4.10 Using logic models in research and evaluation of Health EDRM interventions

Authors

Dylan Kneale, **Mukdarut Bangpan**, and **James Thomas**, Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre), University College London, London, United Kingdom.

Hugh Sharma Waddington, International Initiative for Impact Evaluation (3ie), London, United Kingdom; London School of Hygiene and Tropical Medicine, London, United Kingdom.

4.10.1 Learning objectives

To understand the following about the use of logic models in Health EDRM:

1. The importance of logic models for research and evaluation in Health EDRM;
2. Methods for constructing and using a logic model to guide research and evaluation projects.

4.10.2 Introduction

This chapter outlines how logic models can be used to conceptualize how interventions are intended to work, and their relationship with the broader context in which they take place – focusing on Health EDRM settings. Logic models are tools used to outline assumptions about the chains of processes, activities or events expected to occur during the implementation of an intervention, and the way in which these lead to changes in outcomes. They provide an initial set of assumptions about how different components of an intervention are expected to change outcomes, and can be used to develop further sub-research questions to investigate the validity of these assumptions. Logic models can also be used to communicate findings from research and evaluation activities, and can serve as useful tools in planning an intervention, including for the identification of relevant outcomes and monitoring of its delivery. However, this chapter will focus primarily on the use of logic models for research and evaluation purposes.

4.10.3 Why use a logic model in research and evaluation?

Programme theory refers to a number of collaborative approaches that allow stakeholders to work together to identify what should be done about a particular health challenge, how this should be done, and the intended outcomes and impact. A logic model is a framework for programme theory that graphically depicts a series of assumptions or steps about how an intervention is expected to achieve impact.

A logic model provides an accessible way for developing a shared understanding across different stakeholders of what an intervention is intended to achieve and a theory of how this will happen. Although there are several ways in which logic models can be used during the design of research and evaluation studies, they provide a means to explore two issues of relevance to policy makers and healthcare practitioners.

Firstly, logic models help users to theorize how the observed impacts of an intervention reflect factors around the implementation of the intervention and/or to its design *(1)*. For example, an intervention in a flood-prone area that is intended to help people to prepare for a disaster might include raising awareness of what should be included in a household disaster preparedness kit (for example, a torch and a supply of bottled water) *(2–3)*. The intervention as a whole might consist of a series of educational components delivered in community settings and a mass media campaign to improve knowledge of what should be included in the kit. If an evaluation study then found that the intervention did not lead to an improvement in knowledge, a logic model may help the researchers to assess whether this was due to problems with the design of the intervention or with its implementation. Using a logic model in an evaluation study provides a framework for understanding how an intervention works, and for producing evidence that can help to differentiate between an intervention that was not implemented properly and one that was not theorized properly (that is, even though it was properly implemented, it did not have a beneficial effect) *(4)*.

Secondly, using a logic model as the framework for research and evaluation in Health EDRM provides nuanced evidence that can be used to better understand how, where, and among whom the intervention is more likely to succeed *(5)*. For example, if the aforementioned disaster preparedness intervention was found to be successful in a particular setting, a well-specified logic model could be used to design an evaluation to establish if both components (the educational intervention and the mass media campaign) were necessary for success if the intervention were to be implemented elsewhere. Similarly, the logic model might be used to consider whether there were characteristics of the setting or population that facilitated or hindered the success of the intervention.

Chapter 3.3 discusses the design of interventions; using logic models supports researchers and evaluators to consider the factors that make interventions succeed or fail, and how these differ according to the characteristics of the setting or the population. Logic models are therefore frameworks that guide researchers, practitioners and policy makers and inform their decisions through developing theories of what an intervention is trying to achieve and how it will meet this aim.

4.10

4.10.4 When are logic models used?

Logic models can be used at different stages of an intervention, and by different stakeholders for different purposes *(4,6)*. They can be used from the outset, in the planning and design of an intervention, as a framework to underpin research into what the intervention is attempting to achieve and whether this is likely to be successful. Once the intervention is in place, logic models can be used to support implementation and to monitor and evaluate progress and performance. Although logic models are usually presented in graphical form, they can be presented in other formats; when presented in a tabular format, this may align with a logframe, which can serve many of the same purposes as a logic model, but has been described as more challenging to use for complex interventions *(4).*

For research and evaluation, logic models can be used to guide the overall conduct and design of the evaluation, including as a framework for identifying the questions that should be addressed, the outcomes that should be measured and the data that should be collected. Until recently, as noted in other chapters, the field of disaster medicine has been impeded in its development by a lack of evaluation studies in the peer-reviewed literature *(6)*. Fortunately, there is now greater emphasis on systematically evaluating disasters and emergencies and their impacts across a range of domains, and understanding how different 'vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment interact to amplify or reduce losses' *(7–8)*. The use of logic models in evaluation studies provides a framework for prioritizing and structuring data collection and analysis and ensuring that an evaluation examines the main components of an intervention and the relationships between them.

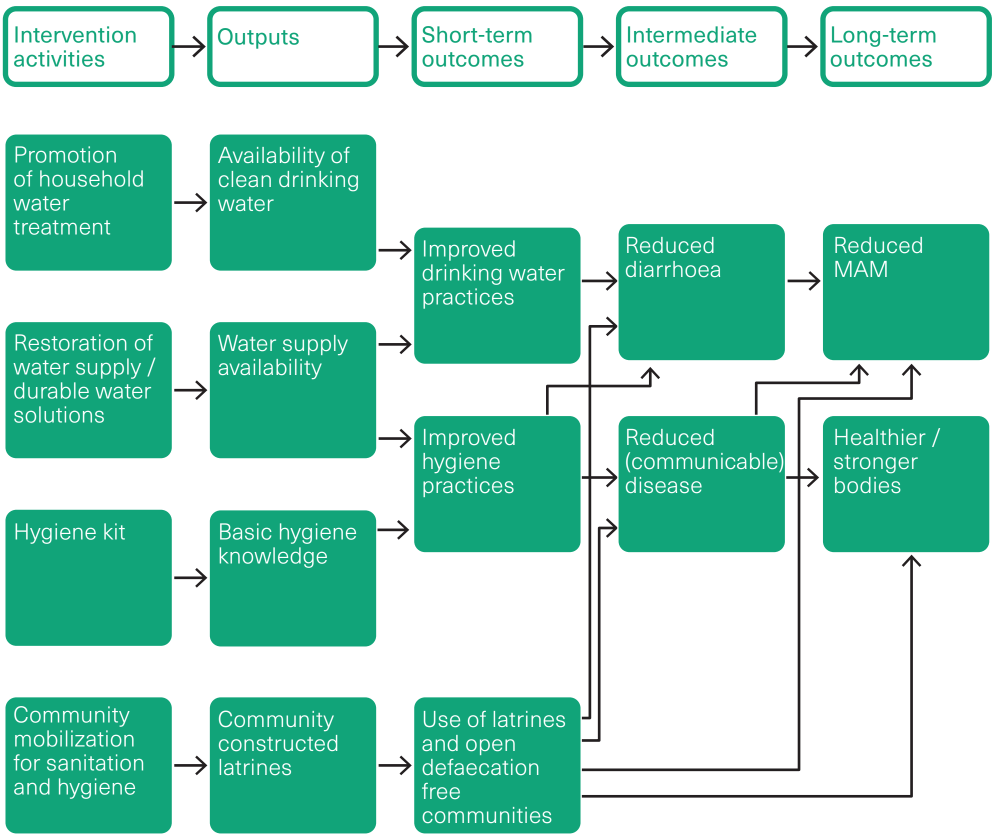
Logic models are also regarded as engagement tools to bring together diverse stakeholders, for example, in allowing them to develop a shared understanding of the priorities and modes of operation of the intervention *(4)*, helping to produce context-specific research knowledge *(9)*, and increasing the likelihood that the results of an evaluation will be accepted and used *(10)*. Logic models are also widely used for communication about evaluation studies *(11)*. Finally, logic models are used in evidence-informed policy and practice when synthesizing evidence from across different studies or settings about the feasibility or impact of a particular intervention approach *(12–13)*, and in making decisions about whether to implement, adapt or innovate a given intervention *(4)*.

Logic models may also be used at different levels, from theorizing how a single intervention might 'work' through to theorizing the impact of a suite of interventions forming a large programme. The latter will likely require the development of complicated multi-strand and multi-level logic models that might seek to depict the actions of several different nongovernmental organizations, institutions and other stakeholders. However, across these different purposes, the processes of interpreting and constructing a logic model follow similar principles.

4.10.5 Interpreting a logic model

A logic model is a graphical representation of intervention processes and how they change outcomes, depicted as chains of cause-and-effect relationships *(14)*. Figure 4.10.1 is an adaptation of a logic model supporting the evaluation of an intervention to increase community resilience to disaster in Pakistan, and is adapted from the work of Avdeenko and Frölich *(15)*. The logic model depicts a programme theory of how multi-component interventions involving Water, Sanitation and Hygiene (WASH) can increase resilience to disasters and improve health. Focusing in on a single pathway at the top of the model, representing a pathway between the restoration of water supplies and a reduction in levels of Moderate-Acute Malnutrition (MAM), we read the model from left to right as a series of 'if…then…' statements *(16)*. These statements are based on the premise that if 'x' occurs, 'y' will occur, and are used to link different sections of the chain. Reading from left to right, *if* water treatments are promoted, *then* there will be greater availability of clean drinking water. In turn, *if* there is greater availability of clean drinking water, *then* drinking water practices will improve; and *if* there are improvements in drinking water practices, *then* levels of diarrhoea will reduce. Finally, *if* there is a reduction in diarrhoea, *then* levels of MAM will reduce.

Figure 4.10.1 Logic model for the impacts of WASH activities in improving health as part of interventions to increase community resilience to natural disasters in Pakistan *(15)*



Our reading of the logic model and focus on a single strand is a simplified interpretation of how the intervention may reduce levels of MAM. For example, it is recognized within forms of guidance around WASH interventions (17) that behaviour change is not automatic with the provision of clean water supplies, and should be explicitly programmed alongside environmental, social inclusion and treatment and care interventions. Furthermore, the logic model actually shows five different potential pathways that might lead to such a reduction, all or only some of which may be needed in order for a reduction to be observed *(15)*. Because the model indicates that a reduction in MAM may be achieved through different pathways or combinations of components (known as equifinality), the intervention can be considered to be complex in nature, requiring a particular suite of analytical tools for its evaluation *(14)*.

4.10.6 Features of a logic model

Logic models depict often highly complex interventions in a manageable and interpretable way. In order for logic models to provide a framework to support research and evaluation studies, they must contain elements that summarize the assumptions of how the intervention works. These elements include:

- The outcomes or the change that the intervention is trying to bring about
- Indicators of implementation that show what was meant to be delivered
- Mechanisms that show how what was being delivered as part of the intervention leads to a change in the outcome
- Characteristics of the context in which the intervention takes place that are likely to influence its implementation or its effectiveness *(18–19)*.

To ensure that a logic model captures these elements, they should represent – at a minimum – intervention activities or inputs, outputs, the intervention outcomes (which may be ordered chronologically), and the relationships between these. These elements are defined in Table 4.10.1, along with other elements that frequently occur in logic models, some of which may be particularly important for Health EDRM interventions.

Table 4.10.1 Definitions of frequently occurring elements of logic models used in intervention research *(6, 13, 20–21)*

Elements of logic models used in intervention research	Definition
Distal or long-term outcomes	Long-term outcomes are those theorized to occur following the initiation of an intervention and reflect broad concepts which are often analogous with the ultimate aims of the intervention.
Intermediate outcomes	Intermediate outcomes are theorized as being necessary pre-conditions of achieving distal or long-term outcomes and occur during follow-up after an intervention has ended. They may reflect behaviours that are among the ultimate aims of the intervention.
Short-term or proximal outcomes	Short-term outcomes are theorized to occur at the end of an intervention or soon after it has ended, as a direct result of the intervention. They are theorized to be necessary pre-conditions for triggering intermediate outcomes.
Outputs	Outputs are descriptive indicators of what the specific activities generate, and quantified and qualified indicators of the implementation of intervention activities. Unlike outcomes, outputs are under the direct control of those delivering the intervention.
Intervention inputs: Activities or intervention components and processes	Activities or components of the intervention that reflect what is being delivered. These are necessary to trigger the expected intervention processes and outputs. They may be represented as sequences of events in themselves, where one intervention component must take place before another component can begin.
Intervention inputs: Resources	Resources that are secured in order to deliver an intervention. They may be financial or may reflect the input or support of different stakeholders and might be identified through asset mapping processes (Chapter 3.1).
Contextual factors or external factors	These include population characteristics and the characteristics of the context or setting where the intervention takes place, which may moderate the way in which the intervention is expected to 'work'. For disaster and emergency interventions, these may reflect pre-existing conditions or new factors that have emerged as a result of an event (for example, the emergence of violence or spread of a communicable disease such as cholera).
Connecting arrows	These form chains, linking intervention inputs with outputs and outcomes. Connecting arrows signal the direction in which the sequence of events take place and can be used to represent more complex relationships
Additions for disaster or emergency interventions *(6)*: Goals	These are broad statements about the long-term expectations of what should happen as a result of the intervention (see Salabarría-Peña, Apt and Walsh (*22)* for a further example).
Additions for disaster or emergency interventions *(6)*: Objectives	Statements describing the changes to be achieved, and the way in which change will occur (linked to the broader goal, with multiple objectives supporting the goal).
Additions for disaster or emergency interventions *(6)*: Impacts	Impacts reflect the way in which the intervention is theorized to meet its overall goal. As Birnbaum and colleagues *(6)* explain, impacts are the 'so-what' of the intervention. They represent the 'high-level' systemic change achieved at a community or population level (in practice, there may also be overlap with long-term outcomes).

4.10

4.10.7 Constructing a logic model de novo

This section will briefly discuss the steps involved in developing a logic model de novo. There are several comprehensive resources to support this process *(4, 6, 13, 16, 20, 23)*, some of which include templates to guide researchers and policymakers *(24),* including one specifically developed for disaster-related interventions *(6)*.

A first step in developing a logic model is to search for existing logic models for the intervention of interest *(13)*. However, despite nearly 60 years of the use of logic models by evaluators *(4)*, existing examples can be difficult to locate. Furthermore, any existing logic model will need to be adapted to reflect different contexts or priorities. Nevertheless, reviewing existing models is a useful preliminary exercise in starting to theorize the outcomes of interest and how they should be sequenced, and in identifying some key intervention processes linking inputs with outputs and outcomes *(25)*.

4.10.8 Steps in creating a logic model

1. Involve stakeholders.
Before developing a logic model, a key step is to secure the involvement of a range of stakeholders, in order to strengthen the salience of the model and its value in subsequent research activities *(8, 10)*. Different stakeholders (such as evaluators, policy-makers, community leaders) tend to hold different views and understandings, which are useful to incorporate when dealing with the uncertainty and complexity in humanitarian crises. Among other benefits, the involvement of a diverse range of stakeholders can:

- Create a useful challenge to the assumptions made in deciding how an intervention changes outcomes.
- Provide an opportunity to develop a consensus as to which outcomes measure the effectiveness of the intervention, and which outputs signal whether the intervention was successfully implemented.
- Ensure that diverse perspectives are represented.
- Help to identify how contextual factors extraneous to the intervention may facilitate or hinder the delivery of the intervention.
- Enhance the usefulness of the evidence produced for different practitioners and policy-makers.

2. Identify the purpose or goal of the intervention.
The overarching research question (Chapter 3.5), purpose or goal of the intervention should be identified and the major assumptions should be outlined. This may include key changes that have taken place in disaster or emergency settings, and theorizing about how these external factors will influence the goal of the intervention.

3. Begin depicting the chain of events, starting with the distal outcomes.
It is customary for the development of a logic model to begin by identifying and representing (usually in boxes) the distal or long-term outcomes that are expected to result from implementation of the intervention.

4. Specify intermediate and proximal outcomes.
The next step involves working backwards to identify or hypothesize the necessary preconditions (intermediate and proximal or short-term outcomes) that are needed to reach these distal outcomes. For example, in Figure 4.10.1, it was hypothesized that reducing the levels of MAM (long-term outcome) required reduction in levels of diarrhoea (intermediate outcome).

5. Continue to develop outcome chains.
The steps needed to reach longer-term outcomes may involve a number of pre-conditions (changes in outcomes) that are needed. Several "links", represented as boxes or other shapes, could be added to the outcome chain.

6. Add intervention outputs.
After identifying outcomes, outputs are identified and represented within the model. Outputs are descriptive indicators of what the specific intervention activities generate, and represent necessary pre-conditions to reach outcomes, but are not necessarily goals in themselves (see Table 4.10.1).

7. Develop intervention inputs/activities.
Continuing to work backwards from the outcomes and outputs, chains of intervention inputs are specified. Areas of ambiguity about precisely how intervention activities are sequenced (that is, a 'black box' of intervention inputs) may be represented in the logic model as a single box, with the research or evaluation study building understanding of how the intervention is implemented.

8. Complete initial model.
An initial logic model will consist of input chains, comprising an intervention's components and resources and how these are sequentially implemented, outputs, and outcome chains.

9. Consider the nature of mechanisms.
Mechanisms, or pathways of action, describe the nature of the action occurring between intervention inputs and outputs and outcomes. Not all relationships depicted within a logic model are simple linear (cause-effect) relationships, and more complex relationships may need to be included to better represent the likely mechanisms and to help guide data collection or analysis. An example is presented below and further examples are available elsewhere *(26–28)*.

10. Consider the role of context, settings and stakeholders.
Additional external or contextual factors, including the characteristics of populations, communities and other stakeholders involved in interventions, should be theorized and represented. These characteristics may be necessary for the intervention to 'work' (that is to say, without them the intervention cannot be implemented) or may moderate its effectiveness and amplify or dampen its success. In some cases, it may be easier to develop separate causal chains, or even separate models if an intervention is theorized to work very differently across diverse settings, populations or stakeholders.

11. Continue to iterate
It is expected that several iterations of the logic model will be developed before a preferred model is produced, with iterations representing an improvement in clarity, the conceptual soundness of the logic model, and more logical sequencing and organization of its elements. The logic model should be assessed for its consistency with existing research, broader theory, knowledge about the setting and logical plausibility *(4)*. Further iteration and development of the models may take place while the research or evaluation study is being conducted, on the basis of new knowledge generated (see also 'Update on the basis of new learning' below).

12. Consider unintended consequences.
Outcomes of interventions may deviate from their intended outcomes, and it is important to theorize about these unanticipated and adverse impacts. This process is described as modelling "dark logic" within interventions *(29)*.

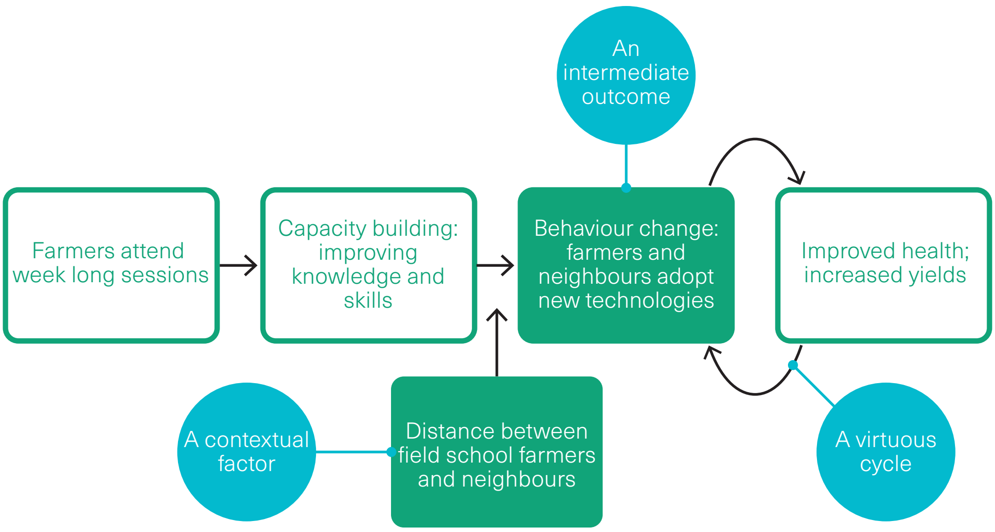
13. Update on the basis of new learning.
The research process is expected to generate new knowledge and evidence that may lead to changes in the logic model, or lead to an entirely new way of understanding how the intervention works. For examples of how logic models were updated based on new evidence see Harris et al *(25)* and Waddington and White *(30)*.

4.10.9 Representing more complex relationships in a logic model

To show how more complex relationships can be included in a logic model, we draw on the example of farmer field schools (FFS). FFS bring together groups of farmers in a community to empower them through learning about best practices in agriculture and, increasingly, about prevention, preparedness and response to disasters. The approach uses participatory models of education, including field-based experiments on neighbouring plots of land through a growing season, in order to examine the impact of best-practice techniques. FFS are believed to be useful in mitigating exposure to disasters and climate change *(31)*. The interventions have been considered as a means of reducing the risks of pesticide-related health emergencies *(30)* and as post-recovery measures for disaster-affected farmers *(32)*.

A systematic review of the effectiveness of FSS on outcomes including health was supported using a logic model *(30)*. A simplified and adapted version of that logic model is shown in Figure 4.10.2. The pathway outlines the steps between attending a FFS and improved health and yields, with three features of interest highlighted that can be represented in logic models. The first is the explicit mention of the intermediate outcome, which represents a factor that lies on the causal pathway between the intervention and distal outcomes. This demonstrates the functionality of a logic model being developed through theorizing a chain of pre-conditions needed to link the intervention with the outcome. The second feature of interest is the inclusion of hypothesized contextual factors (geographical and social distance between farmers) that are expected to moderate the extent to which new skills and behaviours developed among FFS participants will lead to improved knowledge and behavioural change among neighbouring farmers as well. Here, this contextual factor may amplify or dampen the relationship between exposure to the intervention and the outcomes. Such factors may interrupt or support the chain of events, but are not integral links in the causal chain. The third feature of interest is a ‘virtuous circle’, which is depicted in Figure 4.10.2 as a process whereby the adoption of new technologies among field school farmers and neighbour farmers leads to better health outcomes, by reducing farmers’ exposure to pesticide in the environment, and better yields, via community-wide adoption of improved practices. This suggests that the impacts of the intervention could strengthen over time, and as the benefits of new technologies become apparent, this stimulates further adoption of new technologies. Virtuous cycles are activated when initial changes in the outcome create the opportunities for further positive self-reinforcing changes. Negative changes can be represented as ‘vicious cycles’. Virtuous and vicious cycles are two of several more complex relationships that can be depicted in a logic model *(4, 26–28)*.

Figure 4.10.2 Logic model adapted from a systematic review of the effectiveness of farmer field schools *(30)*



4.10.10 Logic model variants

As tools in research and evaluation studies, logic models offer flexibility and a spectrum of forms and uses are available in the literature. Some different variants of logic models are outlined below, drawing in part on work by Rehfuess et al *(21)*. These variants arise from differences in the priorities of the logic model at different stages of the research or evaluation study, or its scope.

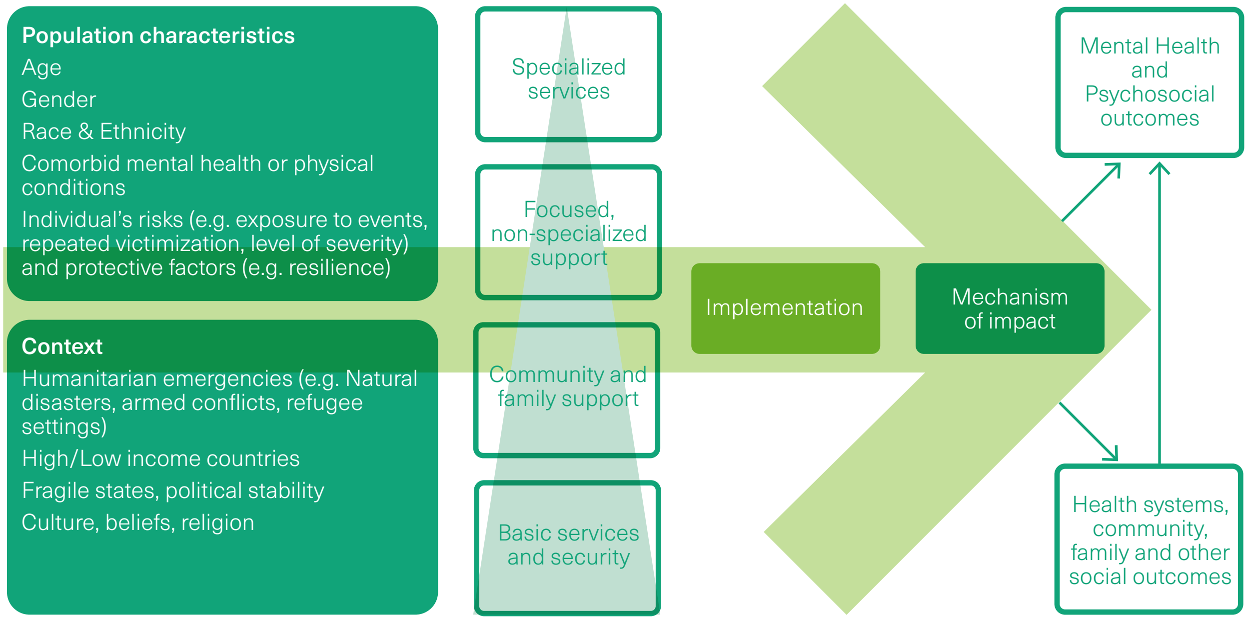
Variant 1: Static, staged and iterative logic models

A static logic model is one that is specified before the research or evaluation study, and remains in place without iteration throughout the study (although there may be an assessment at the end of the study as to how well the theory explained the evidence). A staged logic model is one where the theory is adapted or changed on the basis of interim findings or new knowledge, at planned stages of the research or evaluation study. Iterative logic models are those that are adapted at any point in the research or evaluation study to reflect findings or new knowledge. This latter approach is more organic and responsive to new insights that may emerge, new questions that may arise, and any change in the priorities of the intervention *(25)*. A logic model should be assessed, and updated as appropriate, based on the findings of the research or evaluation study, with both the original and updated versions made available.

Variant 2: System-based and process-based logic models
A second distinction is between system-based logic models that aim to theorize aspects of complexity around the relationship between an intervention and the broader context and how these interact, and process-based logic models that focus more theorizing aspects of complexity between the processes occurring as part of an intervention and its multiple outcomes. Clearly there is some overlap between these types of model, and a single research or evaluation study may draw on both *(21)*. Process-based logic models tend to represent input and output chains in greater detail, reflecting a priority around understanding temporal sequences of intervention processes. Meanwhile, a system-based logic model depicts the system as 'the interaction between the participants, the intervention, and the context [in which it] takes place' *(21, p.15)*.

A system-based logic model may be particularly useful in accounting for the myriad ways in which different interconnecting components of health systems are impacted by health emergencies and disasters, and theorizing how interventions can restore these systems and 'build back better' to improve health. An example of a system-based logic model is reproduced from the paper by Bangpan, Chiumento, Dickson, and Felix *(33)*, which highlights in a simplified way the types of population characteristics, contextual and implementation factors and the combinations of these factors which may influence the effectiveness of mental health and psychosocial support interventions on people affected by humanitarian emergencies. Interventions in Health EDRM are often complex and sensitive to the context in which they are undertaken. This means that an intervention that is effective in one type of setting may be ineffective (or even harmful) in another population or setting, without modification *(34)*. A system-based logic model provides a starting point for theorizing whether there are aspects of the context (setting and existing health infrastructure) or population that are likely to facilitate or hinder the implementation and effectiveness of an intervention (Figure 4.10.3).

Figure 4.10.3 Components to consider in a system-based logic model *(33)*



Terminology used when theorizing how interventions work
Although we outline the use of logic models, there are a number of different, overlapping, terms for tools that have been used to conceptualize how interventions work. Table 4.10.2 provides definitions for some of the alternative terminology in use, although in practice there are several overlaps between these concepts.

4.10

Table 4.10.2 Definitions of frequently occurring terms around the use of programme theory

Type of (Programme) Theory	Definition
Programme theory	A hypothesis explaining how an intervention is expected to lead to a change in the outcome. Graphical representations of programme theory can be developed into logic models or theories of change.
Logic model	A graphical representation of intervention processes, and outcomes linked by arrows indicating the direction of effect, which are developed into chains of cause-and-effect relationships.
Theory of change	Theories of change are used to represent complex interventions. Although there is overlap, unlike logic models, theories of change are more explanatory as they require all of the underlying assumptions of how and why different components, activities and outputs lead to a change in outcomes to be specified at the outset, as well as an indication of the context and the stakeholders affected. There can be multiple causal chains for different stakeholders. While there are differences between logic models and theories of change *(35)*, these differences are fuzzy and in practice the terminology is often used interchangeably.
Logical framework	The term logical framework or logframe is used to describe an array of different approaches. In some cases, the term is conflated with logic models. However, there are examples of logframes that are used more as project management tools that track how outputs, outcomes and impact are achieved according to different activities *(36)*. While useful as a project management tool, logframes are likely to be less useful as a tool for theorizing how interventions work, and particularly as a tool for theorizing aspects of complexity in interventions *(37)*.
Middle-range theory	Middle-range theories connect high-level sociological theories with empirical knowledge. In the context of interventions, middle-range theories include general principles about the ways in which interventions will ‘work’ across a range of situations (drawn from high-level theory), but also include some granular detail around intervention causal chains that can inform specific decisions about an intervention. Nevertheless, they are usually more generalized than programme theory, although there are several commonalities between middle-range theory and programme theory more generally *(38)*. There are few specific examples in the development literature of middle-range theories *(39)*.
Conceptual framework	Conceptual frameworks outline the main elements of the intervention and how it is meant to work, and may include a description of the context in which an intervention is expected to take place. A conceptual framework is not necessarily a graphical outline and the nature of the relationships between different components may not be explicitly articulated.

4.10.11 Using logic models in evaluation and research

Logic models can be useful, practical aids for conducting a variety of research and evaluation studies, in several ways:

- As an engagement tool with stakeholders in the design of research and evaluation studies, ensuring that a diverse set of views are represented from the outset.
- Helping to design specific research and evaluation questions that can be used to guide studies and, similarly, in helping to identify the types of research approaches and methods that are suitable for answering questions that emerge from the logic model.
- Helping to decide what information needs to be collected about intervention inputs and activities, the characteristics of the contexts, and outputs and outcomes.
- Helping to design plans of how the research or evaluation data will be processed and for interpreting the findings.
- Communicating the results of the study through updating or redrawing of logic models on the basis of new knowledge.

Using a logic model provides a framework for understanding how an intervention channels an effect between the inputs and outcomes (40–41). Logic models are useful in unpacking the intervention 'black box' to aid understanding of the processes by which interventions can generate impact *(42).* This approach to producing evidence can help to move "beyond 'business as usual', generic programme designs through [developing] a greater awareness of the context", with the logic model being a useful tool "to test the assumptions, demonstrate impact and learn from [interventions]" (*43,* p11).

4.10.12 Conclusions

There is increasing concern around improving the availability and use of evidence for Health EDRM *(44–45)*. At the core of good quality evidence is the use of theory to increase the robustness of the findings, the applicability and validity of any recommendations and enhance the generalizability (external validity) of the findings to other settings.

Using a logic model to theorize how an intervention works and how it interacts with context, and designing a research or evaluation study to test this theory, can be a useful basis for making decisions about which interventions to implement in which areas and for which types of emergency, as well as identifying whether interventions may need adaptation. Furthermore, for interventions that do not appear to be effective, evidence that is driven by theory is more likely to help distinguish between failures in intervention design and failures in intervention implementation (potentially due to context). Logic models represent a practical and applied approach for developing a theory of how interventions work which can be updated to incorporate new learning obtained through research and evaluation.

4.10

4.10.13 Key messages

- **Logic models provide a useful basis for thinking conceptually about how an intervention should 'work' to change outcomes. They are a graphical representation of the stages linking intervention inputs and outputs, outcomes and impacts.**
- **Logic models can be used to reflect assumptions about contexts and to illustrate more complex relationships.**
- **There are a number of steps to follow when developing a logic model, but perhaps one of the most important elements of good practice is that logic models should be developed with the input of stakeholders to challenge some of the (potentially erroneous) assumptions made by the research team.**

4.10.14 Further reading

Resources that include logic model templates

Birnbaum ML, Daily EK, O'Rourke AP, Kushner J. Research and evaluations of the health aspects of disasters, part VI: interventional research and the Disaster Logic Model. Prehospital and Disaster Medicine. 2016: 31(2): 181-94.

Rohwer A, Booth A, Pfadenhauer L, Brereton L, Gerhardus A, Mozygemba K, et al. Guidance on the use of logic models in health technology assessments of complex interventions. 2016 https://www.integrate-hta.eu/wp-content/uploads/2016/02/Guidance-on-the-use-of-logic-models-in-health-technology-assessments-of-complex-interventions.pdf (accessed 6 February 2020).

Resources on how to develop a logic model afresh

Kneale D, Thomas J, Harris K. Developing and Optimising the Use of Logic Models in Systematic Reviews: Exploring Practice and Good Practice in the Use of Programme Theory in Reviews. PLoS ONE. 2015: 10(11): e0142187.

Resource on using logic models in research on complex interventions

Kneale D, Thomas J, Bangpan M, Shemilt I, Waddington H, Gough D. Causal chain analysis in systematic reviews of international development interventions. CEDIL Inaugral Papers. Centre of Excellence for Development Impact and Learning, London. 2018. https://cedilprogramme.org/wp-content/uploads/2017/12/Inception-Paper-No-4.pdf (accessed 6 February 2020).

Applied examples

Bangpan M, Chiumento A, Dickson K, Felix L. The impact of mental health and psychosocial support interventions on people affected by humanitarian emergencies: a systematic review. In Humanitarian Evidence Programme. Oxfam GB, Oxford. 2017: https://policy-practice.oxfam.org.uk/publications/the-impact-of-mental-health-and-psychosocial-support-interventions-on-people-af-620214 (accessed 6 February 2020).

Waddington H, White H. Farmer field schools: from agricultural extension to adult education. 3ie Systematic Review Summary 1. International Initiative for Impact Evaluation, London. 2014. https://www.3ieimpact.org/sites/default/files/2019-05/srs1_ffs_revise_060814_final_web_2.pdf (accessed 17 July 2020).

4.10.15 References

1. Bamberger M, Rao V, Woolcock M. Using mixed methods in monitoring and evaluation: experiences from international development. 2010. https://openknowledge.worldbank.org/handle/10986/3732 (accessed 6 February 2020).
2. British Red Cross. Prepare an emergency kit: Be ready to cope with a crisis. 2020 https://www.redcross.org.uk/get-help/prepare-for-emergencies/prepare-an-emergency-kit (accessed 6 February 2020).
3. Chan EYY, Guo C, Lee P, Liu S, Mark CKM. Health emergency and disaster risk management (Health EDRM) in remote ethnic minority areas of rural China: The case of a flood-prone village in Sichuan. International Journal of Disaster Risk Science. 2017: 8(2): 156-63.
4. Funnell SC, Rogers PJ. Purposeful program theory: effective use of theories of change and logic models (volume 31). San Francisco, CA: John Wiley & Sons. 2011.
5. White H. Theory-based impact evaluation: principles and practice. Journal of development effectiveness. 2009: 1(3): 271-84.
6. Birnbaum ML, Daily EK, O'Rourke AP, Kushner J. Research and evaluations of the health aspects of disasters, part VI: interventional research and the Disaster Logic Model. Prehospital and Disaster Medicine. 2016: 31(2): 181-94.
7. Aitsi-Selmi A, Egawa S, Sasaki H, Wannous C, Murray V. The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. International Journal of Disaster Risk Science. 2015: 6(2): 164-76.
8. Sendai Framework for Disaster Risk Reduction 2015 - 2030. UNISDR. 2015. https://www.unisdr.org/we/inform/publications/43291 (accessed 6 February 2020).
9. Oliver S, Roche C, Stewart R, Bangpan M, Dickson K, Pells K et al. Stakeholder Engagement for Development Impact Evaluation and Evidence Synthesis. 2018. https://cedilprogramme.org/wp-content/uploads/2018/10/Stakeholder-Engagement-for-Development.pdf (accessed 6 February 2020).

4.10

10. Dwyer JJ, Makin S. Using a program logic model that focuses on performance measurement to develop a program. Canadian Journal of Public Health. 1997: 88(6): 421-5.
11. Jones ND, Azzam T, Wanzer DL, Skousen D, Knight C, Sabarre N. Enhancing the Effectiveness of Logic Models. American Journal of Evaluation (published online first). 2019: doi: 10.1177/1098214018824417
12. Anderson LM, Petticrew M, Rehfuess E, Armstrong R, Ueffing E, Baker P, et al. Using logic models to capture complexity in systematic reviews. Research Synthesis Methods. 2011: 2(1): 33-42.
13. Kneale D, Thomas J, Harris K. Developing and Optimising the Use of Logic Models in Systematic Reviews: Exploring Practice and Good Practice in the Use of Programme Theory in Reviews. PloS ONE. 2015: 10(11): e0142187.
14. Kneale D, Thomas J, Bangpan M, Waddington H, Gough D. Conceptualising causal pathways in systematic reviews of international development interventions through adopting a causal chain analysis approach. Journal of Development Effectiveness. 2018: 10(4): 422-37.
15. Avdeenko A, Frölich M. Impacts of increasing community resilience in the face of natural disasters through humanitarian aid in Pakistan. 2019. https://www.3ieimpact.org/sites/default/files/2019-06/IE100-TW6.1028-humanitarian-ACTED-Pakistan.pdf (accessed 6 February 2020).
16. WK Kellogg Foundation. Logic model development guide. 2004 https://www.bttop.org/sites/default/files/public/W.K.%20Kellogg%20LogicModel.pdf (accessed 6 February 2020).
17. WASH and health working together: a 'how-to' guide for neglected tropical disease programmes (9241515007). WHO. 2018. https://apps.who.int/iris/bitstream/handle/10665/279913/9789241515009-eng.pdf (accessed 6 February 2020).
18. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ. 2015: 350: h1258.
19. Morgan-Trimmer S, Smith J, Warmoth K, Abraham C. Introduction to logic models. 2018. https://www.gov.uk/government/publications/evaluation-in-health-and-well-being-overview/introduction-to-logic-models (accessed 6 February 2020)
20. Knowlton LW, Phillips CC. The logic model guidebook: Better strategies for great results. Thousand Oaks, CA: Sage. 2012.
21. Rehfuess EA, Booth A, Brereton L, Burns J, Gerhardus A, Mozygemba K, et al. Towards a taxonomy of logic models in systematic reviews and health technology assessments: a priori, staged and iterative approaches. Research Synthesis Methods. 2017: 9(1): 13-24.
22. Salabarría-Peña Y, Apt B, Walsh C. Practical use of program evaluation among sexually transmitted disease (STD) programs. 2007. https://www.cdc.gov/std/program/pupestd.htm (accessed 6 February 2020).

23. Pfadenhauer L, Rohwer A, Burns J, Booth A, Lysdahl KB, Hofmann B, et al. Guidance for the Assessment of Context and Implementation in Health Technology Assessments (HTA) and Systematic Reviews of Complex Interventions: The Context and Implementation of Complex Interventions (CICI) Framework. 2016. https://www.integrate-hta.eu/wp-content/uploads/2016/02/Guidance-for-the-Assessment-of-Context-and-Implementation-in-HTA-and-Systematic-Reviews-of-Complex-Interventions-The-Co.pdf (accessed 6 February 2020).

24. Rohwer A, Booth A, Pfadenhauer L, Brereton L, Gerhardus A, Mozygemba K, et al. Guidance on the use of logic models in health technology assessments of complex interventions. 2016 https://www.integrate-hta.eu/wp-content/uploads/2016/02/Guidance-on-the-use-of-logic-models-in-health-technology-assessments-of-complex-interventions.pdf (accessed 6 February 2020).

25. Harris K, Kneale D, Lasserson TJ, McDonald VM, Grigg J, Thomas J. School-based self-management interventions for asthma in children and adolescents: a mixed methods systematic review. Cochrane Database of Systematic Reviews. 2019: (1): 1:CD011651.

26. Davies R. Representing Theories Of Change: A Technical Challenge With Evaluation Consequences. 2018. https://mande.co.uk/wp-content/uploads/2018/09/2018-08-31-Inception-Paper-No-15-MandE-NEWS-PDF-copy-2.pdf (accessed 6 February 2020).

27. Kneale D, Thomas J, Bangpan M, Waddington H, Gough D. Causal chain analysis in systematic reviews of international development interventions. 2018. https://cedilprogramme.org/wp-content/uploads/2017/12/Inception-Paper-No-4.pdf (accessed 6 February 2020)

28. Rogers PJ. Using Programme Theory to Evaluate Complicated and Complex Aspects of Interventions. Evaluation. 2008: 14(1): 29-48.

29. Bonell C, Jamal F, Melendez-Torres GJ, Cummins S. “Dark logic”: theorising the harmful consequences of public health interventions. Journal of Epidemiology and Community Health. 2014: 69(1): 95-8.

30. Waddington H,White H. Farmer field schools: from agricultural extension to adult education. 3ie Systematic Review Summary 1, International Initiative for Impact Evaluation, London. 2014: https://www.3ieimpact.org/sites/default/files/2019-05/srs1_ffs_revise_060814_final_web_2.pdf (accessed 16 July 2020).

31. Meijboom M, Tiwari S, Dubbeling M. Enhancing climate resilience of Gorakhpur by buffering floods through climate-resilient peri-urban agriculture. 2016. https://ruaf.org/document/enhancing-climate-resilience-of-gorakhpur-by-buffering-floods-through-climate-resilient-peri-urban-agriculture/ (accessed 6 February 2020).

32. Mariyono J, Luther GC, Bhattarai M, Ferizal M, Jaya R, Fitriana N. Farmer field schools on chili peppers in Aceh, Indonesia: Activities and impacts. Agroecology and Sustainable Food Systems 2013: 37(9): 1063-77.

33. Bangpan M, Chiumento A, Dickson K, Felix L. The impact of mental health and psychosocial support interventions on people affected by humanitarian emergencies: a systematic review. Humanitarian Evidence Programme. Oxford: Oxfam GB. 2017. https://fic.tufts.edu/assets/Mental-Health-Systematic-Review.pdf (accessed 6 February 2020).

34. Greene MC, Jordans MJ, Kohrt BA, Ventevogel P, Kirmayer LJ, Hassan G et al. Addressing culture and context in humanitarian response: preparing desk reviews to inform mental health and psychosocial support. Conflict and Health. 2017: 11(1): 21.

35. Clark H, Anderson AA. Theories of Change and Logic Models: Telling Them Apart. 2004. https://www.theoryofchange.org/wp-content/uploads/toco_library/pdf/TOCs_and_Logic_Models_forAEA.pdf (accessed 6 February 2020).

36. DFID. Guidance on using the revised Logical Framework. 2011. https://www.gov.uk/government/publications/dfid-how-to-note-guidance-on-using-the-revised-logical-framework (accessed 6 February 2020).

37. Floate H, Durham J, Marks GC. Moving on from logical frameworks to find the 'missing middle' in international development programmes. Journal of Development Effectiveness. 2019: 11(1): 89-103.

38. Pawson R. Middle Range Theory and Programme Theory Evaluation. In: Vaessen J, editor. Mind the Gap: Perspectives on Policy Evaluation and the Social Sciences. 2008.

39. CEDIL Call for Proposals Programme of Work 2: Generalising evidence through middle range theory. CEDIL. 2019. https://cedilprogramme.org/wp-content/uploads/2019/03/CEDIL-call-spec-for-PoW-2.pdf (accessed 6 February 2020).

40. Illari P, Russo F. Causality: Philosophical theory meets scientific practice. OUP Oxford. 2014.

41. Reiss J. Causation in the social sciences: Evidence, inference, and purpose. Philosophy of the Social Sciences 2009: 39(1): 20-40.

42. White H. Theory based systematic reviews. Journal of Development Effectiveness. 2018: 10(1): 17-38.

43. Vogel I. Review of the use of 'Theory of Change' in international development. 2012 http://www.theoryofchange.org/pdf/DFID_ToC_Review_VogelV7.pdf (accessed 6 February 2020).

44. Gerdin M, Clarke M, Allen C, Kayabu B, Summerskill W, Devane D, et al. Optimal evidence in difficult settings: improving health interventions and decision making in disasters. PLoS Medicine. 2014: 11(4): e1001632.

45. Kayabu B, Clarke M. The use of systematic reviews and other research evidence in disasters and related areas: preliminary report of a needs assessment survey. PLoS Currents: Disasters. 2013: 22 January. 4.10.15