

ARTICLE

# Navigating complexity in real-world intervention evaluation: Insights from three case studies

Lisa S.E. Harms, Tugce Varol and Gido Metz

## Abstract

Evaluation takes place in Intervention Mapping Step 6. Various evaluation questions, outcomes, measures and designs can be used to guide the evaluation process. Although the use of gold standards, such as a randomized controlled trial is recommended, these may not align with interventions in real-life settings. This paper describes the complexity of evaluating public health interventions in real-world contexts. Three case studies highlight the challenges of evaluation when: (i) interventions need to be developed and implemented quickly; (ii) changes to the intervention content or its implementation are desirable; and (iii) interventions are already publicly available and accessible. Our aim was to advance the field by sharing experiences and critically reflecting on how to embrace complexity.

**Key words:** Evaluation, Intervention Mapping, Complexity, Research Methodology

## IM step 6: characteristics and challenges

---

Textbox 1: Basic steps for Intervention Mapping Step 6 (derived from Bartholomew Eldredge et al., 2016)

---

The main aim of Intervention Mapping Step 6 is to develop a plan to guide evaluation. Several tasks can be distinguished:

- 1) Task 1: write process and effectiveness questions. These questions will come from a review of the program logic models, goals, and objectives and the IM matrices.
  - 2) Task 2: develop indicators and measures to assess the selected effect and process evaluation questions.
  - 3) Task 3: specify designs for conducting process and effect evaluations.
  - 4) Task 4: specify and complete the evaluation plan.
- 

In Intervention Mapping (IM) Step 6, evaluation takes place (Textbox 1, Bartholomew Eldredge et al., 2016). In earlier IM steps, a planning group will have developed logic models to understand the health problem, and logic models of change on which the intervention is based. These logic models provide input for evaluators to develop evaluation questions. In terms of evaluation designs, there is a general distinction between effect evaluation and process evaluation. In effect evaluation, researchers determine whether the intervention is associated with changes in health, behavioral, or environmental outcomes, determinants, or performance objectives (Kok et al., 2017). Effect evaluation can be described as either efficacy or effectiveness. Efficacy refers to a program that is evaluated under controlled conditions, such as with motivated volunteers who participate in the program regardless of the time and effort required. Effectiveness refers to a program evaluated under real-world conditions (Godwin et al., 2003), for example, with representatives of the at-risk group. Process evaluation seeks to describe how a program is implemented. Relevant questions related to process evaluation include whether an intervention was implemented as intended, for example in terms of adherence, whether contextual factors affected implementation, what hindered or facilitated implementation, and the extent to which the intended audience was satisfied with the intervention (Moore et al., 2015; Stutterheim et al., 2025). In addition, process evaluation allows for critical reflection on intervention design and helps determine whether the success or failure of an intervention is due to the intervention itself or the way it was implemented or applied (Bartholomew Eldredge et al., 2016; Stutterheim et al., 2025).

The evaluation design determines how confidently an evaluator can assess indicator changes and attribute them to the program. Randomized controlled trials (RCTs) are referred to as the gold standard of effect evaluation due to its rigor and ability to make causal inferences (Hariton and Locascio, 2018). RCTs require the selection of primary outcomes, careful randomization, and no changes in the content of the intervention or how it is delivered (Houle, 2015). This unfortunately misaligns with interventions in real-life settings that are already widely available, which limit randomization and control (Koelen et al., 2001). Moreover, the lengthy process of the RCT hinders evaluation of interventions that need to be developed and delivered quickly, for example because of a pandemic. Over the years, alternative research methods have become increasingly viable options (Bonten et al., 2020; Skivington et al., 2021). For example, in the Dutch and British frameworks for evaluation and recognition of interventions, qualitative and mixed research methods are now deemed valuable alongside RCTs in ascertaining intervention effectiveness (Dutch Partnership for Recognition of Interventions, 2018; Skivington et al., 2021).

The aim of this paper is not to discredit the RCT as a means of evaluating interventions. Rather, it aims to draw attention to the challenges and complexity of evaluating public health interventions in a real-world context. By presenting three cases of studies that, in their own way, addressed the challenges of the use of the RCT, we hope to contribute to the search for meaningful ways of evaluation.

## Case study 1: Evaluation of interventions under time pressure and uncertainty in crisis situations

In times of crisis, such as the coronavirus disease (COVID-19) pandemic, rapid and effective responses are critical to safeguarding the safety and well-being of individuals. The dynamic and rapidly evolving nature of the pandemic posed challenges to implementing traditional gold standard evaluation methods, such as RCTs, in applied settings. This first case study discusses COVID-19 prevention within an organizational context, particularly, addressing the pandemic within a university setting through behavior change interventions, and the complexities of planning, implementing, and evaluating behavior change interventions amidst the uncertainties introduced by the COVID-19 pandemic (Varol, 2023). As the COVID-19 pandemic trajectory was unprecedented, the objectives of the project evolved as the situation developed. The first phase of the study took place from September to December 2020, when the university transitioned to hybrid education. This allowed students to attend in-person classes under strict COVID-19 regulations, including social distancing, testing, and isolation if symptoms appeared (Varol, 2023). During this phase, we conducted interviews and surveys with students to explore their adherence to the university's COVID-19 guidelines and identify the factors influencing their behavior. The survey was aimed at students intending to visit the university's buildings within the next two months, with the goal of selecting the relevant determinants of adherence to inform the development of a targeted intervention (Varol et al., 2021). However, due to a rapid surge in COVID-19 cases and hospitalizations, the university closed again in December 2020, just before the Christmas break. As a result, the focus shifted away from the original intervention targeting on-campus behavior. Instead, we adapted our approach by using the insights from the initial study to develop a new intervention. This intervention aimed to deliver a tailored message to students during the holiday season, emphasizing safety and precautionary measures for the upcoming festivities (Varol et al., 2021). The constantly changing conditions made it challenging to plan and assess the effectiveness of the intervention. The original plan was to develop and implement an on-campus intervention, but this became increasingly difficult due to the evolving circumstances.

The second phase of the project took place from January to July 2021, when education shifted back to online formats due to government lockdowns, coinciding with the start of the Dutch vaccination rollout. During this period, we conducted a survey to explore students' vaccination intentions, as well as their reasons for choosing to vaccinate or not. Based on the survey findings, key determinants such as concerns about vaccine safety and side effects, as well as perceived norms, were identified and targeted in the development of an online intervention to support students in making informed vaccination decisions (Varol et al., 2022). The intervention was delivered through a vaccination webpage on the university's website, which included information about vaccinations, practical details, frequently asked questions, and videos developed based on the study's findings, specifically addressing the identified determinants, with contributions from university experts. The online intervention went live once students became eligible for vaccination, with the goal of helping them make informed decisions about getting vaccinated (for more information about the program, see ten Hoor et al., 2022; Varol et al., 2022).

Conducting an effect evaluation was challenging due to: 1) the rapidly changing conditions throughout the pandemic, such as changes in regulations and discontinuation of AstraZeneca (van Amerongen et al., 2024), and 2) the need for both intervention and control groups to properly assess the impact. In the context of COVID-19 vaccination at a university, where vaccination was voluntary, ethical concerns also emerged. Conversations with students revealed that some preferred neutral information from the university, stressing that vaccination should remain a personal choice and that the university should not mandate it (ten Hoor et al., 2022; Varol, 2023).

The implementation and evaluation of the interventions were planned from the outset (Fernandez et al., 2019). However, in our project, the urgency of implementation outweighed the focus on effect evaluation, as it took place in an applied setting where the primary goal was to address the COVID-19 pandemic. As highlighted by Silubonde-Moyana et al. (2023), early implementation was found to be linked with greater effectiveness in reducing COVID-19 cases and deaths.

However, effect evaluation is not the only approach for assessing interventions; process evaluation also plays a crucial role (Bartholomew Eldredge et al., 2016). Process evaluation focuses on evaluating the reach and implementation of the intervention. In the case of the vaccination videos, process evaluation involved tracking the number of views and gathering feedback from students on the content and delivery of the intervention.

In crisis situations characterized by uncertainty and time pressure, conducting an effect evaluation might be challenging. However, despite these challenges, process evaluation can offer valuable insights into the implementation and impact of the intervention.

## Case study 2: Evaluation of interventions in real-life settings

The second case study argues that interventions - and the evaluation of interventions - can take place in real-life settings and should be viewed as events within a complex system (Hawe et al., 2009). Put simply, schools, workplaces and communities are already a dynamic collection of end-users, implementers and other stakeholders. Once introduced, the intervention will interact with the system (Shiell et al., 2008) and adapt accordingly (Patton, 2011; Guijt et al., 2012). It is therefore unlikely that the intervention or context will remain stable. In fact, when seeking intervention-context fit, keeping the intervention stable is actually undesirable. This became evident during the non-linear development and evaluation of two lifestyle interventions (Harms, 2024).

Up for Cooking (UfC) is an adaptable cooking intervention for Dutch families. UfC aimed to promote a healthy diet through the promotion of food literacy skills, which were incorporated as core components and played a role in the behavior change process (Harms et al., 2023). An action-oriented research approach with a dual focus on effectiveness and implementation was used to collect data closer to the real-life setting. In short, observations recorded how each core component was implemented and the modifications that were made. Semi-structured interviews addressed what planned adaptations were made to adapt UfC to each context. Effectiveness was evaluated using a pre-post questionnaire to assess food literacy behaviors. Over time, it became clear that *how* the intervention was implemented (i.e., *intervention form*), could differ while still achieving the same performance objective. For example, a group discussion with the implementer on budget shopping or food labels, or the completion of an assignment on such topics, both provide practical information. Different intervention forms allowed the implementer to tailor UfC to different contexts, ultimately increasing the intervention-context fit. However, a more traditional evaluation design (e.g., RCT)

would have concluded a suboptimal implementation of the assignment sheets, or would have required an intervention form with fixed components to ensure internal validity.

Similarly, participatory action research with three iterations was used to develop and evaluate the SuperFIT take-home kit. The aim of the take-home kit was to promote healthy energy balance-related behaviors in young children (Harms et al., 2024). Parents (i.e., end-users) and implementers on multiple levels were included, representing the complex system in which the intervention took place. Semi-structured interviews addressed barriers and facilitators to implementation, and open-ended questionnaires covered acceptability and feasibility. Impact, rather than effectiveness, was recorded as either self-reported impact by parents, and self-observed or overheard impact (e.g., in children's behavior) by implementers. Apart from the fact that iterations were used to arrive at an acceptable and feasible intervention, it also gave us a much better understanding of the impact of the intervention as an event in a system. As with UfC, no general list of successful implementation strategies could be produced, nor could one perfect take-home kit. What worked for one family, parent or implementer, did not work for others. Furthermore, individual actions during implementation had an influence on the reported impact. The evaluation of an intervention should therefore not be seen in isolation from the implementation strategies (Curran et al., 2022). Rather than focusing on 'did it work and for whom', as more conventional evaluation designs would have done, our case study shows, in line with Curran et al. (2022), that intervention evaluation should not be considered in isolation from implementation strategies.

Both examples demonstrate the compatibility of mixed-method and action-oriented approaches to understand the impact of the intervention as events within a system, in interaction with the context (Moore et al., 2021). More research is needed to combine context sensitivity and traditional research designs to develop pragmatic solutions to this evaluation challenge.

### Case study 3: Evaluation of publicly available digital health interventions

The third case study focuses on the evaluation and optimization of the chlamydia page of Sense.info, the primary platform for information and services related to sexual and reproductive health for people aged 12 to 25 in the Netherlands. Sense.info encompasses multiple behavioral outcomes and has been publicly available since 2009. This combination of long-term availability and accessibility to all (which makes randomization difficult) and a wide range of aims (which makes selection of a primary outcome inappropriate) led to the conclusion that the RCT was not the most appropriate evaluation method (Metz et al., 2023). We therefore used what we termed the Cyclic Evaluation Process (CEP), consisting of four phases that incorporate different research methods (Metz, 2024). The first phase involved an analysis of how the developers envisioned use of the intervention and expected it to impact behavior change (i.e., *intended* use). Acyclic Behavior Change Diagrams were used here to visualize the intervention's active ingredients and underlying assumptions (Metz et al., 2022). In the second phase, the *actual* use of the intervention was examined using web analytics, with the aim of identifying usage patterns that either match the expectations based on the analysis of intended use, or reveal inconsistencies between intended and actual use. The assumptions about impact of the intervention formulated here, were then further explored in the third phase, which studied end-user perceptions with a think-aloud study and semi-structured interviews. Upon the successful completion of these stages, a thorough understanding of the potential impact of the intervention, along with recommendations for improvement, had been obtained. The fourth phase was where these recommendations were translated into new or adapted intervention elements. Here, the cyclical nature of the CEP became evident: during this stage, attention had to be focused on the intended use of the modified or newly developed items, which led back to phase 1 of the CEP. Subsequent evaluation cycles could then take place, allowing for continuous optimization.

Based on our analysis of intended use of the Sense.info chlamydia page, we assumed that the page would be most relevant to sexually experienced young people because the page aimed to motivate STI testing and treatment by targeting determinants such as risk perception and self-efficacy with several behavior change principles. However, in the web analysis of phase 2, we found that only a relatively small percentage of page transfers from the Chlamydia page led to the STI testing page, and a relatively high percentage of users who left the site from that page (Metz et al., 2023). These findings led to several assumptions about the use and potential impact of the page, such as that users made an appointment with their general practitioner (GP) or at the Sense consultation hour in a manner other than clicking on the link to the STI test page, or that users did not feel able to get tested and therefore did not click on the link. During the think-aloud study we noted both usability issues and feedback related to the impact of the page (Metz et al., 2024). Some participants indicated that they had not seen the link to the STI testing page, while others expressed a need for more guidance if they suspected that STI testing was necessary and wanted to explore experiences of fellow youth with similar experiences. In the optimization phase, we therefore created role model stories based on the experiences of young people. Subsequently, another evaluation cycle took place, in which participants in the think-aloud study indicated that the stories contributed to increased self-efficacy, skills and intentions to engage in preventive behaviors, and additional suggestions were given for further optimization. A description of the development of these role model stories can be found in another publication (Metz et al., 2025), as well as in chapter 3 of this special issue.

Although the CEP does not allow causal claims, its evaluation and optimization loops are consistent with the need for iterative development with end-user input throughout all phases, as expressed in the literature and in intervention evaluation criteria such as those from the UK Medical Research Council (Skivington et al., 2021; Høstgaard et al., 2017; Jacobs and Graham, 2016; Kwasnicka et al., 2021; Socala et al., 2019). This approach can accelerate the delivery of relevant and meaningful evidence (Jacobs and Graham, 2016; Riley et al., 2013), and continuously improve interventions (Kwasnicka et al., 2021). Ongoing monitoring and optimization of elements tailored to different outcomes suit the dynamic environment of Sense.info and other digital health interventions.

---

**Textbox 2: Practical guidance to navigate complexity in real-world intervention evaluation**

---

The challenges in our three case studies and the practical guidance derived from them are summarized below and linked to the tasks that can be distinguished in Step 6:

- 1) Task 1: Set your priorities in terms of process and effectiveness given the circumstances (e.g., time slot, context, ability to meet requirements).
  - 2) Task 2 and 3: Select an evaluation design that allows you to measure the indicators and measures selected in step 2, and that is most appropriate to the context and characteristics of the intervention. An RCT is the gold standard for assessing effectiveness and provides the ability to make causal inferences, while cyclical or action-oriented approaches provide more scope to embrace complexity.
  - 3) Task 4: Evaluation plans should be practical. For example, the dynamic environment of Sense.info or professionals dealing with crisis situations requires researchers to engage and communicate with practice.
- 

## Concluding remarks

This paper aimed to highlight the characteristics of the evaluation phase of the Intervention Mapping approach and the dilemmas of evaluating interventions. We do not view these dilemmas as limitations or constraints, but rather as challenges. Through three case studies, we demonstrated how we have evaluated our interventions and hope to inspire other evaluators. Additional resources are available to support the selection of appropriate evaluation methods (e.g., Hrynyschyn et al., 2022; Bonten et al., 2020; Curran et al., 2022; Bartholomew Eldredge et al., 2016). Our goal was not to discredit the RCT or any other evaluation method. However, the day-to-day practice of public health interventions is often complex. Our main message to those planning intervention evaluation is to embrace this complexity, to critically reflect on the challenges specific to the intervention, and to select an evaluation method that is appropriate to the evaluation aim.

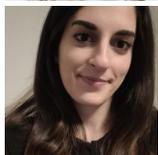
## References

- Bartholomew Eldredge, L. K., Markham, C. M., Ruiter, R. A. C., Fernández, M. E., Kok, G., and Parcel, G. S. (2016). *Planning health promotion programs: An Intervention Mapping approach*. Jossey-Bass Public Health, 4th edition edition.
- Bonten, T. N., Rauwerdink, A., Wyatt, J. C., Kasteleyn, M. J., Witkamp, L., Riper, H., van Gemert-Pijnen, L. J., Cresswell, K., Sheikh, A., Schijven, M. P., and Chavannes, N. H. (2020). Online guide for electronic health evaluation approaches: Systematic scoping review and concept mapping study. *Journal of Medical Internet Research*, 22(8):e17774. <https://doi.org/10.2196/17774>.
- Curran, G. M., Landes, S. J., McBain, S. A., Pyne, J. M., Smith, J. D., Fernandez, M. E., Chambers, D. A., and Mittman, B. S. (2022). Reflections on 10 years of effectiveness-implementation hybrid studies. *Frontiers in Health Services*, 2:1053496. <https://doi.org/10.3389/frhs.2022.1053496>.
- Dutch Partnership for Recognition of Interventions (2018). Erkenning van interventies. Criteria voor gezamenlijke kwaliteitsbeoordeling 2019-2022.
- Fernandez, M. E., ten Hoor, G. A., van Lieshout, S., Rodriguez, S. A., Beidas, R. S., Parcel, G., Ruiter, R. A. C., Markham, C. M., and Kok, G. (2019). Implementation mapping: Using intervention mapping to develop implementation strategies. *Frontiers in Public Health*, 7. <https://doi.org/10.3389/fpubh.2019.00158>.
- Godwin, M., Ruhland, L., Casson, I., MacDonald, S., Delva, D., Birtwhistle, R., Lam, M., and Seguin, R. (2003). Pragmatic controlled clinical trials in primary care: the struggle between external and internal validity. *BMC Medical Research Methodology*, 3(1). <https://doi.org/10.1186/1471-2288-3-28>.
- Guijt, I., Kusters, C., Lont, H., and Visser (2012). Developmental Evaluation: Applying complexity concepts to enhance innovation and use. Technical report.
- Hariton, E. and Locascio, J. J. (2018). Randomised controlled trials – the gold standard for effectiveness research: Study design: randomised controlled trials. *BJOG: An International Journal of Obstetrics & Gynaecology*, 125(13):1716–1716. <https://doi.org/10.1111/1471-0528.15199>.
- Harms, L. S. E. (2024). *Involving parents in lifestyle interventions for children: where is the fun in that?* PhD thesis, maastricht university.
- Harms, L. S. E., Gubbels, J. S., Bessems, K. M. H. H., Penders, S., Pluim, D., and Gerards, S. M. P. L. (2024). Promoting healthy lifestyle behaviours in pre-schoolers with the superfit take-home kit. *Journal of Child and Family Studies*, 33(11):3627–3639. <https://doi.org/10.1007/s10826-024-02936-6>.
- Harms, L. S. E., van Assema, P., Gubbels, J. S., Gerards, S. M. P. L., Linssen, E., Vonken, L., and Bessems, K. M. H. H. (2023). Context matters—the phased development of an adaptable food literacy intervention: Up for cooking. *Health Promotion International*, 38(4). <https://doi.org/10.1093/heapro/daad071>.
- Hawe, P., Shiell, A., and Riley, T. (2009). Theorising interventions as events in systems. *American Journal of Community Psychology*, 43(3–4):267–276. <https://doi.org/10.1007/s10464-009-9229-9>.
- Houle, S. (2015). An introduction to the fundamentals of randomized controlled trials in pharmacy research. *The Canadian Journal of Hospital Pharmacy*, 68(1). <https://doi.org/10.4212/cjhp.v68i1.1422>.
- Hrynyschyn, R., Prediger, C., Stock, C., and Helmer, S. M. (2022). Evaluation methods applied to digital health interventions: What is being used beyond randomised controlled trials?—a scoping review. *International Journal of Environmental Research and Public Health*, 19(9):5221. <https://doi.org/10.3390/ijerph19095221>.
- Høstgaard, A. M. B., Bertelsen, P., and Nøhr, C. (2017). Constructive ehealth evaluation: lessons from evaluation of ehr development in 4 danish hospitals. *BMC Medical Informatics and Decision Making*, 17(1). <https://doi.org/10.1186/s12911-017-0444-2>.
- Jacobs, M. A. and Graham, A. L. (2016). Iterative development and evaluation methods of mhealth behavior change interventions. *Current Opinion in Psychology*, 9:33–37. <https://doi.org/10.1016/j.copsyc.2015.09.001>.
- Koelen, M. A., Vaandrager, L., and Colomé, C. (2001). Health promotion research: dilemmas and challenges. *Journal of Epidemiology and Community Health*, 55(4):257–262. <https://doi.org/10.1136/jech.55.4.257>.
- Kok, G., Peters, L. W. H., and Ruiter, R. A. C. (2017). Planning theory- and evidence-based behavior change interventions: a conceptual review of the intervention mapping protocol. *Psicologia: Reflexão e Crítica*, 30(1). <https://doi.org/10.1186/s41155-017-0072-x>.
- Kwasnicka, D., ten Hoor, G. A., Hekler, E., Hagger, M. S., and Kok, G. (2021). Proposing a new approach to funding behavioural interventions using iterative methods. *Psychology & Health*, 36(7):787–791. <https://doi.org/10.1080/08870446.2021.1945061>.
- Metz, G. (2024). *Cyclic evaluation of web-based public health interventions*. PhD thesis, Maastricht. <https://doi.org/10.26481/dis.20240531gm>.
- Metz, G., Peters, G.-J. Y., and Crutzen, R. (2022). Acyclic behavior change diagrams: a tool to report and analyze interventions. *Health Psychology and Behavioral Medicine*, 10(1):1216–1228. <https://doi.org/10.1080/21642850.2022.2149930>.
- Metz, G., Roosjen, H., Zweers, W., and Crutzen, R. (2023). Evaluating use of web-based interventions: an example of a Dutch sexual health intervention. *Health Promotion International*, 38(4):daab190. <https://doi.org/10.1093/heapro/daab190>.
- Metz, G., Thielmann, R. R., Roosjen, H., Stutterheim, S. E., and Crutzen, R. (2025). Systematic optimization and evaluation of a dutch sexual health intervention: Role model stories for chlamydia prevention, testing, and treatment. *DIGITAL HEALTH*, 11. <https://doi.org/10.1177/20552076241308447>.
- Metz, G., Thielmann, R. R. L. C., Roosjen, H., and Crutzen, R. (2024). Evaluating the impact of a dutch sexual health intervention for adolescents: Think-aloud and semistructured interview study. *JMIR Formative Research*, 8:e48453. <https://doi.org/10.2196/48453>.
- Moore, G., Campbell, M., Copeland, L., Craig, P., Movsisyan, A., Hoddinott, P., Littlecott, H., O’Cathain, A., Pfadenhauer, L., Rehfuess, E., Segrott, J., Hawe, P., Kee, F., Couturiaux, D., Hallingberg, B., and Evans, R. (2021). Adapting interventions to new contexts—the ADAPT guidance. *BMJ*, page n1679. <https://doi.org/10.1136/bmj.n1679>.
- Moore, G. F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O’Cathain, A., Tinati, T., Wight, D., and Baird, J. (2015). Process evaluation of complex interventions: Medical research council guidance. *BMJ*, 350(mar19 6):h1258–h1258. <https://doi.org/10.1136/bmj.h1258>.

- Patton, M. Q. (2011). *Developmental evaluation: applying complexity concepts to enhance innovation and use*. Guilford Press, New York.
- Riley, W. T., Glasgow, R. E., Etheredge, L., and Abernethy, A. P. (2013). Rapid, responsive, relevant (r3) research: a call for a rapid learning health research enterprise. *Clinical and Translational Medicine*, 2(1). <https://doi.org/10.1186/2001-1326-2-10>.
- Shiell, A., Hawe, P., and Gold, L. (2008). Complex interventions or complex systems? implications for health economic evaluation. *BMJ*, 336(7656):1281–1283. <https://doi.org/10.1136/bmj.39569.510521.AD>.
- Silubonde-Moyana, T. M., Draper, C. E., and Norris, S. A. (2023). Effectiveness of behavioural interventions to influence COVID-19 outcomes: A scoping review. *Preventive Medicine*, 172:107499. <https://doi.org/10.1016/j.ypmed.2023.107499>.
- Skivington, K., Matthews, L., Simpson, S. A., Craig, P., Baird, J., Blazeby, J. M., Boyd, K. A., Craig, N., French, D. P., McIntosh, E., Petticrew, M., Rycroft-Malone, J., White, M., and Moore, L. (2021). A new framework for developing and evaluating complex interventions: update of medical research council guidance. *BMJ*, page n2061. <https://doi.org/10.1136/bmj.n2061>.
- Stutterheim, S. E., van der Kooij, Y. L., Crutzen, R., Ruiter, R. A. C., Bos, A. E. R., and Kok, G. (2025). Intervention mapping as a guide to developing, implementing, and evaluating stigma reduction interventions. *Stigma and Health*, 10(1):3–20. <https://doi.org/10.1037/sah0000445>.
- Sucala, M., Ezeanochie, N. P., Cole-Lewis, H., and Turgiss, J. (2019). An iterative, interdisciplinary, collaborative framework for developing and evaluating digital behavior change interventions. *Translational Behavioral Medicine*. <https://doi.org/10.1093/tbm/ibz109>.
- ten Hoor, G. A., Varol, T., Mesters, I., Schneider, F., Kok, G., and Ruiter, R. A. C. (2022). Just-in-time, but still planned: Lessons learned from speeding up the development and implementation of an intervention to promote covid-19 vaccination in university students. *Health Promotion Practice*, 24(5):921–931. <https://doi.org/10.1177/15248399221095077>.
- van Amerongen, A., Zoller, C., and Fouda, A. (2024). Covid-19 in the netherlands: A three-phase analysis. *Health Policy and Technology*, 13(1):100783. <https://doi.org/10.1016/j.hlpt.2023.100783>.
- Varol, T. (2023). *Just in time: Applying behavioral science to create a safe university environment in times of the covid-19 pandemic*. PhD thesis, Maastricht University. <https://doi.org/10.26481/dis.20230629tv>.
- Varol, T., Crutzen, R., Schneider, F., Mesters, I., Ruiter, R. A., Kok, G., and ten Hoor, G. A. (2021). Selection of determinants of students' adherence to covid-19 guidelines and translation into a brief intervention. *Acta Psychologica*, 219:103400. <https://doi.org/10.1016/j.actpsy.2021.103400>.
- Varol, T., Schneider, F., Mesters, I., Ruiter, R. A. C., Kok, G., and Ten Hoor, G. A. (2022). Facilitating informed decision making: Determinants of university students' covid-19 vaccine uptake. *Vaccines*, 10(5):704. <https://doi.org/10.3390/vaccines10050704>.



**Lisa S.E. Harms** works at the Department of Health Promotion, Care and Public Health Research Institute (CAPHRI), Maastricht University, Maastricht, The Netherlands.  
 ORCID: 0000-0002-6832-5894  
 Email: [lisa.harms@maastrichtuniversity.nl](mailto:lisa.harms@maastrichtuniversity.nl)  
 Website: <https://nl.linkedin.com/in/lisa-harms-464a9711a>



**Tugce Varol** works at the Department of Health Promotion, Care and Public Health Research Institute (CAPHRI), Maastricht University, Maastricht, The Netherlands.  
 ORCID: 0000-0003-0737-9802  
 Email: [t.varol@maastrichtuniversity.nl](mailto:t.varol@maastrichtuniversity.nl)  
 Website: <https://nl.linkedin.com/in/tugce-varol-6a5899177>



**Gido Metz** works at the Department of Health Promotion, Care and Public Health Research Institute (CAPHRI) & Healthcare Innovation Lab, Maastricht University (Medical Center), Maastricht, The Netherlands.  
 ORCID: 0000-0002-1093-0311  
 Email: [gido\\_metz@hotmail.com](mailto:gido_metz@hotmail.com)  
 Website: <https://nl.linkedin.com/in/gido-metz-724234ba>