Did the IPCP program contribute to enhanced interprofessional collaboration?				
Mean (sd)	7.69 (0.63)	7.86 (0.64)	7.67 (0.66)	7.50 (0.46)
4 Did you find the connection between the components of this IPCP program good.				
<input type="checkbox"/> Yes	20 (90.9)	7 (100.0)	8 (100.0)	5 (71.4)
<input type="checkbox"/> A little	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
<input type="checkbox"/> No	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
5 Did you find the assignments to be carried out instructive in the context of this IPCP program?				
<input type="checkbox"/> Yes	15 (68.2)	6 (85.7)	6 (75.0)	3 (42.9)
<input type="checkbox"/> A little	7 (31.8)	1 (14.3)	2 (25.0)	4 (57.1)
<input type="checkbox"/> No	0	0 (0.0)	0 (0.0)	0 (0.0)
6 Were the learning objectives of this IPCP program clear?				
<input type="checkbox"/> Yes	15 (68.2)	5 (71.4)	5 (62.5)	5 (71.4)
<input type="checkbox"/> A little	7 (31.8)	2 (28.6)	3 (37.5)	2 (28.6)
<input type="checkbox"/> No	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
7 Did you start acting differently towards your fellow professionals after this IPCP program, in terms of role identity?				
<input type="checkbox"/> Yes	8 (36.4)	4 (57.1)	3 (37.5)	3 (42.9)
<input type="checkbox"/> A little	8 (36.4)	2 (28.6)	3 (37.5)	3 (42.9)
<input type="checkbox"/> No	6 (27.3)	1 (14.3)	2 (25.0)	1 (14.2)
8 Are you sufficiently able to apply in practice what you have learned from the IPCP program.				
<input type="checkbox"/> Yes	15 (68.2)	5 (71.4)	6 (75.0)	4 (57.1)
<input type="checkbox"/> A little	6 (27.3)	1 (14.3)	2 (25.0)	3 (42.9)
<input type="checkbox"/> No	1 (4.6)	1 (14.3)	0 (0.0)	0 (0.0)

## Chapter 6

9	What did you think of the organization of this IPCP program?				
	▫ <i>Insufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>Sufficient</i>	4 (18.2)	0 (0.0)	0 (0.0)	4 (57.1)
	▫ <i>More than sufficient</i>	4 (18.2)	1 (14.3)	3 (37.5)	0 (0.0)
	▫ <i>Good</i>	13 (59.1)	6 (85.7)	4 (50.0)	3 (42.9)
	▫ <i>Very good</i>	1 (4.6)	0 (0.0)	1 (12.5)	0 (0.0)
10	What did you think of the accessibility of the IPCP program coordinator?				
	▫ <i>Insufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>Sufficient</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>More than sufficient</i>	1 (4.6)	0 (0.0)	1 (12.5)	1 (14.3)
	▫ <i>Good</i>	16 (72.7)	6 (85.7)	6 (75.0)	4 (57.1)
	▫ <i>Very good</i>	2 (9.1)	1 (14.3)	1 (12.5)	0 (0.0)
11	Does the teaching material on the online platform provide complete information?				
	▫ <i>Yes</i>	7 (31.8)	3 (42.9)	4 (50.0)	0 (0.0)
	▫ <i>A little</i>	12 (54.6)	4 (57.1)	4 (50.0)	4 (57.1)
	▫ <i>No</i>	3 (13.6)	0 (0.0)	0 (0.0)	3 (42.9)
12	Is the teaching material clearly written (linguistic)?				
	▫ <i>Yes</i>	17 (77.3)	5 (71.4)	8 (100.0)	4 (57.1)
	▫ <i>A little</i>	4 (18.2)	1 (14.3)	0 (0.0)	3 (42.9)
	▫ <i>No</i>	1 (4.6)	1 (14.3)	0 (0.0)	0 (0.0)
13	Are you satisfied with the order in which the teaching material is covered in the IPCP program?				
	▫ <i>Yes</i>	20 (90.9)	7 (100.0)	8 (100.0)	5 (71.4)
	▫ <i>A little</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>No</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
14	Connect the content and form of the lesson to your learning needs (Think of steering, guidance, independence).				
	▫ <i>Yes</i>	15 (68.2)	5 (71.4)	7 (87.5)	3 (42.9)
	▫ <i>A little</i>	6 (27.3)	2 (28.6)	1 (12.5)	3 (42.9)
	▫ <i>No</i>	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.3)
15	Was the trainer well informed about the setup of this IPCP program?				
	▫ <i>Insufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>Sufficient</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>More than sufficient</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>Good</i>	13 (59.1)	5 (71.4)	6 (75.0)	2 (28.6)
	▫ <i>Very good</i>	5 (22.7)	2 (28.6)	2 (25.0)	1 (14.3)
16	Was the trainer enthusiastic?				
	▫ <i>Insufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>Sufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>More than sufficient</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>Good</i>	4 (63.6)	6 (85.7)	4 (50.0)	4 (57.1)
	▫ <i>Very good</i>	6 (27.3)	1 (14.3)	4 (50.0)	1 (14.3)

## Implementation of an interprofessional collaboration in practice program

17	Did the trainer motivate the trainees?				
	▫ <i>Insufficient</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>Sufficient</i>	1 (4.6)	0 (0.0)	0 (0.0)	1 (14.3)
	▫ <i>More than sufficient</i>	2 (9.1)	0 (0.0)	0 (0.0)	2 (28.6)
	▫ <i>Good</i>	13 (59.1)	5 (71.4)	5 (62.5)	3 (42.9)
	▫ <i>Very good</i>	6 (27.3)	2 (28.6)	3 (37.5)	1 (14.3)
18	Did the trainer provide sufficient information when needed?				
	▫ <i>Yes</i>	22 (100.0)	7 (100.0)	8 (100.0)	7 (100.0)
	▫ <i>A little</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	▫ <i>No</i>	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
19	How do you score the trainer? Score 0-10				
	<i>Mean (sd)</i>	8.18 (0.57)	8.14 (0.64)	8.38 (0.48)	8.00 (0.53)
20	How do you rate the IPCP program in general? Score 0-10				
	<i>Mean (sd)</i>	7.64 (0.62)	7.43 (0.49)	7.94 (0.68)	7.50 (0.46)



# 7

## **How context influences the effectiveness of complex primary care interventions: a discussion paper.**

7

Smit LC, Bleijenberg N, Engel J, De Wit NJ, and Schuurmans MJ.

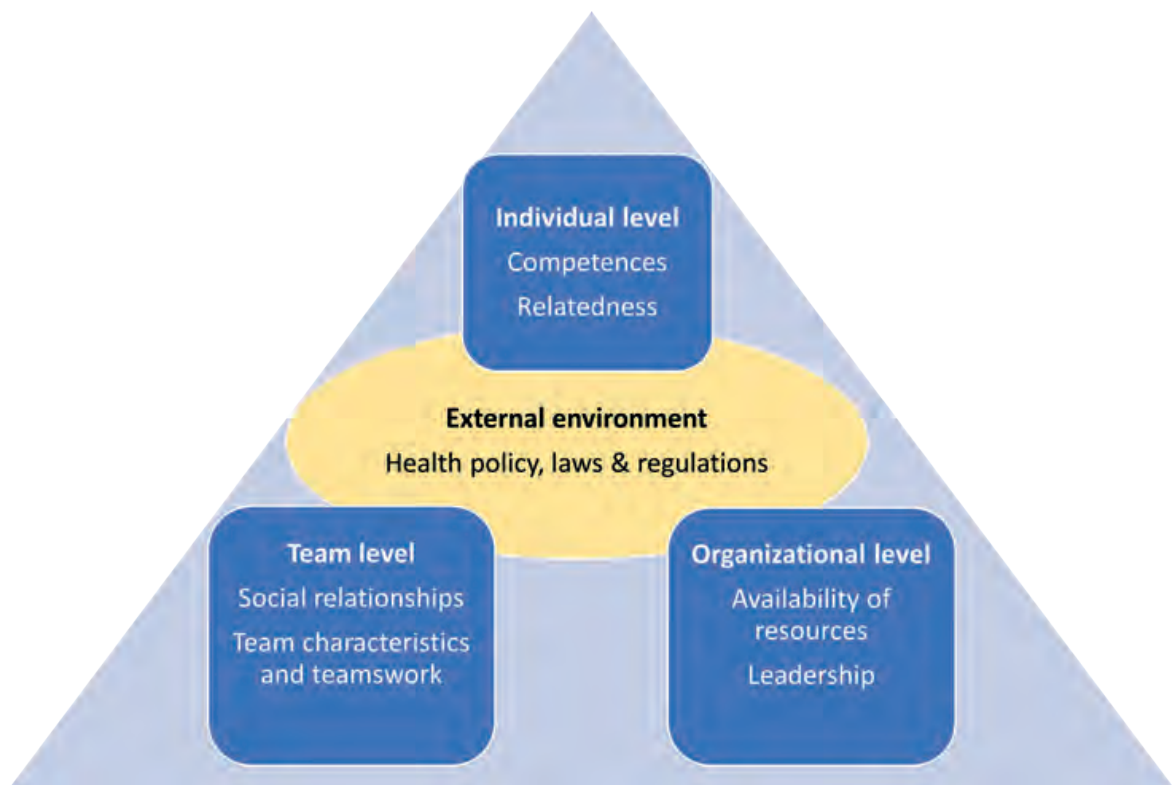
*Under review*

## INTRODUCTION

The world is currently facing a rapidly ageing population, with an increase in the number of older people with multimorbidity and potential frailty.<sup>1,2</sup> For the last two decades, proactive, integrated care has been increasingly promoted as the leading concept in care for frail older people in the community, with a focus on safeguarding their independence.<sup>3-5</sup> Worldwide, many proactive, integrated care interventions are developed to prevent functional decline.<sup>3-5</sup> These are primarily multi-faceted and have interacting components, for which they are considered being complex. Complex interventions have two common characteristics: 1) multiple components; 2) complicated/multiple causal pathways with some times feedback loops, synergies and/or mediators and moderators of effect. In addition, they may also have one or more of the following three additional characteristics; 1) target multiple participants groups, or organisational levels; 2) require multi-faceted adoption, uptake, or integration strategies; 3) or work in a dynamic multidimensional environment.<sup>6</sup>

To examine the superiority of a complex intervention over routine care traditional study designs such as randomised controlled trials (RCT) are frequently used.<sup>7</sup> RCTs are considered the superior design in terms of ‘proof delivery’ when referring to the statistical accuracy of complex interventions. However, the conclusions of RCT, such as that the intervention works ‘on average’, have been criticized as being not helpful, as this leaves the clinician in the dark about where to target resources or how to maximize impact.<sup>8</sup> Moreover, many of these trials show no favourable effect leaving researchers and professionals with more questions than answers (‘did the trial design kill the intervention?’). For instance, in the Netherlands, nine large scaled proactive elderly care programs were evaluated in large (cluster) randomised trials, still, none of them demonstrated clinically superior effects compared to routine care on outcomes such as daily functioning, quality of life and health care consumption.<sup>9-17</sup> The reasons of that failure may be the use of the RCT design, given the importance of the specific context in which the intervention is delivered. This fits in the ongoing discussion about research waste pointing at the inadequate translation of evidence-based innovations from research into daily clinical practice.<sup>18</sup> In a previous study, we showed that the specific context of implementation was not adequately described and taken into account during the development and evaluation process of these proactive primary care programs.<sup>19</sup> Pawson and Tilley (1997) already argued two decades ago that evaluations need to identify ‘what works, for whom, in what circumstances and why?’, rather than merely ‘does it work?’.<sup>20</sup> Implying that implementing and evaluating interventions in the context where they will be used is just as important as measuring their effectiveness.

For over 20 years, the influence of context is recognised and identified as vital when implementing complex interventions.<sup>21</sup> However, most evaluations still neglect the context, which enlarges research waste.<sup>18</sup> Little is known about how and to what extent contextual levels possibly affect the effectiveness of complex interventions in clinical practice. Context reflects characteristics and circumstances that consist of active and unique factors in which the implementation is embedded.<sup>22</sup> As such, context is not a backdrop for implementation, but interacts, modifies and facilitates or constrains the intervention and its implementation.<sup>22-24</sup> Context is therefore a key determinant of the effectiveness of interventions. It is an overarching concept, comprising a physical location (e.g. setting) but also roles, interactions and relationships at multiple levels.<sup>22</sup> These can be divided in the individual level (e.g. micro-level), the team level (e.g. meso-level), organisational level (e.g. meso-level), and the external environment (e.g. system or macro-level)(Figure 1).<sup>24-27</sup>



**Figure 1.** Graphical framework of the discussed contextual factors.

### Context in complex interventions

Although the importance of context is often emphasised, still very few pragmatic guidelines are available.<sup>21,24</sup> O’Cathain and colleagues (2018), for example, did give two recommendations, namely “pay attention to future implementation of the intervention in the real world” and “understand the context” but did not describe tools for researchers to consider.<sup>28</sup> The lack of pragmatic guidance can be explained



by the ambiguity with which context is used in complex intervention research. This ambiguity leads to a great variety of frameworks, making it difficult for researchers to account for context properly within the development, implementation and evaluation of complex interventions.<sup>21,22,27,29,30</sup>

Therefore, the aim of this discussion paper is to critically reflect on the influence of context when evaluating effectiveness of complex primary care interventions. We will discuss the impact of context on three levels (e.g. individual, team, and organisation level), illustrate this with specific examples from previous studies we conducted. Furthermore, we will describe future perspectives on how context can be taken into account when developing and evaluating complex interventions.

### **Individual level: training of professionals**

The individual level comprises the individual autonomy, self-efficacy, knowledge, attitudes and beliefs that are described as influential contextual conditions as well as the interpretations of individuals about the innovation.<sup>27</sup> Training of professionals is often necessary before applying a complex intervention, but does not always receive sufficient attention.<sup>19</sup> In a previous study, we systematically assessed nine Dutch large-scaled proactive primary care programs aiming to capture possible challenges in the development and evaluation process. This generated insights into why all of these interventions failed to have a significant effect on patient outcomes.<sup>19</sup> We concluded that the training of care professionals who deliver the intervention was diverse, from 8-hour training till 128-hours training, and that evaluation of the training, to ensure acquired competences, was neglected in most programs. Training of interventionists is a necessary prerequisite for the intervention to ensure adequate uptake in daily practice, within implementation science this is regarded as a vital implementation strategy.<sup>31-33</sup> Training can be seen as an opportunity for professionals to become informed on how to deliver the intervention as it was initially planned, learn about the program's target population, and practice the required skills and competences.<sup>34</sup> Competences are defined as the confidence a professional must have in his/her own abilities to deliver the program, which can be increased by a training.<sup>35,36</sup> Practice nurses involved in one of the nine primary care programs indicated that they need a learning curve in delivering the intervention over time and acknowledged that it was initially challenging to conduct the intervention as intended because they were used to a different way of working.<sup>37</sup> One can argue that when professionals are not adequately equipped or trained they may not deliver the intervention as intended (e.g. low intervention fidelity) which possibly affects intervention effectiveness.

When providing integrated and, more specifically, interprofessional care for older people, it is essential that professionals know their own role and each other's role.<sup>38</sup> Professionals need to know what others can contribute, need to value everyone's work, and to know what the boundaries and the alignment of disciplines are.<sup>38</sup> This social relatedness reflects the connection with the environment and the trust in each other.<sup>35</sup> In practice we noticed that professionals were not feeling capable in providing integrated care as they missed relatedness with other primary care professionals. In this light, we developed an interprofessional educational program for primary care and evaluated its feasibility.<sup>39,40</sup> Interprofessional collaboration in practice places the interests of the older person at the heart of care delivery. The competences needed by professionals to enable successful collaboration across professions were integrated enactment of knowledge, skills, values, and attitudes.<sup>38</sup> These competences embedded in the interprofessional program, correspond to the mentioned contextual drivers on individual level. Professionals fulfil a crucial role in if and how an intervention works (or not) because they make particular decisions in delivering the intervention (or not). This 'reasoning', induced by underlying social and psychological factors, of the professionals in delivering the intervention is what also determines its effectiveness.<sup>20</sup>

Based on the previous examples, we conclude that training is crucial in developing and sustaining complex primary care programs. The training should specifically emphasize acquiring competences, social relationships and maintain professional autonomy as these factors can enhance implementation success of providing proactive integrated care.

### **Team level: network analysis**

Key contextual drivers at this level are the team's perceptions of the availability of resources, their capabilities in delivering an intervention, local leadership, the social relationships between team members and management, team characteristics and teamwork, including team stability and workload.<sup>27</sup> However, within intervention research, there is little emphasis on the team's contextual determinants, and they are usually overlooked in the classification of context.<sup>27</sup>

This was also seen in the evaluation of the nine large scale elderly care trials in which we conclude that little attention was paid to the context in general within the development as well as evaluation phase.<sup>19</sup> Hardly any information was available about the characteristics of the interventionists and their team, which is remarkable since teams are very important within organisations and play a crucial role in the provision of integrated care. In our study, in which we tested the feasibility of the interprofessional educational program, we followed the network development of

three community districts and evaluated the team collaboration.<sup>40</sup> The community districts differed concerning the density of the networks and the degree of mutual collaboration between professionals. In the least dense network, professionals had mostly one-sided contacts, which means that the nature of the communication regarding care for older people was initiated from one specific professional instead that contacts were reciprocally initiated. Two cross-sectional studies of health care professionals found that reciprocity was a significant predictor of contacts used for advice and that reciprocal contacts characterized 93% of such relationships.<sup>41,42</sup> One can question whether there is interprofessional collaboration if communication is not reciprocally.<sup>43,44</sup> Furthermore, our analysis showed which professionals were crucial in the network. For example, one general practitioner self-indicated to be a key player in the care of older people. However, based on the social network data, we observed that this general practitioner was not the key player in the network; instead a practice nurse was. Unravelling the team network of interest before the implementation of the intervention can provide useful information regarding the characteristics of each professional, their social relationships and how the team works or collaborates. This information can tailor the efforts in implementing an innovation.

Additionally, we showed in our scoping review that unravelling networks by means of social network analysis (SNA) could be of great value within the development and evaluation process of complex interventions.<sup>45</sup> During the development phase, SNA can provide strategies to consider the social context of programme delivery, determine the appropriate methods and communication needs, and identify particular change agents and opinion leaders in the network to focus on.<sup>46-49</sup> The results of our scoping review showed that SNA seems underused in evaluating complex intervention research and that SNA was not used in the development phase of the included studies.<sup>45</sup> Based on our examples, we highlight the importance of team collaboration in delivering complex primary care interventions, and the need to unravel networks at the start of developing a complex interventions. Moreover, SNA as a research method has great potential when developing and evaluating complex interventions in clinical practice.

### **Organisational level: availability of resources and leadership**

In contrast to team level, there is much evidence about the influence of context on organisational level.<sup>27,50</sup> The scope and perspectives on context, however, differ. Some refer to organisational support or facilitating factors, while others focus on (the availability of) organizational resources. Or more specific in terms of adequate training, staffing, time and space.<sup>27</sup> Additionally, leadership is mentioned as a key contextual driver as well as organisational norms, organizational climate-,

size, change, structure and capacity on organisational level.<sup>27</sup> The availability of resources and leadership are two subconstructs of the readiness of an organisation to implement an intervention that will be emphasized given their impact on delivering a proactive primary care.<sup>25,51</sup>

The availability of organisational resources is crucial in delivering a complex intervention and sustaining it over time. The availability of resources, however, can be a barrier in primary care.<sup>52</sup> In the Netherlands, health and social care organisations with different financial resources are involved in providing proactive care for older people. This specific lack of integration of budgets across organizations makes the appropriate availability of resources hard to achieve.<sup>53-55</sup> Furthermore, major staff shortages in care for older people are imminent. These shortages form a barrier to equip professionals properly, as direct patient care will always take precedence instead of implementing proactive preventive care.<sup>50</sup> Therefore, organisational support in allowing time for the often inevitable reduction in productivity until the intervention has its uptakes in practice is necessary.<sup>25</sup>

In case of shortages in the number of professionals, additional professionals can be employed in order to facilitate intervention fidelity.<sup>52</sup> However, when (research) funding stops organizational contextual adjustments are then frequently made to deliver the intervention without knowing its impact, or interventions are stopped completely due to financial constraints inducing research waste.<sup>33,56</sup> We observed in our study of general practices that delivered a proactive care program that some practices deliberately chose to shift the frailty screening from the age of 60 years to 75 years and older.<sup>57</sup> Their motivation was to reduce the number of patients that needed to be screened and subsequently the number of patients that needed a (time-consuming) comprehensive geriatric assessment at home. The frailty screening of the age of 60 was initially a vital component of the proactive primary care program.<sup>9</sup> The results of our study showed that choices made in the screening of potential frail older people showed a significant difference in the study outcome (e.g. emergency admissions).<sup>57</sup> The change of target population, made by the organisation, can possibly affect study outcomes. In this light, researchers should be aware of the difficulties in addressing context on the organisational level and the possibility that adaptations in a complex care innovation are made by organisations themselves based on organizational constraints without considering the potential impact on patient outcomes. These difficulties can best be overcome to consider relevant contextual organisational factors with all involved stakeholders in an early stage of developing a novel complex care intervention. Suggesting the need for stakeholder involvement from the development phase of complex intervention research as a relevant key action.<sup>28</sup>

Leadership is also an essential part of the readiness of an organisation to implement an intervention.<sup>25,27</sup> The term ‘leadership’ can refer to leaders at any level of the organisation, including executive and informal leaders, middle management, front-line supervisors, and team leaders, who have a direct or indirect influence on the implementation.<sup>25</sup> This influence can be evaluated for example by assessing the presence or absence of leaders in the implementation process, how leaders are brought on board (e.g., appointed, volunteered), the role of leaders in the organisation (formal and/or informal roles), and their role in implementation in which SNA can be a valuable methodology.<sup>25,45</sup> As previously mentioned, with the quantitative social network data, we observed in one of our studies that a key player in the network was a practice nurse instead of the physician who claimed to be the key player. To generate an in-depth understanding of why this nurse was a key player, a qualitative approach could be used, forming a mixed-methods SNA design.<sup>45,58</sup> As explaining the “why” is just as important besides effectiveness research.<sup>8,20</sup> In conclusion, understanding the organisational level is difficult, but important to achieve resources and leadership across organisations in primary care. Additionally, SNA can be valuable in understanding the organisational level to support and sustain successful implementation.

### **Future perspective on development and evaluation of complex primary care interventions**

The different levels reflect the dynamic and interacting characteristics of contextual factors and their impact on if and why a complex primary care intervention works or not. As these levels cannot be separated from each other, intervention development cannot be strictly separated from implementation. Ideally, implementation research should run parallel and integrated with the evaluation of the intervention as it uncovers determinants of success from the real-world context, which potentially reduces research waste type II. This type of research waste is defined as “the lack of effective and sustainable translation and implementation of complex interventions from the trial world into daily clinical practice”.<sup>18</sup> Integrating implementation research early in the research process can guide the systematic uptake of research findings and other evidence-based practices into routine practice, and can reduce this specific type of research waste II.<sup>18</sup>

From our critical reflection, three remarks can be made on how to address the implementation context at the discussed levels within the development and evaluation of complex interventions.

First, contextual factors within each level can be considered as intermediate outcomes before measuring effectiveness. Interprofessional collaboration was, for example, discussed as crucial in providing proactive integrated care. To study the effect of proactive, integrated care, insight into interprofessional collaboration is essential as this will affect the outcomes of the intervention. Recent literature identified common contextual factors and suggested using this not as a checklist to apply in every study but as a reminder for researchers.<sup>21,27,30</sup> A reminder to ask, with the participation of all stakeholders involved, the right questions concerning their specific intervention. This to prevent salient contextual factors and to minimize the risk of overlooking important ones.<sup>21,27,30</sup> Intermediate outcomes can be of value as for example monitoring data to keep the implementation process transparent as working mechanisms of the intervention and implementation strategies can then be adjusted when necessary.

Second, our critical reflection highlighted that other methods than RCTs should be considered when measuring effectiveness of an intervention to account for the dynamic and interacting context to explain what works, for whom, in what circumstances and why. These reflections showed that the contextual dimension ‘social relationships’ was present on all discussed levels. Within a professional’s feeling of relatedness, when working in teams and on the organizational level contained by leadership. Social relationships play an essential part in the context of implementation for which SNA can be highly valuable. Quantitative social network analysis provides an “outsider view” of networks, mapping and measuring aspects of social relations in a systematic and precise way, while qualitative approaches, although less common, provides an “insider view”, exploring the subjective meaning of a network to members and revealing the reasons for individual behaviour.<sup>59,60</sup> Combining both into a mixed methods SNA design offers a vibrant “outside-inside view” of social relations and a nuanced understanding of the structure of the network and the forces that produce it, which can inform the intervention development as well as implementation strategies.<sup>46,60</sup> Furthermore, within the evaluation design, the implementation process can also be integrated knowing as hybrid designs, which are defined as a design with a dual focus (in terms of testing and observing) assessing both clinical effectiveness and implementation.<sup>61</sup> Only when implementation research is integrated within the evaluation phase of complex intervention research, optimal account for contextual conditions on the individual, team and organizational level can be realized.

Third, training of professionals is crucial in order to reach and account for fidelity and adaptation of interventions (the degree that they were delivered and taken up as planned in the targeted group). Researchers should be aware of the importance of

adequate training for all involved professionals in intervention delivery. However, the remark we are making here goes further toward the higher as well as secondary vocational educational programs. The search for a high quality of care for older people is high on the agenda giving the changing demographics represented by the high numbers of developed and implemented integrated care interventions. Professionals are continuously confronted with new innovations in everyday care which means they also have to adapt continuously. Therefore, educational programs should focus on cross-curricular competences such as interprofessional collaboration, leadership, and adaptive capacity to educate future professionals in dealing with continuous changes and innovations in health care.

In this discussion, we focused on the individual, team and organization level. A fourth level, the macro or system level, considers contextual factors from the external environment such as health policy, public reporting structures, the structure and dynamics of the wider health service and the capacity of the community, which can occur on regional, national or international level.<sup>27</sup> Changing laws and regulations, projectification, and financial structures can negatively affect the implementation.<sup>56,62,63</sup> Effective participation in health policy requires specific competences from professionals such as leadership, political or strategical and communication skills.<sup>64-66</sup> These competences are, in our opinion, related to the discussed individual, team and organization level as individual skills, relationships, leadership skills and the availability of resources (e.g. employers should support professionals—especially those in leadership roles—to work with policy decisionmakers) were highlighted as important contextual factors. In this, the external environment interacts with the individual, team and organization level, as shown in Figure 1.

## CONCLUSION

Complex interventions are complex by nature as it is targeted on both professionals and patients, multi-faceted, with many interacting components. Therefore, complex interventions can be approached as a set of potentially effective and interacting mechanisms that can result in a certain effect within a specific context. Insights into the context should inform (further) intervention development and guide the implementation process, including the best fitting implementation strategies and the choice of intermediate outcomes. Hence, all relevant stakeholders should be involved from the start and prioritize with each other the specific context to analyze on the individual, team and organisational level with attention for the target population and external environment. Examining the specific context is an ongoing

process that should be monitored over time so that intervention development as well as the implementation process can steer a new course in time to adapt to the context. Different methodological approaches in evaluation, considering the impact of context will help reduce research waste and realize effective proactive primary care programs for older people. Implementing complex interventions is like building a boat: the tests on seaworthiness, customer satisfaction or internal processes are never done at once after the boat has been built. It is an continuous, interacting process during the construction, sometimes even continuing after the boat has been launched.



## REFERENCES

1. Mercer S, Furler J, Moffat K, Fischbacher-Smith D, Sanci L. *Multimorbidity: technical series on safer primary care*. Geneva: World Health Organization; 2016.
2. Vetrano DL, Palmer K, Marengoni A, et al. Frailty and multimorbidity: a systematic review and meta-analysis. *J Gerontol A Biol Sci Med Sci*. 2019;74(5):659–66.
3. Beswick AD, Rees K, Dieppe P, et al. Complex interventions to improve physical function and maintain independent living in elderly people: a systematic review and meta-analysis. *Lancet*. 2008;371(9614):725–35.
4. Markle-Reid M, Browne G, Weir R, Gafni A, Roberts J, Henderson SR. The effectiveness and efficiency of home-based nursing health promotion for older people: a review of the literature. *Med Care Res Rev*. 2006;63(5):531–69.
5. Looman WM, Huijsman R, Fabbriotti IN. The (cost-) effectiveness of preventive, integrated care for community-dwelling frail older people: A systematic review. *Health Soc Care Community*. 2019;27(1):1–30.
6. Guise J-M, Chang C, Butler M, Viswanathan M, Tugwell P. AHRQ series on complex intervention systematic reviews—paper 1: an introduction to a series of articles that provide guidance and tools for reviews of complex interventions. *J Clin Epidemiol*. 2017;90:6–10.
7. Hariton E, Locascio JJ. Randomised controlled trials—the gold standard for effectiveness research. *Br J Obstet Gynaecol*. 2018;125(13):1716.
8. Greenhalgh T, Howick J, Maskrey N. Evidence based medicine: a movement in crisis? *BMJ*. 2014;348.
9. Bleijenberg N, Drubbel I, Schuurmans MJ, et al. Effectiveness of a proactive primary care program on preserving daily functioning of older people: a cluster randomized controlled trial. *J Am Geriatr Soc*. 2016;64(9):1779–88.
10. Blom J, den Elzen W, van Houwelingen AH, et al. Effectiveness and cost-effectiveness of a proactive, goal-oriented, integrated care model in general practice for older people. A cluster randomised controlled trial: Integrated Systematic Care for older People—the ISCOPE study. *Age Ageing*. 2016;45(1):30–41.
11. Metzelthin SF, van Rossum E, de Witte LP, et al. Effectiveness of interdisciplinary primary care approach to reduce disability in community dwelling frail older people: cluster randomised controlled trial. *BMJ*. 2013;347.
12. Looman WM, Fabbriotti IN, de Kuyper R, Huijsman R. The effects of a pro-active integrated care intervention for frail community-dwelling older people: a quasi-experimental study with the GP-practice as single entry point. *BMC Geriatr*. 2016;16(1):1–10.
13. Hoogendijk EO, Van Der Horst HE, Van De Ven PM, et al. Effectiveness of a geriatric care model for frail older adults in primary care: results from a stepped wedge cluster randomized trial. *Eur J Intern Med*. 2016;28:43–51.

14. Ruikes FG, Zuidema SU, Akkermans RP, Assendelft WJ, Schers HJ, Koopmans RT. Multicomponent program to reduce functional decline in frail elderly people: a cluster controlled trial. *J Am Board Fam Med.* 2016;29(2):209–17.
15. Stijnen M, Vrijhoef H, Jansen M, Candel M, Duimel-Peeters I. Effectiveness of a nurse-led home visitation programme on health-related quality of life and disability among potentially frail community-dwelling older people in primary care: a longitudinal, quasi-experimental study. Towards proactive care for potentially frail older people in general practice. 2015;121.
16. Suijker JJ, van Rijn M, Buurman BM, Ter Riet G, Moll Van Charante EP, De Rooij SE. Effects of nurse-led multifactorial care to prevent disability in community-living older people: cluster randomized trial. *PloS One.* 2016;11(7):e0158714.
17. Uittenbroek RJ, Kremer HP, Spoorenberg SL, Reijneveld SA, Wynia K. Integrated care for older adults improves perceived quality of care: results of a randomized controlled trial of embrace. *J Gen Intern Med.* 2017;32(5):516–23.
18. De Geest S, Zúñiga F, Brunkert T, et al. Powering Swiss health care for the future: implementation science to bridge “the valley of death.” *Swiss Medical Weekly.* 2020;150(3738).
19. Smit LC, Schuurmans MJ, Blom JW, et al. Unravelling complex primary-care programs to maintain independent living in older people: a systematic overview. *J Clin Epidemiol.* 2018;96:110–9.
20. Pawson R, Tilley N. *Realistic evaluation.* Sage; 1997.
21. Craig P, Ruggiero ED, Frohlich KL, Mykhalovskiy E, White M, Campbell R, et al. *Taking account of context in population health intervention research: guidance for producers, users and funders of research.* Canadian Institutes of Health Research (CIHR)–National Institute for Health Research (NIHR) Context Guidance Authors Group. Southampton: National Institute for Health Research. 2018. <https://doi.org/10.3310/cihr-nihr-01>. Accessed May 5, 2021.
22. Pfadenhauer LM, Mozygemba K, Gerhardus A, et al. Context and implementation: a concept analysis towards conceptual maturity. *Z Evid Fortbild Qual Gesundheitsw.* 2015;109:103–14.
23. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ.* 2008;337.
24. Pfadenhauer LM, Gerhardus A, Mozygemba K, et al. Making sense of complexity in context and implementation: the Context and Implementation of Complex Interventions (CICI) framework. *Implement Sci.* 2017;12(1):1-7.
25. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4(1):1–15.

26. Chaudoir SR, Dugan AG, Barr CH. Measuring factors affecting implementation of health innovations: a systematic review of structural, organizational, provider, patient, and innovation level measures. *Implement Sci.* 2013;8(1):1–20.
27. Rogers L, De Brún A, McAuliffe E. Defining and assessing context in healthcare implementation studies: a systematic review. *BMC Health Serv Res.* 2020;20(1):1–24.
28. O’Cathain A, Croot L, Duncan E, et al. Guidance on how to develop complex interventions to improve health and healthcare. *BMJ Open.* 2019;9(8):e029954.
29. Nilsen P. Making sense of implementation theories, models and frameworks *Implement Sci.* 2015;10(1):53.
30. Nilsen P, Bernhardsson S. Context matters in implementation science: a scoping review of determinant frameworks that describe contextual determinants for implementation outcomes. *BMC Health Serv Res.* 2019;19(1):1–21.
31. Powell BJ, McMillen JC, Proctor EK, et al. A compilation of strategies for implementing clinical innovations in health and mental health. *Med Care Res Rev.* 2012;69(2):123–57.
32. Deschodt M, Laurent G, Cornelissen L, et al. Core components and impact of nurse-led integrated care models for home-dwelling older people: a systematic review and meta-analysis. *Int J Nurs Stud.* 2020;105:103552.
33. Karrer M, Hirt J, Zeller A, Saxer S. What hinders and facilitates the implementation of nurse-led interventions in dementia care? A scoping review. *BMC Geriatr.* 2020;20:1–13.
34. Lorthios-Guillement A, Richard L, Filiatrault J. Factors associated with the implementation of community-based peer-led health promotion programs: a scoping review. *Eval Program Plann.* 2018;68:19–33.
35. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol.* 2000;55(1):68.
36. Vissman AT, Eng E, Aronson RE, et al. What do men who serve as lay health advisers really do?: Immigrant Latino men share their experiences as Navegantes to prevent HIV. *AIDS Educ Prev.* 2009;21(3):220–32.
37. Bleijenberg N, Ten Dam VH, Steunenbergh B, et al. Exploring the expectations, needs and experiences of general practitioners and nurses towards a proactive and structured care programme for frail older patients: a mixed-methods study. *J Adv Nurs.* 2013;69(10):2262–73.
38. O’Keefe M, Henderson A, Chick R. Defining a set of common interprofessional learning competencies for health profession students. *Med Teach.* 2017;39(5):463–8.
39. Smit L, Dikken J, Pool I, et al. The Methodological Development of an Interprofessional Educational Program to Provide Proactive Integrated Care for Elders. *J Res Interprof Pract Educ.* 2020;9(2).
40. Smit LC, Dikken J, Moolenaar NM, Schuurmans MJ, De Wit NJ, Bleijenberg N. Implementation of an interprofessional collaboration in practice program: a feasibility study using social network analysis. *Pilot Feasibility Stud.* 2021;7(1):1–12.

41. Keating NL, Ayanian JZ, Cleary PD, Marsden PV. Factors affecting influential discussions among physicians: a social network analysis of a primary care practice. *J Gen Intern Med.* 2007;22(6):794–8.
42. Zappa P. The network structure of knowledge sharing among physicians. *Qual Quant.* 2011;45(5):1109–26.
43. Wener P, Woodgate RL. Collaborating in the context of co-location: a grounded theory study. *BMC Fam Pract.* 2016;17(1):1–15.
44. Dey RM, de Vries MJ, Bosnic-Anticevich S. Collaboration in chronic care: unpacking the relationship of pharmacists and general medical practitioners in primary care. *Int J Pharm Pract.* 2011;19(1):21–9.
45. Smit LC, Dikken J, Schuurmans MJ, De Wit NJ, Bleijenberg N. Value of social network analysis for developing and evaluating complex healthcare interventions: a scoping review. *BMJ Open.* 2020;10(11):e039681.
46. Valente TW, Palinkas LA, Czaja S, Chu K-H, Brown CH. Social network analysis for program implementation. *PloS One.* 2015;10(6):e0131712.
47. Latkin CA, Knowlton AR. Social network assessments and interventions for health behavior change: a critical review. *Behav Med.* 2015;41(3):90–7.
48. Perkins JM, Subramanian S, Christakis NA. Social networks and health: a systematic review of sociocentric network studies in low-and middle-income countries. *Soc Sci Med.* 2015;125:60–78.
49. Moore GF, Evans RE, Hawkins J, et al. From complex social interventions to interventions in complex social systems: future directions and unresolved questions for intervention development and evaluation. *Evaluation.* 2019;25(1):23–45.
50. Datta J, Petticrew M. Challenges to evaluating complex interventions: a content analysis of published papers. *BMC public health.* 2013;13(1):1–18.
51. Kormelinck CMG, Janus SI, Smalbrugge M, Gerritsen DL, Zuidema SU. Systematic review on barriers and facilitators of complex interventions for residents with dementia in long-term care. *Int Psychogeriatr.* 2020;1–17.
52. Kadu MK, Stolee P. Facilitators and barriers of implementing the chronic care model in primary care: a systematic review. *BMC Fam Pract.* 2015;16(1):1–14.
53. Kromhout M, Kornalijslijper N, De Klerk M. *Veranderde zorg en ondersteuning voor mensen met een beperking, Landelijke evaluatie van de Hervorming Langdurige Zorg.* [Altered care and support for people with a disability, National evaluation of the Long-term Care Reform]. Sociaal en Cultureel Planbureau; 2018. Available from: <https://www.scp.nl/binaries/scp/documenten/publicaties/2018/06/27/veranderde-zorg-en-ondersteuning-voor-mensen-met-een-beperking/Veranderde+zorg+en+ondersteuning+voor+mensen+met+een+beperking.pdf> Accessed May 5, 2021.
54. Cameron A, Lart R, Bostock L, Coomber C. Factors that promote and hinder joint and integrated working between health and social care services: a review of research literature. *Health Soc Care Community.* 2014;22(3):225–33.

55. Béland F, Hollander MJ. Integrated models of care delivery for the frail elderly: international perspectives. *Gac Sanit.* 2011;25:138–46.
56. Chalmers I, Bracken MB, Djulbegovic B, Garattini S, Grant J, Gülmezoglu AM, et al. How to increase value and reduce waste when research priorities are set. *Lancet.* 2014;383(9912):156–65.
57. Smit LC, De Wit NJ, Nieuwenhuizen ML, Schuurmans MJ, Bleijenberg N. Influence of organizational context on patient outcomes regarding the effectiveness of a proactive primary care program: a longitudinal observational study. *Under Review.*
58. Froehlich DE, Rehm M, Rienties BC. *Mixed methods approaches to social network analysis.* The Open University of London, UK: Taylor & Francis, 2020.
59. Edwards G. *Mixed-method approaches to social network analysis.* ESRC National Centre for Research Methods Review paper. National Centre for Research Methods; 2010 Available from: [eprints.ncrm.ac.uk/842/](http://eprints.ncrm.ac.uk/842/). Accessed May 5, 2021
60. Fuhse J, Mützel S. Tackling connections, structure, and meaning in networks: quantitative and qualitative methods in sociological network research. *Qual Quant.* 2011;45(5):1067–89.
61. Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care.* 2012;50(3):217.
62. Van Haeften-Van Dijk AM, Van Weert JC, Dröes R-M. Implementing living room theatre activities for people with dementia on nursing home wards: a process evaluation study. *Aging Ment Health.* 2015;19(6):536–47.
63. Wehrens R, Oldenhof L, Bal R. On Staging Work: How Research Funding Bodies Create Adaptive Coherence in Times of Projectification. *Sci Technol Human Values.* 2021;01622439211005557.
64. Montalvo W. Political skill and its relevance to nursing: an integrative review. *J Nurs Adm.* 2015;45(7/8):377–83.
65. Shariff NJ. A Delphi survey of leadership attributes necessary for national nurse leaders' participation in health policy development: an East African perspective. *BMC Nurs.* 2015;14(1):1–8.
66. Waddell A, Adams JM, Fawcett J. Exploring nurse leaders' policy participation within the context of a nursing conceptual framework. *Policy Polit Nurs Pract.* 2017;18(4):195–205.





# SUMMARY



The scientific journal *The Lancet* published a series of reviews demonstrating that 30 to more than 50 percent of scientific studies does not contribute to the knowledge development of health care. This was labelled as research waste. This waste arises from the impurities at different stages of research, as research is not published, has avoidable design flaws, and is unusable or incompletely reported. In addition to the forms of research waste as described in *The Lancet*, more attention has been paid to other forms of waste over the last years. In particular, the waste that arises because scientific findings fails to be applied in clinical practice. One explanation for this is that current intervention research, including the development, evaluation and implementation, does not always match with daily practice, which is a more complex, dynamic and less-resourced real-world setting than the experimental research environment.

The rapidly aging population requires that daily clinical practice must continuously adapt in order to provide optimal care. Due to the increase of frail older people with complex care needs, health care service utilisation and costs increase, urging health care systems to innovate care for older people. Preventive, integrated care is increasingly promoted as the leading concept in future elderly care and key to keep frail older people functioning independently in the community. A proactive primary care program connects the curative medical domain to areas such as prevention, mental health, housing and welfare, and therefore requires an interprofessional collaboration. However, nine large-scaled proactive primary care programs aiming to maintain community-dwelling older people's independence (conducted from 2009 to 2016) could not demonstrated clinically relevant improvement of independence. These observations triggered the question why these so-called complex interventions fail to demonstrate benefit and if this was related to the inadequate design or implementation of the intervention.

Proactive primary care programs for older people can be defined as complex interventions since they are complex by nature, targeted at both professionals and patients, and are multi-faceted, with many interacting components. Generic approaches e.g. a 'one size fits all' may poorly fit the specific setting which could inhibit a successful implementation. For example, a generic approach could evoke resistance of individuals who will be affected by the intervention as well as hamper engagement of individuals who are needed to accomplish a successful implementation. Therefore, to limit the risk of inadequate implementation and the failure to replicate, more emphases should be given in intervention research on the implementation context.

This thesis aimed to unravel and better understand the methodological challenges of complex proactive primary care programs for older people, the impact of the context in which they are delivered, and the importance of interprofessional collaboration to improve their implementation success.

The objectives of this thesis were as follows:

1. To unravel the development, the evaluation and the contextual factors of complex proactive primary care programs for older people living at home.
2. To improve the interprofessional collaboration between professionals involved in complex proactive primary care programs for older people.

## **Part 1. Unravelling the development and evaluation of complex proactive primary care programs for older people living at home.**

The first part of this thesis addresses the unravelling of the development, the evaluation and the contextual factors of complex proactive primary care programs.

**Chapter 2** describes a systematic overview of all written data on nine complex proactive primary care programs (involving 214 general practices throughout the Netherlands) using a validated item list. This study aimed to systematically unravel, compare and synthesise the development and evaluation of nine primary care programs within a controlled trial to further improve the development and evaluation of complex interventions. Results showed little or no attention is paid to the 1) context surrounding the care programme, 2) modelling of processes and outcomes, 3) intervention fidelity and adaptation, and 4) content and evaluation of training for interventionists. An in-depth analysis of the context, modelling of the processes and outcomes, measurement and reporting of intervention fidelity, and effective training for interventionists is needed to enhance the development and replication of future complex interventions.

**Chapter 3** describes a longitudinal observational non-comparative 12 month follow-up study that explores which characteristics of primary care practice influences patient outcomes (e.g. daily functioning and acute admissions) in the context of a clinical effectiveness study, the U-PROFIT 2.0 program. The U-PROFIT program is a complex proactive primary care program to preserve daily functioning by providing an integrated care collaboration between the general practice, district nursing and social care professionals. Relevant characteristics of the primary care practices were: practice neighbourhood socio-economic status, single general

practice versus healthcare centre and ratio of professionals (GPs and nurses) frail older patient per practices. Relevant factors regarding delivery of the program were the interventionist (practice nurse/district nurse), number of years since the start of the implementation and choice of age threshold for frailty screening. Patient outcomes were daily functioning, hospital admissions, emergency department visits, general practice out-of-hours consultations. Linear and generalised linear mixed models were used. A total of 827 frail older people were registered at baseline. Delivery of the program by a district nurse compared to a practice nurse was significantly associated with a decrease in daily functioning on patient-level ( $\beta=2.19$ ;  $P = <0.001$ ). If the U-PROFIT program was implemented three years ago compared to nine years ago was significantly associated with less out-of-hours consultations to a general practice (OR 0.11;  $P = 0.001$ ). Applying the frailty screening from the age of 75 compared to those targeted from the age of 60 years showed a significant increase in emergency admissions (OR 5.26;  $P= 0.03$ ). Several characteristics of general practices were associated with daily functioning and acute admissions of community-dwelling elderly people receiving a complex proactive primary care program. This study showed that the organizational context is vital regarding the choices made in delivering the U-PROFIT 2.0 intervention. The impact of these choices on patient outcomes should be monitored to give direction in the implementation process. Incorporating this ongoing implementation process can result in better-balanced choices to enhance the effectiveness of proactive care for older people living in the community.

**Chapter 4** describes a scoping review that was conducted to identify in which phases of complex intervention research a social network analysis (SNA) is used and to explore the value of SNA for developing and evaluating complex health care interventions. The scoping review was conducted using the Arksey and O'Malley methodological framework. We included complex healthcare intervention studies using SNA and identified the study characteristics, level of complexity of the health care interventions, reported strengths and limitations, and reported implications of SNA. Among 2,466 identified studies, 25 studies were selected for analysis. At first, the results showed that SNA seems underutilised in evaluating complex intervention research. Second, SNA was not used in the development phase of the included studies. Third, the reported implications in the evaluation and implementation phase reflect the value of SNA in addressing the implementation and population complexity. Fourth, pathway complexity and contextual complexity of the included interventions were unclear or unable to access. Fifth, a mixed-methods approach was reported as a strength, as the combination and integration of quantitative and qualitative methods clearly establish the results. SNA is a widely applicable method that can be used in different phases of complex intervention research. SNA can

be of value to disentangle and address the level of complexity of complex health care interventions. Furthermore, the routine use of SNA within a mixed-method approach could yield actionable insights that would be useful to address social networks that are important when implementing complex interventions.

## **Part 2. Improving the interprofessional collaboration between professionals involved in proactive primary care programs for older people**

The second part of this thesis focuses on the interprofessional collaboration between professionals involved in complex proactive primary care programs for older people.

**Chapter 5** describes the methodological development and the final content of an interprofessional collaboration in practice (IPCP) program for primary care. The development of the IPCP program consisted of the following steps: 1) the identification of competencies for IPCP; 2) a needs analysis among healthcare professionals and elderly; and 3) the design of the IPCP program and proposed evaluation. The development process started with the identification of IPCP competencies in a literature review followed by a qualitative needs analysis with semi-structured interviews among eight older people and four health care professionals. The results were discussed during a first consultation with an expert team, which consisted of ten health care professionals. Consensus was reached on the themes of role identity, communication, and shared vision development to form the basis of the program. A second consultation with the experts discussed the first version of the program. Then, consensus was reached on the final version of the program, which included a blended learning approach consisting of two face-to-face meetings, online learning, and on-the-job learning with a sixteen-hour time investment over a six-week period. The IPCP program was developed based on educational strategies and evidence, with the support and knowledge of an expert team to fit the implementation context.

**Chapter 6** describes the feasibility of the implementation of the IPCP program in three community districts and determines the acceptability and feasibility of data collection and analysis regarding the interprofessional collaboration between primary healthcare professionals caring for older people. A questionnaire was used to measure the professionals' learning experience and the acquisition of knowledge and skills regarding the program. Network development was assessed by distributing a social network survey among professionals both attending the program and professionals not attending the program at baseline and five and a half

months later. Network development was determined by calculating the number, reciprocity, value, and diversity of contacts between professionals using social network analysis. The IPCP program was found to be instructive and the knowledge and skills gained were applicable in practice. Social network analysis was feasible to conduct and revealed a spill-over effect regarding network development. Program participants, as well as non-program participants, had larger, more reciprocal, and more diverse interprofessional networks than they did before the program. This study demonstrated the feasibility of implementing an IPCP program in terms of acceptability, feasibility of data collection and social network analysis to measure network development, and indicated the potential to increase interprofessional collaboration between primary healthcare professionals.

The discussion paper in **Chapter 7** critically reflects on the influence of context when evaluating the effectiveness of complex proactive primary care programs. We discussed the impact of context on three levels (i.e. individual, team, and organisational level), illustrating this with specific examples from previous studies we conducted and described future perspectives on how context can be taken into account when developing and evaluating complex interventions. On the individual level, we conclude that training is crucial in developing and sustaining complex primary care programs. The training should emphasize acquiring competences, social relationships and maintain professional autonomy as these factors can enhance implementation success. On team level, team networks can provide useful information regarding the characteristics of each professional, their social relationships and how the team works or collaborates, which can tailor the efforts in implementing an innovation. On the organizational level, researchers should be aware of the difficulties in addressing context and the possibility that adaptations in a complex care innovation are made by organisations themselves based on organizational constraints without considering the potential impact on patient outcomes. Suggesting the need for stakeholder involvement from the development phase of complex intervention research as a relevant key action. Future intervention research should incorporate contextual factors as intermediate outcomes, emphasize on training professionals, and should embrace social network analysis as a method as social relationships play an essential part in the context of implementation. In conclusion, examining the specific context is a continuous and iterative process that starts from the development phase. Insight in this process can ensure that an inadequate addressing of the context is identified in time and provides leverage points for charting a new course. Different methodological approaches in evaluation, considering the impact of context will help reduce research waste and realize effective proactive primary care programs for older people.

# SAMENVATTING

Het wetenschappelijke tijdschrift *The Lancet* publiceerde een serie artikelen die aantoonde dat 30 tot ruim 50 procent van de wetenschappelijke studies niet bijdragen aan de kennisontwikkeling in de gezondheidszorg en beschouwd kunnen worden als research waste (onderzoek verspilling). Research waste komt voort uit onvolkomenheden in de verschillende stadia van onderzoek, bijvoorbeeld wanneer onderzoek niet wordt gepubliceerd, het vermijdbare ontwerpfouten heeft en/ of onbruikbaar of onvolledig is gerapporteerd. Naast de in de *Lancet* beschreven vormen van research waste is er de laatste jaren steeds meer aandacht voor andere vormen van waste. Met name de research waste die ontstaat doordat wetenschappelijke bevindingen uiteindelijk niet worden toegepast in de klinische praktijk. Een verklaring hiervoor is dat huidig interventie onderzoek, inclusief de ontwikkeling, evaluatie en implementatie daarvan, niet goed past in de dagelijkse praktijk, die vaak veel complexer en dynamischer is dan de experimentele onderzoek omgeving.

De snel vergrijzende bevolking maakt dat de dagelijkse zorgpraktijk in de eerstelijns zich continue moet aanpassen om optimale zorg te kunnen bieden. Door de toename van het aantal kwetsbare ouderen met complexe zorgbehoeften nemen het gebruik en de kosten van de gezondheidszorg toe, waardoor gezondheidszorgstelsels worden uitgedaagd om de zorg voor ouderen te innoveren. Proactieve eerstelijns ouderenzorgprogramma's worden in toenemende mate ontwikkeld als het leidende concept in de toekomstige ouderenzorg en spelen een sleutelrol in het streven om bij te dragen aan de zelfredzaamheid van kwetsbare ouderen in de samenleving. Een proactief eerstelijns ouderenzorgprogramma verbindt het curatief medisch domein met domeinen als preventie, geestelijke gezondheidszorg, wonen en welzijn en vraagt daarom om een interprofessionele samenwerking. Negen in de afgelopen jaren uitgevoerde grootschalige proactieve eerstelijns ouderenzorgprogramma's, gericht op het behoud van de zelfredzaamheid van thuiswonende ouderen, lieten in wetenschappelijke evaluatie (uitgevoerd in de periode 2009 tot en met 2016) echter geen klinische verbetering zien van de zelfredzaamheid van ouderen. Deze bevinding roept de vraag op waarom deze zogenoemde complexe interventies onvoldoende impact hebben op patiënten uitkomsten en of dit te maken heeft met een inadequate opzet en/of implementatie van de interventie.

Proactieve eerstelijns ouderenzorgprogramma's kunnen worden gedefinieerd als complexe interventies omdat ze complex van aard zijn, gericht zijn op zowel professionals als patiënten, veelzijdig zijn en veel interacterende componenten hebben. Generieke benaderingen ook wel een 'one size fits all' genoemd, sluiten slecht aan op een specifieke context. Een misfit tussen de interventie en de context kan bijvoorbeeld weerstand oproepen bij individuen die betrokken zijn bij de interventie maar ook de betrokkenheid zelf belemmeren welke juist nodig

is om een succesvolle implementatie te bereiken. Om de kans op een succesvolle implementatie te vergroten zou in interventie onderzoek meer nadruk moeten worden gelegd op de implementatie context.

Het doel van dit proefschrift is het ontrafelen en beter begrijpen van de methodologische uitdagingen voor de ontwikkeling en evaluatie van onderzoek naar complexe proactieve eerstelijns ouderenzorgprogramma's, de impact van de context waarin ze worden uitgevoerd, en het belang van interprofessionele samenwerking om het implementatiesucces te verbeteren.

De doelstellingen van dit proefschrift zijn als volgt:

1. Het ontrafelen van de ontwikkeling, de evaluatie en de contextuele factoren van complexe proactieve eerstelijns ouderenzorgprogramma's.
2. Het verbeteren van de interprofessionele samenwerking tussen professionals die betrokken zijn bij complexe proactieve eerstelijns ouderenzorgprogramma's.

## **Deel 1. Ontrafelen van de ontwikkeling en evaluatie van complexe proactieve eerstelijns ouderenzorgprogramma's.**

Het eerste deel van dit proefschrift beoogt het ontrafelen van de ontwikkeling, de evaluatie en de contextuele factoren van complexe proactieve eerstelijns ouderenzorgprogramma's.

**In Hoofdstuk 2** worden negen proactieve eerstelijns ouderenzorgprogramma's systematisch geanalyseerd met betrekking tot de ontwikkeling en evaluatie van deze programma's. Alle proactieve eerstelijns ouderenzorgprogramma's zijn in grootschalige (cluster) gerandomiseerde trials geëvalueerd in de periode 2009-2016. Hierbij waren 214 huisartsenpraktijken betrokken, waarbij een totaal van 15,058 ouderen uit heel Nederland geïncludeerd waren. Alle schriftelijke gegevens van deze proactieve eerstelijns ouderenzorgprogramma's zijn geanalyseerd met behulp van een gevalideerde itemlijst. Uit de resultaten bleek dat er weinig of geen aandacht was voor de 1) context van het zorgprogramma, 2) modellering van processen en uitkomsten, 3) betrouwbaarheid en aanpassing van de interventie, en 4) inhoud en evaluatie van de training voor interventionisten. Om de ontwikkeling en replicatie van toekomstige complexe interventies te optimaliseren is een diepgaande analyse van de context, modellering van de processen en uitkomsten aangaande de interventie, meting en rapportage van de fidelity (is het programma uitgevoerd zoals gepland), en implementatie van effectieve training voor interventionisten nodig.



**In Hoofdstuk 3** wordt onderzocht welke kenmerken van huisartspraktijken invloed hebben op de patiënten uitkomsten in de context van een specifieke klinische effectiviteitsstudie, het U-PROFIT 2.0 programma. Dit complexe proactieve eerstelijns ouderenzorgprogramma richt zich op het behoud van zelfredzaamheid van thuiswonende ouderen waarbij het integrale zorg levert tussen de huisartspraktijk, wijkverpleging en professionals vanuit het sociaal domein. Relevante kenmerken van de huisartspraktijken waren: sociaaleconomische status van omgeving waarin praktijk is gevestigd, solo huisartsenpraktijk versus zorgcentrum en professional-kwetsbare oudere patiënt ratio per praktijk van huisartsen en verpleegkundigen. Relevante factoren voor de uitvoering van het programma waren de interventionist (praktijkverpleegkundige / wijkverpleegkundige), het aantal jaren (looptijd) sinds de start van de implementatie en de leeftijdsgrens voor kwetsbaarheidsscreening. Patiëntuitkomsten waren dagelijks functioneren, ziekenhuisopnames, bezoeken aan spoedeisende hulp, en huisartsenconsulten buiten kantooruren. Linear and generalized linear mixed modellen werden gebruikt. In totaal werden bij aanvang 827 kwetsbare ouderen geregistreerd. Het uitvoeren van het programma door een wijkverpleegkundige in vergelijking met een praktijkverpleegkundige was significant geassocieerd met een afname van het dagelijks functioneren op patiëntniveau ( $\beta=2.19$ ;  $P<0.001$ ). Implementatie van het U-PROFIT 2.0 programmadrie jaar geleden vergeleken met negen jaar geleden was significant geassocieerd met minder huisartsenpraktijk consulten buiten kantooruren (OR 0,11;  $P = 0,001$ ). Bij het toepassen van kwetsbaarheidsscreening vanaf 75 jaar vergeleken met de doelgroep vanaf 60 jaar, werd een significante toename van spoedopnames waargenomen (OR 5,26;  $P= 0,03$ ). Verschillende kenmerken van huisartsenpraktijken waren geassocieerd met het dagelijks functioneren en acute opnames van thuiswonende ouderen die een proactief eerstelijnszorgprogramma ontvangen. Dit onderzoek toonde aan dat de organisatorische context van vitaal belang is bij de keuzes die worden gemaakt bij het leveren van een complex eerstelijnszorgprogramma. De impact van deze keuzes op patiëntuitkomsten moet worden gemonitord om richting te geven aan het implementatieproces. Oog hebben voor dit continue implementatieproces kan resulteren in uitgebalanceerde keuzes om proactieve zorg voor ouderen in de eerstelijns te verbeteren.

**Hoofdstuk 4** beschrijft een scoping review die is uitgevoerd om te identificeren in welke fasen van complexe interventie onderzoek sociale netwerkanalyse (SNA) kan worden gebruikt én wat de waarde van SNA is voor het ontwikkelen en evalueren van complexe interventies binnen de gezondheidszorg. De scoping review werd uitgevoerd met behulp van het methodologische raamwerk van Arksey en O'Malley. We hebben complexe interventies vanuit de gezondheidszorg geïncludeerd die SNA gebruikten om onderzoek kenmerken, het niveau van complexiteit

van de interventies, de gerapporteerde sterke punten en beperkingen, en de gerapporteerde implicaties van SNA te identificeren. Van de 2.466 geïdentificeerde studies werden 25 studies geïnccludeerd voor analyse. In eerste instantie lieten de resultaten zien dat SNA onderbenut lijkt bij de evaluatie van complexe interventies. Ten tweede werd SNA niet gebruikt in de ontwikkelingsfase van de geïnccludeerde studies. Ten derde weerspiegelen de gerapporteerde implicaties in de evaluatie- en implementatiefase de waarde van SNA bij het aanpakken van de implementatie en populatiecomplexiteit. Ten vierde waren de pathway complexiteit als ook de contextuele complexiteit van de opgenomen interventies onduidelijk of niet toegankelijk. Ten vijfde werd het gebruik van mixed methods als een sterk punt gerapporteerd, aangezien de combinatie en integratie van een kwantitatieve en kwalitatieve methode de resultaten verduidelijkt. SNA is een breed toepasbare methode die in verschillende fasen van complexe interventieonderzoeken kan worden ingezet. SNA kan waardevol zijn om de complexiteit van complexe zorginterventies te ontwarren en aan te pakken. Bovendien zou het routinematige gebruik van SNA binnen een mixed methods aanpak bruikbare inzichten kunnen opleveren over sociale netwerken die van belang zijn bij de implementatie van complexe interventies.

## **Deel 2. Verbeteren van de interprofessionele samenwerking tussen professionals die betrokken zijn bij proactieve eerstelijns ouderenzorgprogramma's.**

Het tweede deel van dit proefschrift richt zich op de verbetering van interprofessionele samenwerking tussen eerstelijns professionals die betrokken zijn bij proactieve eerstelijns ouderenzorgprogramma's.

**Hoofdstuk 5** beschrijft de methodologische ontwikkeling en de uiteindelijke inhoud van een interprofessioneel educatieprogramma in de eerstelijnszorg. Het ontwikkelingsproces begon met de identificatie van interprofessionele samenwerkingscompetenties middels een literatuuronderzoek en een kwalitatieve behoefteanalyse met semigestructureerde interviews onder acht ouderen en vier professionals in de eerstelijnszorg. De resultaten zijn besproken tijdens een eerste consultatie met een deskundig team, bestaande uit tien professionals vanuit de eerstelijnszorg. Over de thema's roldentiteit, communicatie en gedeelde visieontwikkeling is consensus bereikt waarmee de basis van het programma werd gevormd. Een tweede consultatie met de experts besprak de eerste versie van het interprofessioneel educatieprogramma. Vervolgens werd consensus bereikt over de definitieve versie van het programma, dat een blended learning aanpak omvatte bestaande uit twee face-to-face meetings, online leren en leren

op de werkplek met een tijdsinvestering van zestien uur over een periode van zes weken. Het interprofessioneel educatieprogramma is ontwikkeld op basis van educatieve strategieën en wetenschappelijke kennis, en met de steun en kennis van praktijkexperts waardoor het programma aansluit op de implementatie context.

**Hoofdstuk 6** beschrijft de haalbaarheid van de implementatie van het interprofessioneel educatieprogramma in drie wijken in Utrecht en bepaalt het potentieel om de interprofessionele samenwerking tussen eerstelijnsgezondheidszorgprofessionals die voor ouderen zorgen te vergroten. Er is een feasibility studie uitgevoerd om de aanvaardbaarheid en haalbaarheid van gegevensverzameling en -analyse met betrekking tot interprofessionele samenwerking in een wijk te bepalen. Om de leerervaring, en de verwerving van kennis en vaardigheden met betrekking tot het programma te meten, is gebruik gemaakt van een vragenlijst. De netwerkontwikkeling werd beoordeeld, bij aanvang van het programma en vijf en een halve maand daarna, door een sociale netwerk enquête te verspreiden onder professionals die het programma volgden en professionals die het programma niet bijwoonden. Netwerkontwikkeling werd bepaald door het aantal, de wederkerigheid, de waarde en de diversiteit van contacten tussen professionals te berekenen met behulp van sociale netwerkanalyse. Het interprofessioneel educatieprogramma werd als leerzaam ervaren en de opgedane kennis en vaardigheden waren toepasbaar in de praktijk. Analyse van sociale netwerken was haalbaar om uit te voeren en liet een overloopeffect zien met betrekking tot netwerkontwikkeling. Zowel deelnemers aan het programma als niet-programmadeelnemers hadden een grotere, meer wederkerige en meer diverse interprofessionele netwerk dan vóór het programma. Deze studie toonde de haalbaarheid aan van het implementeren van een interprofessioneel educatieprogramma in termen van aanvaardbaarheid, haalbaarheid van gegevensverzameling en sociale netwerkanalyse om netwerkontwikkeling te meten. Tevens liet de studie zien dat er potentieel is om de interprofessionele samenwerking tussen eerstelijnsgezondheidswerkers te vergroten.

De discussiepaper in **Hoofdstuk 7** reflecteert op de invloed van context bij het evalueren van de effectiviteit van complexe proactieve eerstelijns ouderenzorgprogramma's. We bespreken de impact van context op drie niveaus (individueel, team- en organisatieniveau), illustreren dit met specifieke voorbeelden uit eerdere onderzoeken die we hebben uitgevoerd en beschrijven toekomstperspectieven over hoe met context rekening kan worden gehouden bij het ontwikkelen en evalueren van complexe interventies. Op individueel niveau concluderen we dat training cruciaal is in de ontwikkeling én in het borgen van complexe proactieve eerstelijns ouderenzorgprogramma's. De training moet

daarbij nadruk leggen op het verwerven van competenties, sociale relaties en het behouden van professionele autonomie aangezien deze factoren het implementatie succes kunnen vergroten. Op team niveau kan het netwerk van het team waardevolle informatie verschaffen over de kenmerken van elke professional, hun sociale relaties en hoe het team werkt of samenwerkt. Sociale netwerk analyse als methode kan van grote waarde zijn in het verzamelen en analyseren van deze informatie en daarmee richting geven aan de keuze van implementatie strategieën. Op organisatorisch niveau moeten onderzoekers zich bewust zijn van de uitdagingen in het adresseren van de (organisatorische) context. Tevens bestaat de kans dat organisaties zelf aanpassingen doen aan een interventie wanneer er (organisatorische) beperkingen zijn waarbij veelal geen rekening gehouden wordt met de mogelijke impact op patiënten uitkomsten. Dit laat de noodzaak zien voor het betrekken van stakeholders vanaf het begin van de interventie ontwikkeling. Toekomstig interventie onderzoek zou contextuele factoren als intermediaire uitkomsten kunnen gebruiken. Daarnaast zal er meer nadruk moeten gaan liggen bij het opleiden van professionals en zou de sociale netwerkanalyse als methode meer gebruikt moeten worden aangezien sociale relaties een essentiële rol spelen in de context van implementatie.

Concluderend, het onderzoeken van de implementatie context is een continu en iteratief proces dat start vanaf de ontwikkelingsfase. Inzichten in dit proces kan ervoor zorgen dat inadequate aandacht voor de context tijdig gesignaleerd wordt en geeft handvatten om een nieuwe koers uit te zetten. Het gebruik van verschillende methodologische benaderingen bij het evalueren van complexe interventies, waarbij rekening gehouden wordt met de impact van de context, zal research waste kunnen verminderen en effectieve proactieve eerstelijns ouderenzorgprogramma's voor ouderen helpen realiseren.



# **LIST OF PUBLICATIONS AND PRESENTATIONS**

## Scientific international publications

Rieckert A, Schuit E, Bleijenberg N, Ten Cate D, De Lange W, De Man-Van Ginkel JM, Mathijssen E, **Smit LC**, Stalpers D, Schoonhoven L, Veldhuizen JD, Trappenburg JCA. How can we build and maintain the resilience of our health care professionals during COVID-19? Recommendations based on a scoping review. *BMJ Open*. 2021;11:e043718. doi:10.1136/bmjopen-2020-043718

**Smit LC**, Dikken J, Moolenaar NM, Schuurmans MJ, De Wit NJ, Bleijenberg, N. Implementation of an interprofessional collaboration in practice program: a feasibility study using social network analysis. *Pilot Feasibility Stud*. 2021;7:7. doi:10.1186/s40814-020-00746-3

**Smit LC**, Dikken J, Schuurmans MJ, De Wit NJ, Bleijenberg, N. Value of social network analysis for developing and evaluating complex healthcare interventions: a scoping review. *BMJ Open*. 2020, 10:e039681. doi:10.1136/bmjopen-2020-039681

**Smit LC**, Dikken J, Van Wijk M, Pool IA, Schuurmans MJ, De Wit NJ, Bleijenberg N. The methodological development of an interprofessional educational program to provide proactive integrated care for elders. *J Res Interprof Pract Educ*. 2020, 9(2): 1-25. doi:10.22230/jripe.2019v9n2a295

**Smit LC**, Schuurmans MJ, Blom JW, Fabbriotti IN, Jansen APD, Kempen GIJM, Koopmans R, Looman WM, Melis RJF, Metzelthin SF, Moll Van Charante EP, Muntinga ME, Ruikes FGH, Spoorenberg SLW, Suijker JJ, Wynia K, Gussekloo J, De Wit NJ, Bleijenberg N. Unravelling complex primary-care programs to maintain independent living in older people: a systematic overview. *J Clinical Epidemiol*. 2018, 96: 110-119. doi:10.1016/j.jclinepi.2017.12.013

**Smit LC**, Bruins MJ, Patijn GA, Ruijs GJ. Infectious complications after major abdominal cancer surgery: in search of improvable risk factors. *Surg Infect*. 2016, 17(6): 683-693. doi:10.1089/sur.2016.033

## Abstract publications

**Smit LC**, Dikken J, Moolenaar NM, Schuurmans MJ, De Wit NJ, Bleijenberg, N. The evaluation of interprofessional education in primary care: a social network analysis. *Innov Aging*. 2019; 3:S1 47.

**Smit LC**, Dikken J, Van Wijk M, Pool IA, Schuurmans MJ, De Wit NJ, Bleijenberg N. Developing an interprofessional training for primary care: a co-creation with practice, education and research. *Int J Integr Care*. 2018;18(S2): A117, pp. 1-8

## Practice national publications

Rieckert A, Schuit E, Bleijenberg N, Ten Cate D, De Lange W, De Man-Van Ginkel JM, Mathijssen E, **Smit LC**, Stalpers D, Schoonhoven L, Veldhuizen JD, Trappenburg JCA. Behoud van korte en lange termijn fysieke/mentale gezondheid en inzetbaarheid van zorgprofessionals blootgesteld aan COVID-19 crisis werkomstandigheden. Praktische aanbevelingen op basis van bevindingen uit systematisch literatuuronderzoek bij de Covid-19 en vergelijkbare virusuitbraken en interviews met experts en ervaringsdeskundigen. 2 april 2020.

**Smit LC**, Dikken J. Sociale Netwerkanalyse. *TVZ- verpleegkd prakt wet.* 2020, 130:56–57. doi:10.1007/s41184-020-0143-9

**Smit LC**, Van Wijk, M. Effectief communiceren met de SBAR(R). *Nurse Academy O&T.* 2019, 1: 42-46.

Van Wijk M, **Smit LC**, Dikken J, Bleijenberg N. Ontwikkeling van een interprofessionele training in de wijk. *Onderwijs en Gezondheidszorg.* 2018, 42:1 22-23.

**Smit LC**, Dikken J, Schuurmans MJ, Bleijenberg N. Evaluatie van een interprofessioneel educatie programma. *Onderwijs en Gezondheidszorg.* 2018, 42:7 25-28.

## Scientific presentations

- *What is the added value of social network analysis when developing and evaluating complex interventions.* International Conference on Integrated Care, Šibenik, Croatia. 2020.
- *The evaluation of interprofessional education in primary care: a Social Network Analysis.* Gerontological Society of America Annual Scientific Meeting, Austin, Texas. 2019.
- *Interprofessional education in primary care: an evaluation using social network analysis.* SUNBELT conference, Montréal, Canada. 2019.
- *Developing an interprofessional training for primary care: a co-creation with practice, education and research.* International Conference on Integrated Care, Nieuwegein, The Netherlands. 2018.



- *Evaluation of an interprofessional training for primary care.* EARLI ASC, Vienna, Austria. 2018
- *Evaluation of an interprofessional educational program in primary care: does a social network analysis provide the answer?* European Academy of Nursing Science summer conference, Ghent, Belgium. 2018.
- *Unraveling and synthesizing the complexity of multiple proactive nurse-led primary care programs for older persons: a mixed-methods study.* European Nursing Congress, Rotterdam, The Netherlands. 2016.
- *Unraveling and synthesizing the complexity of multiple proactive nurse-led primary care programs for older persons: a mixed-methods study.* STTI European Regional Conference, Utrecht, The Netherlands. 2016.

## Practice presentations

- *Proactieve Ouderzorgprogramma Midden Utrecht.* Symposium Jong en Oud Samen Goud: Hand in hand staan we sterk(er), Rotterdam, The Netherlands. 2019.
- *Ontwikkeling en evaluatie van een interprofessioneel educatie programma in de eerstelijnszorg.* ZonMw onderwijsinnovaties in de ouderenzorg, Den Haag, The Netherlands. 2018.
- *Ontwikkeling en evaluatie van een interprofessioneel educatie programma in de eerstelijnszorg.* Nieuwe Generatie Ouderzorg Conferentie, Ede, The Netherlands. 2018.
- *Ontwikkeling en evaluatie van een interprofessioneel educatie programma in de eerstelijnszorg.* NVMO conferentie, Utrecht, The Netherlands. 2018.
- *Het ontrafelen van de werkzame elementen en synthetiseren van 9 NPO proactieve zorgprogramma's voor kwetsbare ouderen in de eerstelijnszorg.* Geriatriedagen, Den Bosch, The Netherlands. 2017.
- *Het ontrafelen van de werkzame elementen en synthetiseren van 9 NPO proactieve zorgprogramma's voor kwetsbare ouderen in de eerstelijnszorg.* Nationaal Gerontologie congres, Ede, The Netherlands. 2017.

## Educational presentations

- *Workshop interprofessional collaboration.* Summerschool program: Healthy Aging. Hogeschool Utrecht: Utrecht. Juli 2019.
- *Workshop interprofessional samenwerking.* Themadag Interprofessioneel samenwerken. Hogeschool Utrecht: Utrecht. Februari 2019.
- *Workshop interprofessional samenwerking.* Presentatie alumni dag bachelor Verpleegkunde Utrecht. Hogeschool Utrecht: Utrecht. November 2018.
- *Proactieve ouderenzorg eerstelijns.* Interprofessionele nascholing. Poster presentatie. Kennis centrum Gezond en Duurzaam Leven. Utrecht. September 2016.



# DANKWOORD

“*Life event*” is het woord dat omhoog komt als ik nadenk over deze reis van promoveren. Een meerjarig evenement dat in mijn leven heeft plaatsgevonden. Een tijd waarin ik veel mensen ben teggekomen, mee samen heb gewerkt en onnoembaar veel in heb geleerd.

Als eerste wil ik de ouderen en de professionals uit de eerstelijnsouderenzorg bedanken voor de input in mijn onderzoeken. Zonder jullie was er geen proefschrift geweest en door jullie komen we weer een stap verder in het realiseren van effectieve proactieve zorg voor thuiswonende ouderen!

Natuurlijk ook grote dank aan mijn promotieteam: Prof. dr. Marieke Schuurmans, Prof. dr. Niek de Wit en dr. Nienke Bleijenberg. Beste *Marieke*, voor velen een groot voorbeeld en boegbeeld van de verplegingswetenschap! Maar ook ik als gezondheidswetenschapper, die van buitenaf het promotietraject inrolde, kan dit stellig beamen. Je bevoegenheid voor het vak en het enthousiasme in onze promotie overleggen, waarin je mij als persoon nooit vergat, zijn voor mij altijd heel waardevol geweest in de begeleiding. Mijn paardensport hobby heb je altijd toegejuicht en nooit bekritiseerd qua tijdsinvestering - menig idee is zelfs ontstaan op het paard of tussen het hooi, stro en paardenmest. Vele malen dank voor alle begeleiding en support. Het heeft mij gebracht naar waar ik nu sta - met een mooi proefschrift in de hand! Beste *Niek*, als hoogleraar huisartsgeneeskunde was je rol essentieel in onze promotie overleggen. Niet alleen het paardrijden en de wedstrijden werden met regelmaat geëvalueerd, maar natuurlijk ook het onderzoek. Zinnen als “toch ben ik het daar niet mee eens” of “ik zie het zo” fungeerden als een spiegel. Minder wollig schrijven heb ik van jou geleerd. Dit voortschrijdend inzicht en Marieke haar woorden “kill your darlings” hielpen erg. Dank voor alle begeleiding, dat heb ik altijd zeer gewaardeerd. Beste *Nienke*, dank voor je support en ondersteuning de afgelopen jaren. Je enthousiasme voor de ouderenzorg is en werkt aanstekelijk. Altijd kon je het belang van de ouderenzorg onderstrepen, ook wanneer de methodologie het onderwerp zo nu en dan volledig overnam. We hebben gezien dat de methodologie een belangrijk onderdeel is om effectieve proactieve ouderenzorg te realiseren. Ik kijk er dan ook naar uit hier samen verdere stappen in te gaan zetten. Hopelijk kunnen we dan wat vaker sociale netwerk analyse-koffiemomentjes (liefst cappuccino-karamel) inplannen in plaats van het slappe digitale aftreksel van de afgelopen tijd.

Graag wil ik prof. dr. M.F van der Schaaf, prof. dr. H.P.J. van Hout, prof. dr. R.A. Bal, prof. dr. M.H. Emmelot-Vonk en prof. dr. R.A.M.J. Damoiseaux hartelijk danken voor het plaatsnemen in de promotiecommissie, het kritisch lezen en beoordelen van mijn proefschrift. Prof. dr. L. Schoonhoven, hartelijk dank voor de deelname aan de oppositie.

Mijn eerste artikel was een artikel met wel geteld 19 coauteurs. Elk van jullie vertegenwoordigde één van de negen ouderenzorgprogramma's (geïnitieerd vanuit het Nationaal Programma Ouderenzorg) die ik onder de loep mocht nemen. Graag wil ik jullie bedanken voor de inzet en support. Jullie hebben ons ontzettend veel inzicht gegeven in de ouderenzorgprogramma's, waardoor wij verdere stappen konden zetten hoe te kijken naar dit soort complexe interventies.

Het ontwikkelen en evalueren van een interprofessionele training in de wijk is mede tot stand gekomen met een team van betrokken onderzoekers, docenten en professionals uit het veld. Graag wil ik enkele personen bedanken die deze training tot een succes hebben gemaakt. Allereerst dank ik *Daphne Wiersma* die destijds via Stichting Volte als vertegenwoordiger vanuit het werkveld bijdroeg aan de ontwikkeling van de training en als docent deze training gaf; het was een eer om met je samen te werken! *Inge Pool*, ook jou wil ik hartelijk bedanken voor je input en support in de ontwikkeling van de training. Je expertise op het gebied van werkplekleren en je kijk op onderwijskundige aspecten, was heel waardevol in de ontwikkeling van onze training. *Nienke Moolenaar*, jij was en bent nog steeds mijn rots in de branding. Collega Jeroen opperde ooit het begrip sociale netwerk analyse (iets waar ik nog nooit van had gehoord). Samen vonden we jou. Jij hebt mij wegwijs gemaakt in een voor mij volledig nieuwe wereld: die van social network analysis (SNA). Jij kon mij op een beeldende manier in een deel van deze interessante wereld rondleiden. Je hebt mij enorm geholpen om SNA toe te passen in het evalueren van de training en ik ben nog steeds dol enthousiast over deze methode! Het congres in Wenen was denk ik wel het hoogtepunt. Van veel te dure, beroemde, Weense chocoladetaart - de Sachertorte - tot een filharmonisch concert in het Wiener Musikverein. Het was een geweldige week! Heel erg bedankt voor je enthousiasme en het overbrengen van je kennis. Dit boekje was er niet geweest zonder jou.

In de tijd van de interprofessionele training heeft het woord collega's plaatsgemaakt voor vrienden. *Jeroen*, jouw gezelligheid, openheid, knallen op de juiste momenten en recht door zee gaan, zijn aspecten wat samenwerken voor mij tot een feestje maakt. Bij jou plopte het idee op over SNA, waar ik vervolgens hard achteraan rende omdat dit volgens mij het "ei van Columbus was". Je bent m'n partner in crime geweest op drie van mijn artikelen waarvoor ik je erg dankbaar ben! Lieve *Marjolein*, ik leerde je kennen als collega-docent bij de Bachelor Verpleegkunde. We merkten al snel dat we heel fijn konden samenwerken. Jij met je docentenhart, hart voor de ouderen, en een creativiteit waar ik alleen maar van kan dromen! Uiteindelijk was je naast Daphne één van de docenten in de training en dat deed je geweldig! Naast het serieuze hebben we ook heel veel lol gehad op bijvoorbeeld de

introkampen, waar de biertjes rijkelijk vloeiden, de foute muziek veel te hard stond en we allebei rond liepen als Keessieeee (van Flodder). Inmiddels liggen de wilde jaren achter ons en hebben we verscheidene mijlpalen meegemaakt (ik trouwen, jij trotse ouders samen met Ruben van Diede en Maas). Marjolein, je bent mijn *friend for life* geworden en de keuze voor mijn 2<sup>e</sup> paranimf kon daarom alleen maar jij zijn!!

Collega's en oud-collega's lectoraat Proactieve Zorg voor Thuiswonende Ouderen (voorheen Chronisch Zieken). Carolien, Nienke B, Ymkje, Roelof, Pieterbas, Jeroen, Sigrid, Thora, Debbie, Yvonne K, Mariska en Nienke D; jullie waren mijn collega's toen ik startte. Dank voor het wegwijs maken in de nieuwe wereld van promoveren. Maar ook om te overleven in het nieuwe gebouw HL-7. Dit laatste was zeer nodig daar niemand meer een eigen kamer had, fijn dat we al snel onze ruimte bij de trap (1<sup>e</sup> verdieping) konden bemachtigen! Ook mijn nieuwe collega's wil ik graag noemen: Jessica, Inge, Yvonne, Wietske, Anja, Hugo, Dieke, Janneke, Dagmar, Rixt, Selma en Marit. Ik ben altijd erg blij geweest met jullie frisse input in mijn onderzoeken, de gezellige lectoraatsbesprekingen en uitjes! Blij dat jullie het team zijn komen versterken. Met Nienke D en Jessica heb ik de driejarige EANS summer school doorlopen, wat was dit een leerzame en mooie tijd (Gent staat nog helder op mijn netvlies...)! Dank jullie allen voor de fijne support en interesse in mijn onderzoek. Fijn om in een team als deze te mogen werken!

'Baby date vriendinnen' alias Jessica, Inge en Yvonne. Wat ben ik blij met lectoraat-collega's en lieve vriendinnen als jullie. Onze groepsapp naam is van *high-tea date* geswitcht naar zoals de naam het al zegt: *baby bezoekjes*. Dat ik begon met een pup in plaats van een baby maakte voor jullie niets uit. Inmiddels zijn alle baby's en pup al 1.5 tot 2 jaar en is Jessica begonnen met ronde 2 (wat ben ik blij voor je!!). Lieve meiden, wat hebben we fijne momenten gehad met elkaar, de app groep was soms hard aanpoten met >100 gemiste app berichten per keer, maar het was het absoluut waard. Jullie waren en zijn mijn vraagbaak, uitlaadklep en oase van gezelligheid! *Jes*, ik kijk uit naar je boekje over nurse-sensitive uitkomsten in de wijkverpleging! *Inge*, je onderwerp leren met kwaliteitsstandaarden is echt fantastisch! *Yvon*, zet hem op die eindsprint, de wetenschap wacht op je kennis omtrent de implementatie van een verpleegkundige interventie in 12 ziekenhuizen! Laten we snel de volgende baby date inplannen—dit keer bij mij thuis en nee, geen puppy date!

Verder wil ik graag de collega's van de onderzoeksgroep Verplegingswetenschap en de aanwezigen van de researchbesprekingen bedanken voor hun interesse en het meedenken over mijn onderzoek.

MIZW (voluit Master Innovatie in Zorg en Welzijn) collega's. Sinds twee jaar mag ik jullie team versterken. Wat een geweldig warm bad is dit! Jullie bevologenheid met innovaties in zorg en welzijn is fantastisch om te zien! Ik voel me thuis in dit diverse team met één gezamenlijke missie: studenten zorginhoudelijke en bedrijfskundige inzichten te kunnen laten combineren en toepassen zodat de kwaliteit van leven van de burger, cliënt of patiënt verbetert. Onderdelen uit mijn proefschrift hebben inmiddels een plekje gekregen in het onderwijs en het is mooi om te zien dat onderwijs, praktijk en onderzoek hierdoor samen komen. Bovenal wil ik *Marlou*, inmiddels mijn leidinggevende, en *Roelof* bedanken dat ik deel mag uitmaken van deze opleiding. Lieve *Josien*, ook jou wil ik heel erg bedanken! Ik ken je al sinds mijn start als docent bij de Bachelor Verpleegkunde. Daar werkten we samen, en inmiddels werken we opnieuw heel nauw samen op onze twee cursussen binnen de MIZW. Wat kijk ik op tegen jouw scherpzinnigheid en analytisch vermogen. Wat was ik daarom ook blij dat je mij bent gaan helpen in het schrijven van de discussie paper! Ik hoop dat we nog lange tijd mogen samenwerken! Lieve *Floor-Anne*, ook jouw naam mag niet ontbreken. Dank voor je gezelligheid en vrolijke noot! Nooit is iets je teveel! Fijn dat we deze mijlpijl samen mogen vieren, op naar meer mijlpalen (loempia's en tosti's)!

Mijn collega's van de Bachelor Verpleegkunde. Floortje, Robbert Jan, (Josien), Anneleen, (Marjolein), Marieke en alle anderen. Dank voor jullie vriendschap, gezelligheid en luisterend oor! Hopelijk gaan we elkaar in de toekomst weer veel vaker zien; binnen IVS en natuurlijk daarbuiten!

Mijn lieve vrienden van vroeger en onlangs verworven. Een paar namen zijn voor mij belangrijk: lieve *Marieta*, 15 jaar geleden leerde ik je kennen op de MBO-V. We deelden naast ons vak ook de passie voor paarden. Inmiddels zijn we nog steeds vriendinnen en dank ik je voor alle mooie momenten die ik met je heb gehad en je trouwe support samen met *Jacco*! *Marijke*, jou leerde ik kennen op de VU en nog steeds lijken onze wegen in het leven op elkaar. Dank voor je betrokkenheid en support! Het zijn verder ietwat teveel namen om allemaal op te noemen, maar ik loop jullie niet voorbij! Wat prijs ik mij gelukkig met jullie als vrienden! Dank voor jullie betrokkenheid en het geven van afleiding op de juiste momenten. Verschillende life events hebben we met elkaar doorlopen en dit is er eentje van. Op het promotie feestje gaan we het uitgebreid vieren! Tot dan!

Mijn schoonfamilie, lieve *pap en mam Brunia*. Inmiddels woon ik al enkele jaren bij jullie op het erf en hebben jullie mij de afgelopen 1.5 jaar veel thuis zien rondlopen. Het is een voorrecht dat ik op de "boerderij" kan en mag wonen. Dank voor het openstellen van jullie harten en de support in het nastreven van mijn dromen (en



het grootbrengen van mijn geweldig lieve man); mede daardoor sta ik hier! Lieve *Karin en Jos*. Lieve *Erica* en nichtje *Senna*. Sinds vorig jaar ben ik officieel, 2 zussen, een zwager en een lief nichtje rijker. Wat ben ik daar blij mee! Vaak hebben we het over toekomstdromen en wat ons bezighoudt. Allemaal hebben we er een aantal afgevinkt, dat voelt heerlijk. Dank voor jullie support en interesse in mijn onderzoek. Mijn uitleg erover was waarschijnlijk nogal wollig en lastig te volgen, maar jullie pakten altijd de essentie eruit! Dank daarvoor! Op naar veel familie etentjes, puike wijntjes (#PuikeWijnen) en gezelligheid!

Mijn lieve ouders, mijn lieve *paps en mams*. Wat hebben jullie ons (ja, ik spreek nog altijd in meervoud - dat heb je als je een eeneiige tweeling bent) maar zeker mij ook altijd gesteund. Als jongste in het gezin van vijf kinderen heb ik mij altijd gehoord en geliefd gevoeld. Lieve *mam*, je stond en staat altijd voor mij klaar met je zorgzaamheid, gezelligheid en heerlijke kookkunsten, nooit is iets je teveel! Lieve *pap*, je bent iemand van niet al te veel woorden, maar je wijsheid en vaderlijke raad is vaak in weinig woorden al veelzeggend genoeg en daar ben ik je altijd erg dankbaar voor! Jullie vonden onderwijs altijd erg belangrijk, maar ook dat je bent wie je bent en dat je daar het beste uit moet halen. Tijdens mijn promotietraject realiseerde ik mij dat ik dit proefschrift mede voor jullie (als 70+'ers) schreef en dat was misschien wel mijn grootste drijfveer. Jullie liefde voor mij hebben me gebracht tot wie ik ben als persoon en waar ik nu sta in mijn leven. Wat ben ik jullie daar toch enorm dankbaar voor! Maar nu stop ik wel even met het vergaren van diploma's, goed?

Broers en zussen heb je niet voor even maar je hele leven!

*Wilco*, fijn dat jij mijn allergrootste, langste en oudste broer bent. De gerookte zalm met kerst doet mij door het hele jaar heen watertanden en geen zalmpje is bestand tegen jouw rookkunsten!

Edwin en Marleen, altijd kan ik bij jullie terecht voor een luisterend oor, maar zeker ook voor gezelligheid. Met *Meike* en *Rense* erbij is het altijd een en al reuring maar wat is dat toch leuk (proud auntie - jullie grootste fan)! Lieve *Edwin*, een grote broer hebben is altijd fijn, zeker eentje die ook altijd wil helpen in de zomer met hooibalen sjouwen van het land (geintje)! Je kan altijd goed luisteren als ik over van alles en nog wat aan het ratelen was. De laatste tijd merken we dat "time flies" en moeten we vaker broer en zus momenten inplannen, maar dat komt zeker goed! Lieve *Marleen*, een extra zus, zo zie ik je altijd en wat ben ik daar super blij mee!

Alles kan ik met je delen en je hebt altijd wijze raad (over relaties, trouwen, maar ook kinderen - ideaal). Zullen we snel een avond nagels gaan lakken en onderwijf luid kakelend?

Lieve *Eline*, voor mij was je altijd de *big sis*! Inmiddels ben ik wat langer dan jij en zijn onze leeftijden dusdanig ondergeschikt dat het omgedoopt is tot *sweet sis*! Maar E, jij bent altijd iemand geweest tegen wie ik op keek. Mijn grote, zelfstandige zus die al jong verpleegkundige was en daarna haar doelen had gericht om operatie assistente te worden. Inmiddels kom je al vele jaren aan met de grootste, geweldige en soms ook de meest zielige verhalen over het wel en wee op de OK, maar wat geniet ik daar altijd enorm van. De afgelopen twee jaar kwam je ineens mijn (onderzoeks)wereld in wandelen. Ik had je warm gemaakt om de Master Innovatie in Zorg en Welzijn te doen waarbij ik de grote eer had om jou, als je kleine zusje, les te mogen geven (het heeft onze zusterlijke affectie niet veranderd kan ik oprecht zeggen). Inmiddels ben je een masterdiploma rijker en ben ik als MIZW docent en zus super trots op jou! Dank voor al die jaren die je er voor mij was als *big sis*!

Lieve *Francien*, ooit begonnen we als twee meisjes vrolijk huppelend naar de kleuterschool met onze blonde vlechten achter ons aan wapperend. Een life time verder zijn we nog steeds onafscheidelijk (een eeneiige tweeling ben je voor altijd)! Onze passie voor de paarden delen we, en daarnaast nog zoveel meer. Altijd ben je er voor mij, support je mij in wat ik ook doe, zelfs als ik weer iets “typisch Linda’s” heb uitgehaald. De volgende quote kan dan ook niet ontbreken (zeker niet voor een docente Engels): “*We stick with each other wherever we go. We have been playmates for as long as you know. I hope this continues the rest of our lives. It’s not often one is born with a best friend for life!*” Voor de start van mijn promotieonderzoek wist ik het al: jij bent sowieso mijn paranimf! Nu gaan we de rollen iets omdraaien, daar jij je ook hebt laten verleiden om de master MIZW te gaan doen! Nu al trots op je!! Cien, ik kijk er naar uit straks weer veel samen bij onze paarden (en inmiddels veulens) rond te lopen, te rijden, op concoursen te gaan, slappe lach te krijgen, snoepjes te eten en de rest van de tijd met onze bootjes-mannen (ja, Arjan!) lekker te gaan varen!

Lieve, lieve *Sjouke*. Tijdens coronatijd leefde ik in twee werelden. Mijn thuiswerkwereid en de wereld (of hoe noemden onze vrienden het.. “je imperium”?) van een super mooi watersportbedrijf (#bruniawatersport) dat ondanks de pandemie natuurlijk gewoon doorgaat. Wat heb jij mij de afgelopen jaren mooie werktripjes (zoals we het maar noemden) gegeven om er even uit te zijn: Engeland, Ierland, Finland, Frankrijk, Duitsland, Spanje maar ook Nieuw-Zeeland. Onze twee werelden en persoonlijkheden zijn totaal verschillend; jij een

handelaar bij uitstek, een type als “hoe de wind waait” en ik... typetje vastgeroest, controle freak en “zal je dat nu wel doen”. Maar dit is waar we elkaar hebben gevonden en aanvullen. Inmiddels ben je sinds een jaar mijn lieve man geworden! Lieve Sjouke, na het promoveren komt een nieuwe fase in ons leven die ik maar wat graag met jou in ga. Want als alles goed mag gaan komt er eind oktober een nieuw langdurig life event.. Een klein ventje dat ons promoveert tot ouders alias “gezinnetje Brunia”!!

# Curriculum Vitae

Linda was born on August 18th 1989, in Zwolle, the Netherlands. In 2006, she started to study nursing at the secondary vocational education school Landstede in Zwolle. After graduating in 2010, she started a shortened Bachelor of Nursing program at the University of Applied Sciences Windesheim in Zwolle. During her studies, she started to work as a care helper and later on as registered nurse at a nursing home from 2007 till 2020. Linda began a pre-master in health sciences at the Free University Amsterdam. In 2013 she obtained her bachelor's degree in Nursing and finished her pre-master. Then she proceeded with the master Health Sciences, specialization Infectious Diseases and Public Health. She finished the master program in 2014. In that same year, she started working as a researcher at the Isala Hospital in Zwolle on infectious complications after major abdominal surgery.



Since September 2015, she started at the University of Applied Sciences-Utrecht as a lecturer at the Bachelor of Nursing and with her PhD-project within the Research Centre for Healthy and Sustainable Living at the University of Applied Sciences Utrecht. In September 2018, she started as a lecturer at the Nursing Science program at University Utrecht. The following year she began as a lecturer at the Master of Integrated Care Design at the University of Applied Science Utrecht.

The methodological challenges in intervention research puzzles Linda and inspires her at the same time in pioneering new research methodologies to optimize the development and evaluation of complex interventions. Linda is determined to continue her work in this research area and share her insights within education.



