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Built to last? The sustainability of health system improvements, interventions and change strategies: A study protocol for a systematic review.

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4 **Built to last? The sustainability of health system improvements, interventions**
5 **and change strategies: A study protocol for a systematic review.**
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ABSTRACT (206 words)

Introduction: To conduct a systematic review and identify, synthesise and draw meaning from studies that measure the sustainability of interventions and change programs in the health system. Ultimately, the goal is to establish the academic base for sustainable *initiatives* to contribute to the sustainability of *health systems*.

Methods and analysis: The protocol outlines a method by which to execute a rigorous systematic review. The design includes applying primary and secondary data collection techniques, such as a comprehensive database search complimented by contact with experts, searching secondary databases and reference lists, including through snowballing. The review and analysis process will occur via an abstract review followed by a full-text screening process. The inclusion criteria include: English language, peer-reviewed, primary, empirical research articles published after 2011, in scholarly journals, for which the full text is available. No restrictions on location will be applied. The review that results from this protocol will synthesize and compare characteristics of the included studies. Ultimately, it is intended that this will make it easier to identify and design sustainable interventions.

Ethics and dissemination: As no primary data was collected, ethical approval was not required. Results will be disseminated in conference presentations, peer-reviewed publications and amongst policymaker bodies interested in creating sustainable health systems.

ARTICLE SUMMARY: STRENGTHS AND LIMITATIONS OF THE STUDY

- Defining sustainability is challenging, making it difficult to develop inclusion criteria.
- The protocol is multi-faceted, with pluralist methods being deployed to identify useful articles.
- An updated systematic review in this area is much-needed and will be a useful reference for clinicians, policymakers and researchers.
- The search strategy has been refined by building on the search strategies of previous systematic reviews.

**Built to last? The sustainability of health system improvements, interventions
and change strategies: A study protocol for a systematic review.**

INTRODUCTION

Rationale

Health systems are facing a battery of formidable challenges. Populations are ageing;(1-4) there is a rising prevalence of chronic conditions;(5-8) complex patients have multiple co-morbidities;(9-12) new technologies are creating new models of care;(13, 14) 20% or more of healthcare spending is wasteful;(15) the role of the patient is changing with a growing ‘consumer culture’ and demand for patient-centred health care models;(16-19) there is pressure to increase standards of patient safety and quality of care;(20-23) the costs of care are rising;(24, 25) and there are increased fiscal pressures to pay for everything.(26, 27) Every health system is striving for solutions that find and deploy viable methods to meet growing demands whilst capitalising on new technologies and ensuring that core processes of care remain of high quality.(28) However, the problem is complex. Health system sustainability—the capacity to deliver affordable, cost-effective outcomes over time—requires numerous stakeholders, multiple approaches and coordinated actions undertaken across various system components.(29) Whilst there have been previous related reviews,(30-38) there is an absence of up-to-date evidence on how disparate programs and interventions are achieving sustainability and how they might contribute to, or help inform, system sustainability. We propose a review aiming to provide a comprehensive summary of the evidence for the sustainability of interventions, programs and improvement efforts undertaken in the health sector.

Defining sustainability

Health systems comprise “all the activities whose primary purpose is to promote, restore and maintain health”(39)(p5). Sustainable health systems have sufficient resources to meet their objectives and are able to adapt at a rate that is faster than that of the changing environment:(40) in short, they keep up with developments, or leapfrog them. What constitutes a sustainable health system has been poorly articulated in the literature.(37, 41) Scheirer and Dearing define sustainability as “the continued use of program components and activities for the continued achievement of desirable program and population outcomes”.(42)(p2060) Scheirer describes three separate operational definitions of sustainability: 1) the continued health benefits for individuals beyond the initial funding period; 2) the continuation of program activities within an organisation; and 3) the continued ability of a community to develop and deliver health promotion programs.(43)

Wiltsey Stirman et al.(30) noted that the current body of sustainability research is limited by a lack of working definitions and models of sustainability to guide researchers. In their review of sustainable interventions, 65% of studies did not provide an operational definition of sustainability. Studies that provided one most frequently cited Scheirer’s definition.(43)

This protocol recognises that sustainability, as a complex construct, can be defined and operationalised in multi-faceted ways. Rather than subscribe to a precise definition, a sustainable health system is broadly conceptualized as one that is resilient, that endures, and adapts to constant pressures.(4, 40) Ultimately, sustainable strategies are identified as those that last, and contribute to improvement, over

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3 time.(30, 43)
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8 **Prior reviews of sustainable health systems**

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10 Several reviews have investigated the sustainability of interventions and programs
11 and their effect on outcomes, each looking at different areas or levels of the health
12 sector.(30-38) Some have focused on sustainability in specific regions, such as
13 Canada and the United States,(31) or sub-Saharan Africa.(32) Others have looked at
14 specific types of programs or interventions, such as chronic disease programs and
15 interventions,(33, 34) medical professionals' adherence to clinical practice
16 guidelines,(35) and the influence of interventions on sustaining culture change.(36)
17 Approaches to achieving program sustainability have also been investigated, without
18 examining outcomes.(37, 38)
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31 Wiltsey Stirman et al.'s review took a more expansive approach to studying
32 sustainable interventions. Without limiting their review by context, the authors
33 examined a broad scope of studies to assess the sustainability of interventions, the
34 outcomes they provided, and their influences in a variety of countries and health
35 settings.(30) They revealed a “fragmented and underdeveloped” body of
36 research.(30)(p13) Five years later, with growing pressure on our health systems, and
37 increased interest in sustainable health care, there is a need to establish the current
38 state of the evidence.
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51 **Objectives**

52 Following Wiltsey Stirman et al.(30), the objective of our review is to provide an
53 account of the sustainability of interventions, programs and improvement efforts in
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3 health settings. We aim to analyse research conducted since Wiltsey Stirman et al.'s
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5 2012 study and will be guided by the research questions outlined in their review: 1)
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7 How has sustainability been defined? 2) At what levels and units of analysis has it
8
9 been studied? 3) What research methods have been used? 4) Over what time periods?
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11 5) What outcomes have been reported in the empirical literature? 6) What were the
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13 findings? and, 7) What has research told us to date about influences on sustainability?
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17 Synthesising the most relevant and up-to-date literature will provide important
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19 information for decision-makers, researchers, health professionals, clinicians, and
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21 patients interested in collaborating on sustainable interventions, programs and
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23 improvement efforts. Ultimately, the goal is for sustainable *initiatives* to contribute to
24
25 the sustainability of *health systems*.
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31 **METHODS**

32 **Eligibility criteria**

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34 Guided by previous reviews(30, 32, 43-45), studies will be included if they report on
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36 either the status of an ongoing intervention, program or improvement, or the
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38 continued health benefits after the initial program period, or program funding, ends.
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40 Studies that provide evidence on the influence of program sustainability will be
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42 included regardless of whether this was the primary aim of the study.
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48 *Outcome measures*

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50 Outcome measures will include objective measures of sustainability, such as
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52 improved health and safety, or cost reduction with sustained quality over time.
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54 Indicators of sustainability are expected to be highly heterogeneous, and consequently
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56 multiple methods of measuring sustainability will be considered.
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Report characteristics

Following earlier reviews(30, 32, 43-45), publications will be considered against the following inclusion criteria: English language, peer-reviewed, primary, empirical research articles published after 2011, in scholarly journals, for which the full text is available. No restrictions on location will be applied. In order to provide a comprehensive review of the peer-reviewed evidence, grey literature will be excluded.

Information sources

Our search terms, as detailed in the search strategy (Table 1), are intended to cover a wide range of terminology used to define, measure and study sustainability. Search terms will be applied to the databases CINAHL, EMBASE, and Ovid MEDLINE. These databases were selected due to their specific focus on biomedical, health system, allied health, and nursing research. Health care-related subject headings (i.e., Health care delivery, Delivery of health care) will be employed to limit the search to healthcare settings.

Table 1: Search strategy

Topic	Search terms
Sustainability	Sustainab* OR “sustainable development” OR continuation OR continual OR institutional* OR resilien* OR durab* OR viab* OR stability OR stable OR persist* OR maintenance OR routin*
AND	
Improvement/	Improvement OR improve OR innovation OR reform* OR intervention OR program* OR strateg* OR project OR plan OR

intervention	“change management”
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Additional search methods will be conducted to reduce the likelihood that relevant articles are overlooked. Applying a snowballing approach, a hand search of bibliographic references of key systematic reviews will be conducted, and experts in the field will be contacted for advice on potential studies for inclusion. Additionally, a title search will be conducted using the Scopus and Web of Science databases, which include articles from medicine and health sciences, in addition to the arts, humanities and social sciences.

Study records

Data management

Using the strategy specified in Table 1, and informed by the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) statement, the initial search will be carried out by three researchers (JHe, KL and EM). These researchers will also examine the reference lists of pertinent reviews and contact appropriate experts in the field for advice on potentially relevant articles. Data will be imported into an EndNote library by LT and duplicates will be deleted.

Selection and data collection processes

To ensure consensus on the retained articles, abstracts from 5% of the Endnote library will be randomly assigned for assessment by pairs of reviewers (EM, JHe; KL, LT; GL and MC) against the inclusion criteria. Inter-rater agreement rates will be calculated for each pair using Cohen’s Kappa. Any discrepancies between authors

concerning the inclusion or exclusion of articles will be discussed by all reviewers as a group, with JB as arbitrator, until a consensus is reached. Each researcher will then independently review 20% of the remaining abstracts against the inclusion criteria.

Following this process, included abstracts will be randomly assigned to the reviewers for a full text review against the inclusion criteria. A data extraction sheet will be used to record relevant information from included studies and reasons for exclusion for omitted studies (Supplementary file 1).

Data items and definitions

The concept of sustainability is ambiguously defined. As such, we define key terms used in the current systematic review protocol in Box 1. The data extraction sheet will record article details, context and setting, number of sites, type of study, details of improvement or intervention, assessment period, measures of sustainability, and key findings for individual studies.

Box 1

Definitions of variables

Sustainability: Continuation of interventions, programs and improvement efforts within health systems after initial implementation efforts or cessation of funding.(30)

Outcomes: The impact or benefits of interventions, programs and improvement efforts that continue after initial implementation efforts or cessation of funding.(30)

Outcomes and prioritization

Following Wiltsey Stirman et al.(30), and in line with Scheirer's definitions of sustainability,(43) sustainable outcomes may manifest as ongoing health benefits for individuals, the continuation of program activities, or the durability of community

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3 capacity. Priority will be given to studies that address sustainability over a longer time
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5 frame. For example, studies assessing the sustainability of an improvement
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7 intervention over years, as opposed to months, will provide more valuable
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9 information about sustainability and its long-term effects. Other studies which will be
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11 prioritised include those that provide a working definition of sustainability, and those
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13 that report on multiple sustainability outcomes.
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16 17 18 19 **Risk of bias in individual studies**

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22 Where appropriate, study bias will be assessed using a Risk of Bias Template,
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24 specifically the Cochrane Collaboration's tool for assessing risk of bias, adapted from
25
26 the Cochrane Handbook for Systematic Reviews.(46) Articles will be independently
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28 assessed and classified as 'high' or 'low' risk of bias. Consideration of bias will be
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30 given when interpreting the results of the review.
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33 34 35 36 **Data synthesis**

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39 Based on previous systematic reviews of this type(30, 41, 44, 47), a quantitative meta-
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41 analysis of data may not be feasible. In the event that it is possible, a random-effects
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43 model will be used.(48) Depending on the findings from the literature review, a
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45 scoping meta-review may also be undertaken.(47) Where meta-analysis is not
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47 appropriate, data will be summarised using a narrative synthesis approach.(49) The
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49 synthesis will focus on the overall evidence for sustained effectiveness of
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51 interventions, programs and improvement efforts.
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58 59 60 **Meta-biases**

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3 In publishing this protocol we aim to avoid publication bias or selective outcome
4 reporting by detailing our search and inclusion criteria, and by employing a data
5 extraction form.(50) Publication bias will also be limited by searching the reference
6 lists of key systematic reviews and with the use of snowballing techniques to locate
7 articles that may not have been detected in the database searches.(48)
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14 15 16 17 **Confidence in cumulative evidence**

18 We will assess the quality of evidence using an appropriate assessment tool, such as
19 the Grading of Recommendations Assessment, Development and Evaluation
20 (GRADE) approach.(51) Each study will be categorised by level of quality, in
21 accordance with the chosen assessment tool.
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32 **CONCLUSION**

33 The challenge of creating and maintaining a sustainable health system is an enduring
34 problem faced by all health system stakeholders: politicians, funders, providers,
35 insurers, policymakers and patients. Ageing populations and increasing demands for
36 services present substantial challenges to the affordability of health care systems,
37 making the need for an urgent solution all the more necessary. We do not know
38 enough about how interventions, programs and improvement efforts, especially recent
39 ones, are contributing to sustainability, nor the effect which they may have on system
40 durability. The proposed review will provide a synthesis of the most current evidence
41 on the sustainability of improvement interventions and will be of use to those
42 interested in contributing to improved long-term health systems outcomes on a large
43 scale.
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Amendments

Any deviations from this protocol will be reported in the final systematic review, accompanied by a justification of why these alterations are necessary.

Author's Contributions

JB conceptualized the study and leads the team's work. LT and GL drafted the initial manuscript and search strategy, assisted by KL and JHe. Important contributions to refine and improve the manuscript were provided by JB, KL, JHe, EM, JHo and MC.

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Competing Interests

There are no competing interests.

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Supplementary file 1. Data extraction sheet

Article details (authors, title, endnote reference)			
Context; setting			
Number of sites			
Type of study: qualitative, quantitative, mixed method; cross-sectional, longitudinal			
Details of improvement/intervention			
Assessment period (or period of program/intervention)			
Measures of sustainability			
Key findings			

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Secondary Subject Heading:	Health policy, Public health
Keywords:	sustainability, health systems improvement, interventions, complex systems, systematic review, study protocol

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4 **Built to last? The sustainability of health system improvements, interventions**
5 **and change strategies: A study protocol for a systematic review.**
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ABSTRACT (241 words)

Introduction: The sustainability of health care interventions and change programs is of increasing importance to researchers and health care stakeholders interested in creating sustainable health systems to cope with mounting stressors. The aim of this protocol is to extend earlier work and describe a systematic review to identify, synthesise and draw meaning from studies published within the last five years which measure the sustainability of interventions, improvement efforts, and change strategies in the health system. **Methods and analysis:** The protocol outlines a method by which to execute a rigorous systematic review. The design includes applying primary and secondary data collection techniques, consisting of a comprehensive database search complemented by contact with experts, and searching secondary databases and reference lists, using snowballing techniques. The review and analysis process will occur via an abstract review followed by a full-text screening process. The inclusion criteria include: English language, peer-reviewed, primary, empirical research articles published after 2011, in scholarly journals, for which the full text is available. No restrictions on location will be applied. The review that results from this protocol will synthesize and compare characteristics of the included studies. Ultimately, it is intended that this will help make it easier to identify and design sustainable interventions, improvement efforts and change strategies.

Ethics and dissemination: As no primary data was collected, ethical approval was not required. Results will be disseminated in conference presentations, peer-reviewed publications and amongst policymaker bodies interested in creating sustainable health systems.

ARTICLE SUMMARY: STRENGTHS AND LIMITATIONS OF THE STUDY

- Defining sustainability is challenging, making it difficult to develop inclusion criteria.
- The protocol is multi-faceted, with pluralist methods being deployed to identify useful articles.
- An updated systematic review in this area is much-needed and will be a useful reference for clinicians, policymakers and researchers.
- The search strategy has been refined by building on the search strategies of previous systematic reviews.

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3 **Built to last? The sustainability of health system improvements, interventions**
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10 **INTRODUCTION**

11 **Rationale**

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14 Health systems are facing a battery of formidable challenges. Populations are
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16 ageing;(1-4) there is a rising prevalence of chronic conditions;(5-8) complex patients
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18 have multiple co-morbidities;(9-12) new technologies are creating new models of
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20 care;(13, 14) 20% or more of health care spending is wasteful;(15) the role of the
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22 patient is changing with a growing ‘consumer culture’ and demand for patient-centred
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24 health care models;(16-19) there is pressure to increase standards of patient safety and
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26 quality of care;(20-23) the costs of care are rising,(24, 25) driven in part by high
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28 prices for new cancer and orphan drugs;(26-28) and there are increased fiscal
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30 pressures to pay for everything medicine can do.(29, 30) Every health system is
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32 striving for solutions that find and deploy viable methods to meet growing demands
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34 whilst capitalising on new technologies and ensuring that core processes of care
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36 remain of high quality.(31) However, the problem is complex. Health system
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38 sustainability—the capacity to deliver affordable, cost-effective outcomes over
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40 time—requires numerous stakeholders, multiple approaches and coordinated actions
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42 undertaken across various system components.(32, 33) Sustainable health systems are
43
44 ones that have sufficient resources to meet their objectives and are able to adapt to a
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46 changing environment;(34) in short, they keep up with developments, or leapfrog
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48 hurdles. One way in which policymakers, decision-makers, and health care
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50 management try to achieve the sustainability goal is through the implementation of
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3 improvements, interventions, and change strategies.

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5 Whilst older reviews have been conducted on this topic,(35-43) a synthesis of the
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7 more recent evidence, regarding how disparate programs and interventions are
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9 achieving sustainability and how they might contribute to or help inform system
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11 sustainability, is absent. Therefore, we propose a systematic review with an in-depth
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13 focus on the sustainability of such improvement programs.
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16 17 18 19 **Defining sustainability**

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21 Sustainability is poorly defined in the literature,(35, 42, 43) which has hindered the
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23 development of a consensus, evidence-based, operational paradigm for research and
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25 evaluation.(43, 44) A seminal report released by the World Commission on
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27 Environment and Development in 1987 articulated “sustainable development” as that
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29 which “meets the needs of the present without compromising the ability of future
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31 generations to meet their own needs” and as a “process of change in which the
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33 exploitation of resources, the direction of investments, the orientation of technological
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35 development, and institutional change are all in harmony and enhance both current
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37 and future potential to meet human needs and aspiration”.(45) This trans-disciplinary
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39 conceptualisation of sustainability construes it as a multi-dimensional dynamic
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41 interplay of economic, social and ecological factors.(42)
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45 Regarding the sustainability of improvement programs in health care, a focus on
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47 innovation and organisational development has led to the conceptualisation of
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49 sustainability as the “ongoing delivery of health programmes, which may be
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51 measured by the longevity of independent projects, or how well programmes become
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53 institutionalised in organisation or health and social systems”.(44)(p1580) This
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3 approach has been criticised for promoting the continuation and institutionalisation of
4 health programs with insufficient prioritisation of enduring health outcomes. Gruen et
5 al. (2008) argue that sustainability instead requires “ongoing cycles of reflection,
6 planning, and action”.(44)(p1587) Hudson and Vissing (2013) argue that health
7 benefits may be better achieved through alternate programs or treatments, therefore
8 requiring the constant evaluation and evolution of existing programs and
9 interventions.(43) They contend that a blinkered adherence to program maintenance
10 may fail to promote population health.

11
12 Envisaging sustainable interventions as static tools fails to take into account the
13 complex adaptive nature of health care systems.(43, 44, 46) Within a complex
14 adaptive system framework, sustainability interventions can be better seen as another
15 variable(47) which act on the dynamic system. We can potentially refine and improve
16 interventions over time, to sustainably meet contextual needs and maintain desirable
17 patient outcomes.(33)

18
19 Earlier this decade, Wiltsey Stirman et al. (2012) noted that the current body of
20 sustainability research is limited by a lack of working definitions and models of
21 sustainability to guide researchers.(35) In their review of sustainable interventions,
22 65% of studies did not provide an operational definition of sustainability, whereas
23 those that did, frequently cited Scheirer’s (2005) definitions, which are based on
24 earlier work of Shediac-Rizkallah and Bone (1998).(48, 49) Scheirer (2005) describes
25 three separate operational definitions for interventions which promote sustainability:
26 1) the continued health benefits for individuals beyond the initial funding period; 2)
27 the continuation of program activities within an organisation; and 3) the continued
28 ability of a community to develop and deliver health promotion programs.(48) In a
29 later paper on sustainability, Scheirer and Dearing (2011) defined sustainability as

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3 “the continued use of program components and activities for the continued
4 achievement of desirable program and population outcomes”.(47)(p2060) In our
5 review we will consider an amalgam of Scheirer (2005) and Scheirer and Dearing’s
6 (2011) definitions.(47, 48) We have selected these definitions of sustainability based
7 on an understanding of health systems as complex adaptive systems and the
8 prioritisation of health outcomes alongside the maintenance of programs, or program
9 elements.
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22 **Prior reviews of sustainable health interventions and programs**

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24 Several reviews have investigated the sustainability of interventions and programs
25 and their effects on outcomes, typically looking at different areas or levels of the
26 health sector.(35-44) Some have focused on sustainability in specific regions, such as
27 Canada and the United States,(36) or sub-Saharan Africa.(37) Others have looked at
28 specific types of programs or interventions, such as chronic disease programs and
29 interventions,(38, 39) medical professionals’ adherence to clinical practice
30 guidelines,(40) and the influence of interventions on sustaining culture change.(41)
31 Approaches to achieving program sustainability have also been investigated, without
32 examining outcomes.(42, 43)
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45 Gruen et al. (2008) conducted a broader systematic review looking at both empirical
46 studies and conceptual frameworks of health program sustainability.(44) They
47 focused on health programs assessed over a defined period. The authors then
48 identified factors they believed to be associated with the programs’ sustainability. The
49 authors developed a conceptual framework for sustainability planning grounded in
50 sustainability science, which regards health programs as complex systems.
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3 Likewise, Wiltsey Stirman et al.'s (2012) review took a more expansive approach to
4 studying sustainable interventions, whilst maintaining a focus on empirical
5 studies.(35) Without limiting their review by context, the authors examined a broad
6 scope of studies to assess the sustainability of interventions, the outcomes they
7 provided, and their influences in a variety of countries and health settings.(35) They
8 revealed a “fragmented and underdeveloped” body of research, suffering from a lack
9 of methodological rigor and definitional consensus.(35)(p13) The authors note that
10 the absence of validated measures, of program monitoring post implementation and of
11 real-time observations have also affected the evidence-base. Five years later, with
12 growing pressure on our health systems, and increased interest in sustainable health
13 care, there is a need to establish the current state of the evidence.
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31 Objectives

32 Following Wiltsey Stirman and colleagues,(35) the objective of our review is to
33 provide an account of the sustainability of interventions, improvement efforts, and
34 change strategies in health settings. We aim to analyse research conducted since
35 Wiltsey Stirman et al.'s 2012 review in order to provide an updated synthesis of the
36 literature on health and sustainability the past five years. As Figure 1 shows,
37 considerable growth in publications focused on sustainability in health care has
38 occurred between 2013-2016, supporting the need for an updated review of the
39 evidence.
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<Insert Figure 1 here>

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3 **Figure 1: Publication titles containing the words “health” and “sustainability”,**
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5 **1978-present. Adapted from Hudson and Vissing (2013), using data from Google**
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7 **Scholar.**
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12 Following Wiltsey Stirman et al. (2012), the review will be guided by the following
13 research questions: 1) How has sustainability been defined? 2) At what levels and
14 units of analysis has it been studied? 3) What research methods have been used? 4)
15 Over what time periods? 5) What outcomes have been reported in the empirical
16 literature? 6) What were the findings? 7) What has research told us to date about
17 influences on sustainability? and, 8) How is sustainability conceptualized in a
18 complex adaptive system?
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29 This systematic review will provide an essential contribution by synthesising the most
30 relevant and up-to-date literature in this area. It seeks to provide important
31 information for decision-makers, researchers, health professionals, clinicians, and
32 patients interested in collaborating on sustainable interventions, programs and
33 improvement efforts.
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43 **METHODS**

44 **Eligibility criteria**

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46 Guided by previous reviews,(35, 37, 46, 48, 50) studies will be included if they report
47 on either the status of an ongoing intervention, program or improvement, or the
48 continued health benefits after the initial program period, or program funding, ends.
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53 Similar to Wiltsey Stirman and colleagues, there is no specified time frame between
54 program or funding completion, and assessment of outcomes, but rather, each study
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3 with be evaluated on a case-by-case basis. Studies that provide evidence on the
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5 influence of program sustainability will be included regardless of whether this was the
6
7 primary aim of the study.
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10 *Outcome measures*

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12 Outcome measures will include objective measures of sustainability, such as
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14 improved health and safety,(35, 44) or cost reduction with sustained quality over
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16 time.(38) Indicators of sustainability are expected to be highly heterogeneous, and
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18 consequently multiple methods of measuring sustainability will be considered.
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22 *Report characteristics*

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24 Following earlier reviews,(35, 37, 46, 48, 50) publications will be considered against
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26 the following inclusion criteria: English language, peer-reviewed, primary, empirical
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28 research articles published after 2011, in scholarly journals, for which the full text is
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30 available. No restrictions on location will be applied. In order to provide a
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32 comprehensive review of the peer-reviewed evidence, grey literature will be
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34 excluded.
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42 **Information sources and search strategy**

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44 Our search terms, as detailed in the search strategy (Table 1), are intended to cover a
45
46 wide range of terminology used to define, measure and study sustainability. Search
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48 terms will be applied to the databases CINAHL, EMBASE, and Ovid MEDLINE.
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51 These databases were selected due to their specific focus on biomedical, health
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53 system, allied health, and nursing research. Health care-related subject headings (i.e.,
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55 Health care delivery, Delivery of health care) will be employed to limit the search to
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57 health care settings.
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Table 1: Search strategy

Topic	Search terms
Sustainability	Sustainab* OR “sustainable development” OR continuation OR continual OR institutional* OR resilien* OR durab* OR viab* OR stability OR stable OR persist* OR maintenance OR routin*
AND	
Improvement/ intervention	Improvement OR improve OR innovation OR reform* OR intervention OR program* OR strateg* OR project OR plan OR “change management”

Additional search methods will be conducted to reduce the likelihood that relevant articles are overlooked. Applying a snowballing approach, a hand search of bibliographic references of key systematic reviews will be conducted, and experts in the field will be contacted for advice on potential studies for inclusion. Additionally, a title search will be conducted using the Scopus and Web of Science databases, which include articles from medicine and health sciences, in addition to the arts, humanities and social sciences.

Study records

Data management

Using the strategy specified in Table 1, and informed by the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) statement, the initial search will be carried out by three researchers (JHe, KL and EM). These researchers will also examine the reference lists of pertinent reviews and contact

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3 appropriate experts in the field for advice on potentially relevant articles. Data will be
4 imported into an EndNote library by LT and duplicates will be deleted.
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7 *Selection and data collection processes*

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10 To ensure consensus on the retained articles, abstracts from 5% of the EndNote
11 library will be randomly assigned for assessment by pairs of reviewers (EM, JHe; KL,
12 LT; GL, JH) against the inclusion criteria. Inter-rater agreement rates will be
13 calculated for each pair using Cohen's Kappa. Any discrepancies between authors
14 concerning the inclusion or exclusion of articles will be discussed by all reviewers as
15 a group, with JB as arbitrator, until a consensus is reached. Each researcher will then
16 independently review the remaining abstracts against the inclusion criteria.
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20 Following this process, included abstracts will be randomly assigned to the reviewers
21 for a full text review against the inclusion criteria. A data extraction sheet will be used
22 to record relevant information from included studies and reasons for exclusion for
23 omitted studies (Supplementary file 1). It is expected that this process will begin soon
24 after publication of the protocol, and we are scheduling to complete by mid-2018.
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27 **Data items**

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29 The data extraction sheet will record article details, definition of sustainability (if
30 provided), context and setting, number of sites, type of study, details of improvement
31 or intervention, assessment period, measures of sustainability, and key findings for
32 individual studies.
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43 **Outcomes and prioritization**

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3 Following Wiltsey Stirman et al.,(35) and in line with Scheirer's, and Scheirer's and
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5 Dearing's definitions of sustainability,(47, 48) outcomes refer to the ongoing impact
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7 or health benefits of interventions, programs, change strategies, and improvement
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9 efforts that continue after initial implementation efforts or cessation of funding.
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11 Priority will be given to studies that address sustainability over a longer time frame.
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13 For example, studies assessing the sustainability of an improvement intervention over
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15 years, as opposed to months, will provide more valuable information about
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17 sustainability and its long-term effects. Other studies which will be prioritised include
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19 those that provide a working definition of sustainability, and those that report on
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21 multiple sustainability outcomes.
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28 **Risk of bias in individual studies**

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31 Where appropriate, study bias will be assessed using a Risk of Bias Template,
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33 specifically the Cochrane Collaboration's tool for assessing risk of bias, adapted from
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35 the Cochrane Handbook for Systematic Reviews.(51) Articles will be independently
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37 assessed and classified as 'high' or 'low' risk of bias. Consideration of bias will be
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39 given when interpreting the results of the review.
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46 **Data synthesis**

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48 Based on previous systematic reviews of this type,(35, 44, 52) a quantitative meta-
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50 analysis of data may not be feasible. In the event that it is possible, a random-effects
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52 model will be used.(53) Depending on the findings from the literature review, a
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54 scoping meta-review may also be undertaken.(54)
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57 Where meta-analysis is not appropriate, data will be summarised using a narrative
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3 synthesis approach.(55) The synthesis will focus on the overall evidence for sustained
4 effectiveness of interventions, programs and change strategies, including barriers and
5 facilitators to their sustainability and the outcomes they produce. Articles will be
6 grouped and discussed according to similarities and differences in their setting,
7 participants, the research methods (e.g., quantitative, qualitative or mixed-method;
8 cross-sectional versus longitudinal), and results obtained. Possible areas of
9 comparison include differences between; micro and macro interventions, short-term
10 and long-term programs, and between low-, middle- and high- countries. Results will
11 be used to determine factors associated with sustainability.(35, 44)
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26 **Meta-biases**

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28 In publishing this protocol we aim to avoid publication bias or selective outcome
29 reporting by detailing our search and inclusion criteria, and by employing a data
30 extraction form.(56) Publication bias will also be limited by searching the reference
31 lists of key systematic reviews and with the use of snowballing techniques to locate
32 articles that may not have been detected in the database searches.(53)
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43 **Confidence in cumulative evidence**

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45 We will assess the quality of evidence using an appropriate assessment tool, such as
46 the Grading of Recommendations Assessment, Development and Evaluation
47 (GRADE) approach.(57) Each study will be categorised by level of quality, in
48 accordance with the chosen assessment tool.
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58 **CONCLUSION**

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3 The challenge of creating and maintaining a sustainable health system is an enduring
4 problem faced by all health system stakeholders, including politicians, funders,
5 providers, insurers, policymakers and patients. Ageing populations and increasing
6 demands for services present substantial challenges to the affordability of health care
7 systems, making the need for an urgent solution all the more necessary. We do not
8 know enough about how interventions, programs and improvement efforts, especially
9 recent ones, are contributing to sustainability, nor the effect which they may have on
10 system durability. The proposed review will provide a synthesis of the most current
11 evidence on the sustainability of improvement interventions and will be of use to
12 those interested in contributing to improved long-term health systems outcomes on a
13 large scale.
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Amendments

Any deviations from this protocol will be reported in the final systematic review, accompanied by a justification of why these alterations are necessary.

Author's Contributions

JB conceptualized the study and leads the team's work. LT and GL drafted the initial manuscript and search strategy, assisted by KL and JHe. Important contributions to refine and improve the manuscript were provided by JB, KL, JHe, EM, JHo and MC.

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Competing Interests

There are no competing interests.

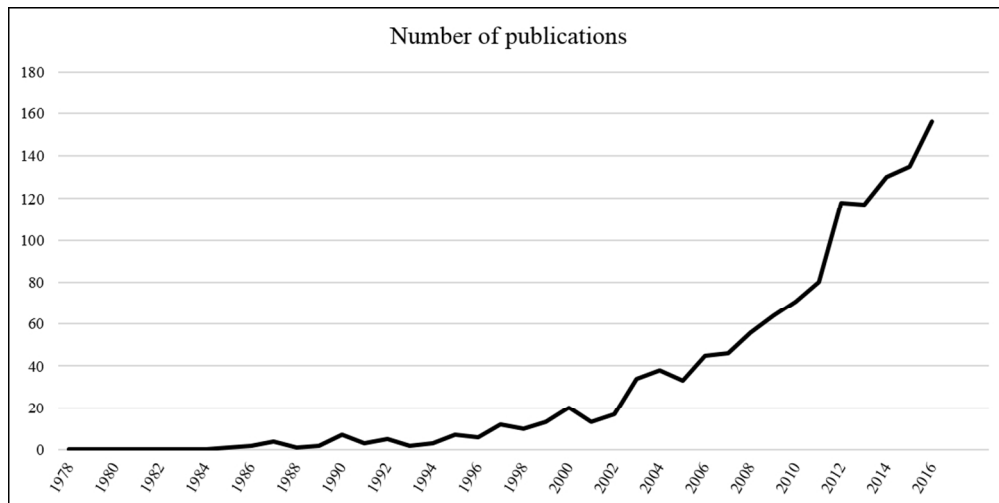


Figure 1: Publication titles containing the words "health" and "sustainability", 1978-present. Adapted from Hudson and Vissing (2013), using data from Google Scholar.

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review only

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4 **Supplementary file 1. Data extraction sheet**
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Article details (authors, title, endnote reference)			
Definition of sustainability			
Context; setting			
Number of sites			
Type of study: qualitative, quantitative, mixed method; cross-sectional, longitudinal			
Details of improvement/intervention			
Assessment period (or period of program/intervention)			
Measures of sustainability			
Key findings			

BMJ Open

Built to last? The sustainability of health system improvements, interventions and change strategies: A study protocol for a systematic review.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018568.R2
Article Type:	Protocol
Date Submitted by the Author:	12-Oct-2017
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Primary Subject Heading:	Health services research
Secondary Subject Heading:	Health policy, Public health
Keywords:	sustainability, health systems improvement, interventions, complex systems, systematic review, study protocol

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Manuscripts

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4 **Built to last? The sustainability of health system improvements, interventions**
5 **and change strategies: A study protocol for a systematic review.**
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10 Jeffrey Braithwaite^{1*}, Luke Testa¹, Gina Lamprell¹, Jessica Herkes¹, Kristiana
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52 systematic review, study protocol
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ABSTRACT (241 words)

Introduction: The sustainability of health care interventions and change programs is of increasing importance to researchers and health care stakeholders interested in creating sustainable health systems to cope with mounting stressors. The aim of this protocol is to extend earlier work and describe a systematic review to identify, synthesise and draw meaning from studies published within the last five years which measure the sustainability of interventions, improvement efforts, and change strategies in the health system. **Methods and analysis:** The protocol outlines a method by which to execute a rigorous systematic review. The design includes applying primary and secondary data collection techniques, consisting of a comprehensive database search complemented by contact with experts, and searching secondary databases and reference lists, using snowballing techniques. The review and analysis process will occur via an abstract review followed by a full-text screening process. The inclusion criteria include: English language, peer-reviewed, primary, empirical research articles published after 2011, in scholarly journals, for which the full text is available. No restrictions on location will be applied. The review that results from this protocol will synthesize and compare characteristics of the included studies. Ultimately, it is intended that this will help make it easier to identify and design sustainable interventions, improvement efforts and change strategies.

Ethics and dissemination: As no primary data was collected, ethical approval was not required. Results will be disseminated in conference presentations, peer-reviewed publications and amongst policymaker bodies interested in creating sustainable health systems.

ARTICLE SUMMARY: STRENGTHS AND LIMITATIONS OF THE STUDY

- Defining sustainability is challenging, making it difficult to develop inclusion criteria.
- The protocol is multi-faceted, with pluralist methods being deployed to identify useful articles.
- An updated systematic review in this area is much-needed and will be a useful reference for clinicians, policymakers and researchers.
- The search strategy has been refined by building on the search strategies of previous systematic reviews.

**Built to last? The sustainability of health system improvements, interventions
and change strategies: A study protocol for a systematic review.**

INTRODUCTION

Rationale

Health systems are facing a battery of formidable challenges. Populations are ageing;(1-4) there is a rising prevalence of chronic conditions;(5-8) complex patients have multiple co-morbidities;(9-12) new technologies are creating new models of care;(13, 14) 20% or more of health care spending is wasteful;(15) the role of the patient is changing with a growing ‘consumer culture’ and demand for patient-centred health care models;(16-19) there is pressure to increase standards of patient safety and quality of care;(20-23) the costs of care are rising,(24, 25) driven in part by high prices for new cancer and orphan drugs;(26-28) and there are increased fiscal pressures to pay for everything medicine can do.(29, 30) Every health system is striving for solutions that find and deploy viable methods to meet growing demands whilst capitalising on new technologies and ensuring that core processes of care remain of high quality.(31) However, the problem is complex. Health system sustainability—the capacity to deliver affordable, cost-effective outcomes over time—requires numerous stakeholders, multiple approaches and coordinated actions undertaken across various system components.(32, 33) Sustainable health systems are ones that have sufficient resources to meet their objectives and are able to adapt to a changing environment;(34) in short, they keep up with developments, or leapfrog hurdles. One way in which policymakers, decision-makers, and health care management try to achieve the sustainability goal is through the implementation of

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3 improvements, interventions, and change strategies.

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5 Whilst older reviews have been conducted on this topic,(35-43) a synthesis of the
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7 more recent evidence, regarding how disparate programs and interventions are
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9 achieving sustainability and how they might contribute to or help inform system
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11 sustainability, is absent. Therefore, we propose a systematic review with an in-depth
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13 focus on the sustainability of such improvement programs.
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16 17 18 19 **Defining sustainability**

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21 Sustainability is poorly defined in the literature,(35, 42, 43) which has hindered the
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23 development of a consensus, evidence-based, operational paradigm for research and
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25 evaluation.(43, 44) A seminal report released by the World Commission on
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27 Environment and Development in 1987 articulated “sustainable development” as that
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29 which “meets the needs of the present without compromising the ability of future
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31 generations to meet their own needs” and as a “process of change in which the
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33 exploitation of resources, the direction of investments, the orientation of technological
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35 development, and institutional change are all in harmony and enhance both current
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37 and future potential to meet human needs and aspiration”.(45) This trans-disciplinary
38
39 conceptualisation of sustainability construes it as a multi-dimensional dynamic
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41 interplay of economic, social and ecological factors.(42)
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45 Regarding the sustainability of improvement programs in health care, a focus on
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47 innovation and organisational development has led to the conceptualisation of
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49 sustainability as the “ongoing delivery of health programmes, which may be
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51 measured by the longevity of independent projects, or how well programmes become
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53 institutionalised in organisation or health and social systems”.(44)(p1580) This
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3 approach has been criticised for promoting the continuation and institutionalisation of
4 health programs with insufficient prioritisation of enduring health outcomes. Gruen et
5 al. (2008) suggest that sustainability instead requires “ongoing cycles of reflection,
6 planning, and action”.(44)(p1587) Hudson and Vissing (2013) argue that health
7 benefits may be better achieved through alternate programs or treatments, therefore
8 requiring the constant evaluation and evolution of existing programs and
9 interventions.(43) They contend that a blinkered adherence to program maintenance
10 may fail to promote population health.

11
12 Envisaging sustainable interventions as static tools fails to take into account the
13 complex adaptive nature of health care systems.(43, 44, 46) Within a complex
14 adaptive system framework, sustainable interventions can be better seen as another
15 variable(47) which act on, and respond to, the dynamic system. We can potentially
16 refine and improve interventions over time, to sustainably meet contextual needs and
17 maintain desirable patient outcomes.(33)

18
19 Earlier this decade, Wiltsey Stirman et al. (2012) noted that the current body of
20 sustainability research is limited by a lack of working definitions and models of
21 sustainability to guide researchers.(35) In their review of sustainable interventions,
22 65% of studies did not provide an operational definition of sustainability, whereas
23 those that did, frequently cited Scheirer’s (2005) definitions, which are based on
24 earlier work of Shediak-Rizkallah and Bone (1998).(48, 49) Scheirer (2005) describes
25 three separate operational definitions for interventions which promote sustainability:
26 1) the continued health benefits for individuals beyond the initial funding period; 2)
27 the continuation of program activities within an organisation; and 3) the continued
28 ability of a community to develop and deliver health promotion programs.(48) In a
29 later paper, Scheirer and Dearing (2011) defined sustainability as “the continued use
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3 of program components and activities for the continued achievement of desirable
4 program and population outcomes".(47)(p2060) In our review we will consider an
5 amalgam of Scheirer (2005) and Scheirer and Dearing's (2011) definitions.(47, 48)
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7 We have selected these characterisations of sustainability based on an understanding
8 of health systems as complex adaptive systems and the prioritisation of health
9 outcomes alongside the maintenance of programs, or program elements.
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20 **Prior reviews of sustainable health interventions and programs**

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22 Several reviews have investigated the sustainability of interventions and programs
23 and their effects on outcomes, typically looking at different areas or levels of the
24 health sector.(35-44) Some have focused on sustainability in specific regions, such as
25 Canada and the United States,(36) or sub-Saharan Africa.(37) Others have looked at
26 specific types of programs or interventions, such as chronic disease programs and
27 interventions,(38, 39) medical professionals' adherence to clinical practice
28 guidelines,(40) and the influence of interventions on sustaining culture change.(41)
29 Approaches to achieving program sustainability have also been investigated, without
30 examining outcomes.(42, 43)
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42 Gruen et al. (2008) conducted a broader systematic review looking at both empirical
43 studies and conceptual frameworks of health program sustainability.(44) They
44 focused on health programs assessed over a defined period. The authors identified
45 factors they believed to be associated with the programs' sustainability. These factors
46 include program design elements (e.g., stakeholder involvement), organisational
47 setting characteristics (e.g., favourable organisational culture), and environmental
48 features (e.g., community engagement). The authors developed a conceptual
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3 framework for sustainability planning grounded in sustainability science, which
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5 regards health programs as complex systems.
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8 Likewise, Wiltsey Stirman et al.'s (2012) review took a more expansive approach to
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10 studying sustainable interventions, whilst maintaining a focus on empirical
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12 studies.(35) Without limiting their review by context, the authors examined a broad
13
14 scope of studies to assess the sustainability of interventions, the outcomes they
15
16 provided, and their influences in a variety of countries and health settings.(35) They
17
18 revealed a “fragmented and underdeveloped” body of research, suffering from a lack
19
20 of methodological rigor and definitional consensus.(35)(p13) The authors note that
21
22 the absence of validated measures, of program monitoring post implementation and of
23
24 real-time observations have also affected the evidence-base. Five years later, with
25
26 growing pressure on health systems, and increased interest in sustainable health care,
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28 there is a need to establish the current state of the evidence.
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35 **Objectives**

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38 Following Wiltsey Stirman and colleagues,(35) the objective of our review is to
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40 provide an account of the sustainability of interventions, improvement efforts, and
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42 change strategies across health settings. We aim to analyse research conducted since
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44 Wiltsey Stirman et al.'s 2012 review in order to provide an updated synthesis of the
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46 literature in the past five years. As Figure 1 shows, considerable growth in
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48 publications focused on sustainability in health care has occurred between 2013-2016,
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50 supporting the need for an updated review of the evidence.
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3 **Figure 1: Publication titles containing the words “health” and “sustainability”,**
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5 **1978-present. Adapted from Hudson and Vissing (2013), using data from Google**
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7 **Scholar.**
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12 Following Wiltsey Stirman et al. (2012), the review will be guided by the following
13 research questions: 1) For the change strategy or intervention studied, has
14 sustainability been defined and deployed in accordance with the evidence? 2) At what
15 levels and units of analysis has it been studied? 3) What research methods have been
16 used? 4) Over what time periods? 5) What outcomes have been reported in the
17 empirical literature? 6) What were the findings? 7) What has research told us to date
18 about influences on sustainability? and, 8) Were health outcomes sustained with
19 continuation of the change strategy or intervention?
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31 This systematic review will provide an essential contribution by synthesising the most
32 relevant and up-to-date literature in this area. It seeks to provide important
33 information for decision-makers, researchers, health professionals, clinicians and
34 patients interested in collaborating on sustainable interventions, programs and
35 improvement efforts.
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45 **METHODS**

46 **Eligibility criteria**

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48 Guided by previous reviews,(35, 37, 46, 48, 50) studies will be included if they report
49 on either the status of an ongoing intervention, program or improvement, or the
50 continued health benefits after the initial program period, or program funding, ends.
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52 Similar to Wiltsey Stirman and colleagues, there is no specified time frame between
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3 program or funding completion, and assessment of outcomes. Rather, each study with
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5 be evaluated on a case-by-case basis. Studies that provide evidence on factors that
6
7 influence sustainability will be included regardless of whether this was the primary
8
9 aim of the study.
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11 *Outcome measures*

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13 Outcome measures will include objective measures of sustainability, such as
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15 improved health and safety,(35, 44) or cost reduction with sustained quality over
16
17 time.(38) Indicators of sustainability are expected to be highly heterogeneous, and
18
19 consequently multiple methods of measuring sustainability will be considered.
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21

22 *Report characteristics*

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24 Following earlier reviews,(35, 37, 46, 48, 50) publications will be assessed against the
25
26 following inclusion criteria: English language, peer-reviewed, primary, empirical
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28 research articles published after 2011, in scholarly journals, for which the full text is
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30 available. No restrictions on location will be applied. In order to provide a
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32 comprehensive review of the peer-reviewed evidence, grey literature will be
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34 excluded.
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43 **Information sources and search strategy**

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45 Our search terms, as detailed in the search strategy (Table 1), are intended to cover a
46
47 wide range of terminology used to define, measure and study sustainability. Search
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49 terms will be applied to the databases CINAHL, EMBASE, and Ovid MEDLINE.
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51 These databases were selected due to their specific focus on biomedical, health
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53 system, allied health, and nursing research. Health care-related subject headings (e.g.,
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55 Health care delivery) will be employed to limit the search to health care settings.
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Table 1: Search strategy

Topic	Search terms
Sustainability	Sustainab* OR “sustainable development” OR continuation OR continual OR institutional* OR resilien* OR durab* OR viab* OR stability OR stable OR persist* OR maintenance OR routin*
AND	
Improvement/ intervention	Improvement OR improve OR innovation OR reform* OR intervention OR program* OR strateg* OR project OR plan OR “change management”

Additional search methods will be conducted to reduce the likelihood that relevant articles are overlooked. Applying a snowballing approach, a hand search of bibliographic references of key systematic reviews will be conducted, and experts in the field will be contacted for advice on potential studies for inclusion. Additionally, a title search will be conducted using the Scopus and Web of Science databases, which include articles from medicine and health sciences, in addition to the arts, humanities and social sciences.

Study records

Data management

Using the strategy specified in Table 1, and informed by the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) statement, the initial search will be carried out by three researchers (JHe, KL and EM). These researchers will also examine the reference lists of pertinent reviews and contact

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3 appropriate experts in the field for advice on potentially relevant articles. Data will be
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5 imported into an EndNote library by LT and duplicates will be deleted.
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8 *Selection and data collection processes*

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10 To ensure consensus on the retained articles, abstracts from 5% of the EndNote
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12 library will be randomly assigned for assessment by pairs of reviewers (EM, JHe; KL,
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14 LT; GL, JH) against the inclusion criteria. Inter-rater agreement rates will be
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16 calculated for each pair using Cohen's Kappa. Any discrepancies between authors
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18 concerning the inclusion or exclusion of articles will be discussed by all reviewers as
19
20 a group, with JB as arbitrator, until a consensus is reached. Each researcher will then
21
22 independently review the remaining abstracts against the inclusion criteria.
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26 Following this process, included abstracts will be randomly assigned to the reviewers
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28 for a full text review against the inclusion criteria. A data extraction sheet will be used
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30 to record relevant information from included studies and reasons for exclusion for
31
32 omitted studies (Supplementary file 1). It is expected that this process will begin soon
33
34 after publication of the protocol, and we are scheduling to complete by mid-2018.
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41 **Data items**

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43 The data extraction sheet will record article details, definition of sustainability (if
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45 provided), context and setting, number of sites, type of study, details of improvement
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47 or intervention, assessment period, measures of sustainability, and key findings for
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49 individual studies.
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55 **Outcomes and prioritization**

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3 Following Wiltsey Stirman et al.,(35) and in line with Scheirer's, and Scheirer and
4
5 Dearing's definitions of sustainability,(47, 48) outcomes refer to the ongoing impact
6
7 or health benefits of interventions, programs, change strategies, and improvement
8
9 efforts that continue after initial implementation efforts or cessation of funding.
10
11 Priority will be given to studies that address sustainability over a longer time frame.
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13 For example, studies assessing the sustainability of an improvement intervention over
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15 years, as opposed to months, will provide more valuable information about
16
17 sustainability and its long-term effects. Other studies to be prioritised include those
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19 that provide a working definition of sustainability, and those that report on multiple
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21 sustainability outcomes.
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28 **Risk of bias in individual studies**

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31 Where appropriate, study bias will be assessed using a Risk of Bias Template,
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33 specifically the Cochrane Collaboration's tool for assessing risk of bias, adapted from
34
35 the Cochrane Handbook for Systematic Reviews.(51) Articles will be independently
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37 assessed and classified as 'high' or 'low' risk of bias. Consideration of bias will be
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39 given when interpreting the results of the review.
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46 **Data synthesis**

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48 Based on previous systematic reviews of this type,(35, 44, 52) a quantitative meta-
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50 analysis of data may not be feasible. In the event that it is possible, a random-effects
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52 model will be used.(53) Depending on the findings from the literature review, a
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54 scoping meta-review may also be undertaken.(54)
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57 Where meta-analysis is not appropriate, data will be summarised using a narrative
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3 synthesis approach.(55) The synthesis will focus on the overall evidence for sustained
4 effectiveness of interventions, programs and change strategies, including barriers and
5 facilitators to their sustainability and the outcomes they produce. Articles will be
6 grouped and discussed according to similarities and differences in their setting,
7 participants, the research methods (e.g., quantitative, qualitative or mixed-method;
8 cross-sectional versus longitudinal), and results obtained. Possible areas of
9 comparison include differences between; micro and macro interventions, short-term
10 and long-term programs, and between low-, middle- and high- countries. Results will
11 be used to determine factors associated with sustainability.(35, 44)
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26 **Meta-biases**

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28 In publishing this protocol we aim to avoid publication bias or selective outcome
29 reporting by detailing our search and inclusion criteria, and by employing a data
30 extraction form.(56) Publication bias will also be limited by searching the reference
31 lists of key systematic reviews and with the use of snowballing techniques to locate
32 articles that may not have been detected in the database searches.(53)
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43 **Confidence in cumulative evidence**

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45 We will assess the quality of evidence using an appropriate assessment tool, such as
46 the Grading of Recommendations Assessment, Development and Evaluation
47 (GRADE) approach.(57) Each study will be categorised by level of quality, in
48 accordance with the chosen assessment tool.
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58 **CONCLUSION**

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3 The challenge of creating and maintaining a sustainable health system is an enduring
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5 problem faced by all health system stakeholders, including politicians, funders,
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7 providers, insurers, policymakers, taxpayers and patients. Ageing populations and
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9 increasing demands for services present substantial challenges to the affordability of
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11 health care systems, making the need for an urgent solution all the more necessary.
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13 We do not know enough about how interventions, programs and improvement efforts,
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15 especially recent ones, are contributing to sustainability, nor the effect which they
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17 may have on system durability. The proposed review will provide a contemporary
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19 synthesis of the factors that influence the sustainability of interventions, improvement
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21 efforts, and change strategies in health settings. It is anticipated that this review will
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23 be of value to researchers, policymakers and others interested in contributing to
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25 sustainable improvements in health settings and ultimately in health system
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Amendments

Any deviations from this protocol will be reported in the final systematic review, accompanied by a justification of why these alterations are necessary.

Author's Contributions

JB conceptualized the study and leads the team's work. LT and GL drafted the initial manuscript and search strategy, assisted by KL and JHe. Important contributions to refine and improve the manuscript were provided by JB, KL, JHe, EM, JHo and MC.

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Competing Interests

There are no competing interests.

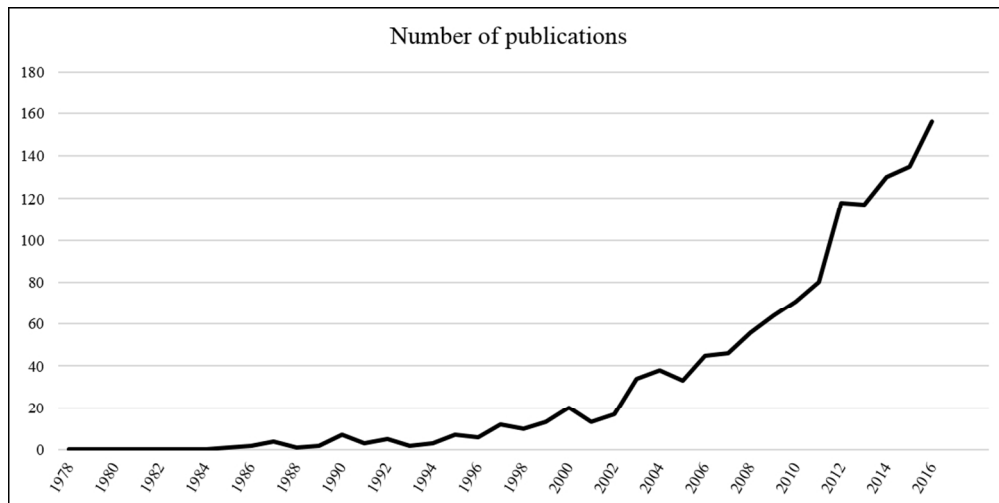


Figure 1: Publication titles containing the words "health" and "sustainability", 1978-present. Adapted from Hudson and Vissing (2013), using data from Google Scholar.

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4 **Supplementary file 1. Data extraction sheet**
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Article details (authors, title, endnote reference)			
Definition of sustainability			
Context; setting			
Number of sites			
Type of study: qualitative, quantitative, mixed method; cross-sectional, longitudinal			
Details of improvement/intervention			
Assessment period (or period of program/intervention)			
Measures of sustainability			
Key findings			