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REVIEW

Communicable disease control programmes and health systems: an analytical approach to sustainability

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There is renewed concern over the sustainability of disease control programmes, and re-emergence of policy recommendations to integrate programmes with general health systems. However, the conceptualization of this issue has remarkably received little critical attention. Additionally, the study of programmatic sustainability presents methodological challenges. In this article, we propose a conceptual framework to support analyses of sustainability of communicable disease programmes. Through this work, we also aim to clarify a link between notions of integration and sustainability. As a part of development of the conceptual framework, we conducted a systematic literature review of peer-reviewed literature on concepts, definitions, analytical approaches and empirical studies on sustainability in health systems. Identified conceptual proposals for analysis of sustainability in health systems lack an explicit conceptualization of what a health system is. Drawing upon theoretical concepts originating in sustainability sciences and our review here, we conceptualize a communicable disease programme as a component of a health system which is viewed as a complex adaptive system. We propose five programmatic characteristics that may explain a potential for sustainability: leadership, capacity, interactions (notions of integration), flexibility/adaptability and performance. Though integration of elements of a programme with other system components is important, its role in sustainability is context specific and difficult to predict. The proposed framework might serve as a basis for further empirical evaluations in understanding complex interplay between programmes and broader health systems in the development of sustainable responses to communicable diseases.

Keywords Health system, communicable disease control programme, sustainability, integration, conceptual framework

KEY MESSAGES

- There are renewed concerns over the sustainability of disease control programmes, and the re-emergence of policy recommendations to integrate programmes with general health systems. However, there is a paucity of empirical evidence regarding whether integration of programmes within broader health systems improves the likelihood of programmatic sustainability.
- Building upon an explicit conceptualization of health systems for the analysis of programmatic sustainability is important if lesson-learning is to be effective and sustainability embedded in programme implementation.
- To advance research on sustainability in health systems, empirical studies drawing upon foundations in the theoretical and conceptual literature are needed.

Introduction

Over the past decade, development assistance for health increased rapidly particularly in areas addressing priority communicable diseases (Brugha 2008; McCoy *et al*. 2009; Ravishankar *et al*. 2009; Samb *et al*. 2009; Murray *et al*. 2011). The rapid inflow of substantial assistance coincided with the proliferation of actors involved in assisting countries to achieve global disease control targets (Shiffman 2008; McCoy *et al*. 2009; Shiffman *et al*. 2009; Balabanova *et al*. 2010). This supportive financial environment facilitated the introduction and rapid scale-up of novel disease control interventions. In recent years, the economic crisis in the West has led to a slowdown in financial commitments and a demand that funding results in strengthened health systems as well as improved disease control (Leach-Kemon *et al*. 2012; Dye *et al*. 2013).

These changes have led to a revisiting of two long-standing and related debates in international development for health: one relates to the sustainability of donor-funded interventions (Bossert 1990; Brown 1998; Garrett 2007; Yang *et al*. 2010; Rushton 2011) and the other relates to a debate on the integration of priority health interventions and general health services (Gonzalez 1965; Mills 1983; Oliveira-Cruz *et al*. 2003; Mills 2005; Atun *et al*. 2008). Debates surrounding sustainability were historically related to tensions between the length of time donors' funding made available and the time required to address public health problems (Brown 1998; Yang *et al.* 2010). Proponents of improved integration of disease programmes into broader health systems have historically argued that this would improve coverage, access, equity and efficiency as well as the sustainability of disease control interventions (WHO 1965; Feenstra and Visschedijk 2002; Unger *et al*. 2003; Visschedijk *et al*. 2003; Briggs and Garner 2006; Unger *et al*. 2006; Atun *et al*. 2008; Mosneaga *et al*. 2008). By contrast, proponents of 'disease-centred' (or vertical) approaches to disease control have argued that dedicated disease-specific programmes are necessary to ensure functional capacity is sustained and control ensured most effectively and efficiently (Walsh and Warren 1979; Lush *et al*. 1999; Raviglione and Pio 2002; Lammie *et al*. 2006).

In spite of the broad concern regarding the contemporary importance of sustainability of communicable disease programmes, the conceptualization of this issue has received remarkably little critical attention. There is a paucity of evidence regarding whether integration of communicable disease programme components within broader health systems improves the likelihood of programmatic sustainability. For several reasons, studying sustainability of health programmes presents conceptual and methodological challenges. Different ideas exist regarding programmatic sustainability for actors in various health research disciplines, contexts and over different time frames (Shediac-Rizkallah and Bone 1998; Gruen *et al*. 2008; Wiltsey Stirman *et al*. 2012). What integration in a health system constitutes also lacks conceptual agreement (Atun *et al*. 2008; Shigayeva *et al*. 2010). Programmatic sustainability is understood as a phenomenon influenced by multiple, often interrelated, contextual factors (Greenhalgh *et al*. 2004; Sibthorpe *et al*. 2005; Gruen *et al*. 2008; Humphreys *et al*. 2008; Scheirer and Dearing 2011; Wiltsey Stirman *et al*. 2012). However, commonly applied (quasi)-experimental and traditional evaluation approaches have limitations in explaining such complexity (Greenhalgh *et al*. 2012; Wiltsey Stirman *et al*. 2012).

Health systems, and programmes within, are increasingly recognized as complex systems (Atun and Menabde 2008; Sturmberg and Martin 2009; Adam and de Savigny 2012; Paina and Peters 2012). Theory-based approaches have been proposed as research methodology to study complexity in health systems (Coker *et al*. 2004; Byng *et al*. 2005; Van Belle *et al*. 2010; Ssengooba *et al*. 2012). Our work presented here builds on a view of health systems as complex adaptive systems. In this article, we propose a conceptual framework to support analyses of sustainability of communicable disease programmes. The framework for programmatic sustainability extends earlier conceptual and analytical developments by Atun *et al*. (2004), Coker *et al*. (2004), and Atun and Menabde, (2008). We extend this earlier work, drawing on constructs related to sustainability derived from complex systems' theories, previous work on conceptualization of integration and health system (Shigayeva *et al*. 2010) and a systematic literature review of peer-reviewed literature on concepts, definitions, analytical approaches and empirical studies on sustainability in health systems. Through this work, we also aim to clarify a link between notions of integration and sustainability.

Theoretical background

Sustainability and integration

Sustainability is a neologism drawn from 'sustain', which means 'to supply with sustenance', 'to make something to be kept up, prolonged or carried on' (*Oxford English Dictionary*).

The sustainability concept originates in research on the behaviour of ecological and socio-economic systems (Goodland 1995; Hueting and Reijnders 1998), an interdisciplinary research area currently referred to as 'sustainability science' (Clark 2007). Though there is no agreement on its operational definition, integral to the sustainability concept is the focus on future needs, where equity, effectiveness and efficiency are central concerns (WCED 1987; Kemp *et al*. 2005).

Within the sustainability sciences discourse, the essence of a system's sustainability is increasingly understood as a system's resilience (Dovers 1996; Gunderson 2000; Holling 2001; Folke *et al*. 2002; Fiksel 2006). There are two broad perspectives on resilience. The first, based on an understanding of nature and society as systems functioning near equilibrium (Holling 1973), is inspired by system dynamic and catastrophe theories (Forrester 1961; Thom 1975). In this discourse, resilience is understood as the degree and speed that a system can withstand threats, disturbances or catastrophic events, and return to a steady equilibrium or a stable state (Fiksel 2003; Mayer 2008). The other view of resilience, which builds on the perspective of complex adaptive systems, emphasizes adaptive capacity and possibilities of multiple equilibriums (Gunderson 2000; Brand and Jax 2007). In this view, the theory emphasizes non-linear interactions among a system's agents under constantly changing conditions where uncertainty, shocks and surprises are inevitable. In complex adaptive systems, resilience incorporates notions of adaptation, self-organization and learning. This perspective focuses on how to persist through continuous development in the face of change and how to innovate and transform into new and more desirable configurations (Folke *et al*. 2002; Fiksel 2003; Folke 2006). In this discourse, resilience is viewed as a socially instituted process of adaptive change, in which innovation is a necessary element (Kemp *et al*. 2005).

The integration concept is central to system theories (Checkland 1981; Scott 1987; Kodner and Spreeuwenberg 2002; Nolte and Mckee 2008). The term means 'organic part of a whole' or 'reunited parts of a whole' (Kodner and Spreeuwenberg 2002). There is a wide range of concepts related to integration. In health systems research, for example, these various concepts include notions of linkage, co-operation, collaboration, partnerships, co-ordination, mergers or networks (Shigayeva *et al*. 2010). Systems are composed of separate but interacting and interdependent agents (e.g. individuals, organizations). Connectivity or interconnectedness (notions of integration) among agents bonds the entity together, thus potentially enabling it to achieve common goals and optimal results (Kodner and Spreeuwenberg 2002). In complex adaptive systems (Box 1), both the absolute number of connections and the strength of these connections play consequential roles in a system's functioning and adaptations (Eidelson 1997) and, thus, are important for resilience (Holling 2001; Fiksel 2003). In a sense, a system's connectivity relates to flexibility or rigidity of internal control (Holling 2001). Inadequate connections may challenge a co-ordinated response to external pressures; however, excessive connections may reduce flexibility and a potential for adaptation (Eidelson 1997; Holling 2001).

Though the term 'sustainability' is not commonly used by organizational theorists, an organization's viability, survival, adaptation and performance are central questions theorists attempt to address. The central argument proposed by the open system model, for example, is that all organizations depend on exchanges with other systems (Scott 1987; Jaffee 2001). A more complex and uncertain environment drives organizations to adapt and change their arrangements for the purposes of survival (i.e. performance, viability, legitimacy). The contingency theory (Lawrence and Lorsch 1967; Galbraith 1973) and resource dependency theory (Pfeffer and Salancik 1978; Aldrich 1979) argue that organizations generally strive for improved performance. Thus, they often build integrative relations with other organizations (or modify internal structure) in the interest of effectiveness and efficiency.

There are tensions in the above-mentioned theoretical perspectives. Along with integration, organizational theorists argue that differentiation (or specializations) and maintaining autonomy are also necessary for organizational viability and survival (Jaffee 2001). Similar tensions could be found in the theoretical literature on inter-organizational relations within other disciplines such as strategic management, economics, sociology and political sciences (Whetten 1981; Oliver 1990). Likewise, propositions from sustainability science suggest that independence and diversity of a system's agents (both structural and functional) are necessary for a system's resilience. These factors provide opportunities for innovations and development as they are a source of learning and a resource base for adaptation and reorganization (Kay *et al*. 1999; Kemp *et al*. 2005).

Box 1. Properties of complex adaptive systems

- Multiple interdependent agents interact in non-linear manner, sometimes involving feedback loops, both positive and negative. Small changes in the environment or within a system may lead to massive system change and vice versa.
- Open to the environment, the system's agents continuously interact with and co-evolve with its environment.
- Path-dependent, non-reversible processes have similar starting points yet lead to different outcomes, even if they follow the same rules. Outcomes are sensitive not only to initial conditions but also to choices made along the way.
- Structured as scale-free networks, which are dominated by a few focal points or hubs with an unlimited number of links, following a power-law distribution
- Capable of self-organizing, a pattern of behaviour emerges iteratively through dynamic and non-linear interactions among the system's agents and components. As a result, the organized behaviour of a system is larger and more complex than the sum of its parts.

Adapted from Paina and Peters (2012) and Sturmberg and Martin (2009).

Health system as complex adaptive systems

Over the past decade, there has been a growing recognition that health systems, including programmes and organizations within, possess properties of complex adaptive systems (Box 1) (Plsek and Greenhalgh 2001; Atun and Menabde 2008; Sturmberg and Martin 2009; Paina and Peters 2012).

In their conception of health systems, Atun *et al*. (2004) characterize a system's components in terms of governance, financing, planning, service delivery, demand generation and evaluation, and they argue that the configuration of these contribute to the achievement of health goals in an equitable, effective and efficient manner (Atun and Menabde 2008). Health systems are open systems situated within broader demographic, economic, political, legal and regulatory, epidemiological, socio-demographic and technological contexts (Coker *et al.* 2004). Embedded within health systems are programmes, and their organizational arrangements and interventions are interlinked (Frenk 1994), their dynamic relationships involve positive and negative feedback loops, collectively shaping the health system's behaviour (Atun and Menabde 2008).

Theory-based approaches have been proposed for the evaluation of complex health interventions, programmes and policy initiatives (Coker *et al*. 2004; Byng *et al*. 2005; Van Belle *et al*. 2010; Ssengooba *et al*. 2012). Though a theory-based approach (also referred to as theory-driven evaluation or theory-driven inquiry) and that proposed by Coker *et al.* (2004) differ in operational definitions and research strategy (Coryn *et al.* 2011; Marchal *et al.* 2012), common principles include the development, testing and refinement of an explicit framework or model on how a programme (or a policy) may result in observed or intended outcomes. We follow Coker *et al*. (2004) [who in turn build on realist evaluation (Pawson and Tilley 1997)] in the development of a programme theory that may provide a better explanation of programmatic sustainability. This approach considers systematically disease control programmes, the health systems within which they sit and their broader context.

Our view accepts the uncertainty of sustainability phenomena, which concerns future scenarios. What is possible, as suggested by Alexander *et al*. (2003), is to identify a potential for sustainability through an analysis of sustainability by proxy on the basis of discoverable capabilities or characteristics, which are hypothesized precursors of sustainability. We extend the work of Atun *et al*. (2004), Coker *et al*. (2004), and Atun and Menabde (2008) by proposing a definition of sustainable disease control programme, and programmatic characteristics (or capabilities), which can explain a potential for programmatic sustainability. We did so by conducting a systematic literature review. Next, we present the methods of the literature review and its results. This is followed by the presentation of the proposed framework for programmatic sustainability. We conclude the article with the discussion of limitations to the proposed conceptual approach.

Methods

Our review includes conceptual and/or analytical frameworks, reviews (overviews) of conceptual or methodological approaches to sustainability, systematic reviews of sustainability in health systems and empirical studies. The detailed methodology of the systematic literature review, search strategy and the process of selecting papers and studies are presented in Supplementary Appendix S1. Briefly, we searched Medline, Embase and Cochrane databases for papers published in English language between 1 January 1980 and 1 November 2012. The search was limited to papers accessible through the University of London library services. We also reviewed bibliographies of retrieved papers to identify further publications. The search strategy included key terms related to the concept of sustainability including 'sustain*', resilience*', 'viability*', 'institutionalization*', 'routinization*', 'durability*', 'stability*', 'persistence*', and 'continuation*'. The search was restricted to Medical Subject Headings (MeSH) under 'health care', 'health services', and key terms 'health program*', 'health intervention*', 'health system*'.

Identified frameworks were analysed through question probes: (i) what are the characteristics or capabilities that are assumed to be attributes of a sustainable health programme (or an organization, not limited to a single intervention) and (ii) how are health systems and broader political, socio-economic and epidemiological contexts conceptualized and acknowledged? The analysis of identified conceptual frameworks and empirical studies included a synthesis of attributes of the sustainability of a health programme (or an organization). Thematic analysis approach has been used for synthesis (Thomas and Harden 2008). We followed established principles for analysis of qualitative data (Pope *et al*. 2000; Green and Thorogood 2009). Thematic framework was developed during the analysis of conceptual/analytical frameworks. At the initial stage, one researcher extracted section/s of included papers that was outlining factors proposed as influencing sustainability. Extracted sections were coded line-by-line. Codes were compared, refined and grouped into the emerging themes. The initial grouping of emerging themes was implemented according to the level of a health system (an intervention, organization, health system, broader context). A second researcher reviewed the coded data and emerging themes. Through collaborative discussions, emerging themes were interpreted to infer broader programmatic (or organizational) capabilities or characteristics (i.e. higher-order themes). Characteristics of a health system and contextual environment were also summarized. The thematic framework, developed during the analysis of frameworks, was applied for coding, and summarizing the attributes of sustainability found in empirical studies.

Results

Definitions and perspectives on sustainability in health systems

We identify two aspects in identified definitions of sustainability. The first is a focus on 'what is being sustained' (e.g. resources, performance or goals). The second is 'what level(s) or component of a health system' is being considered, whether a health intervention (or an innovation, project, programme), a health organization (or a health service organization, community-based organizations, institution, coalition), a system's functional or structural component (e.g. funds, or human resources) or the overall health system. Illustrative examples of definitions are presented in Table 1.

Sustainability of health interventions.

Definitions of the sustainability of interventions from a public health perspective emphasize the maintenance of benefits to stakeholders over time (Shediac-Rizkallah and Bone 1998; Mancini and Marek 2004; Pluye *et al*. 2004b; Swerissen and

Table 1 Selected definitions of sustainability in health systems

Perspective or research area	Level/component of a health system		
	Health intervention[a]	Health organization[b]	Health system
Public health	'Sustainability is not only the long-term survival of project related changes, but also continued effectiveness and capacity to adapt or replace interventions or programmes within context that constantly changes.' (Bowman *et al.* 2008)	'Maintaining adequate service coverage that will provide continuing control of a health problem, continuing to deliver benefits over long period of time, becoming institutionalized within an organization, and continuing to respond to community issues.' (Nelson *et al.* 2007)	'The sustainability of primary health care is the production of health outputs and outcomes at optimized efficiency with uninterrupted inputs.' (Knippenberg *et al.* 1997)
International development	'Sustainability is the ability of a health project or programme to deliver health services or sustain benefits after major technical, managerial and financial support has ceased.' [USAID, cited in Lafond, 1995a]	'Sustainability is about continued effectiveness over time, which requires the sustained conversion of institutional capacity into performance. It also requires constant adjustment to changes in environment and circumstance.' (Brown 1998)	'Sustainability of a health system is defined as a capacity of the health system to function effectively over time with minimum external input.' (Lafond 1995a)
Innovations, organizational change	'Sustainability is a process of ensuring an adaptive prevention system and a sustainable innovation that can be integrated into ongoing operations to benefit diverse stakeholders.' (Johnson *et al.* 2004).	'When new ways of working and improved outcomes become the norm. Not only the process and outcomes have changed but thinking and attitudes behind them are fundamentally altered and the systems behind them are transformed in support . . . Sustainability means holding the gains and evolving as required.' (NHS Modernization Agency definition, cited in (Greenhalgh *et al.* 2004))	
Systems		'The system is sustainable when it has the capacity to initiate desired changes, or adapt to changes in demand or in environmental conditions while ensuring resources and desired outputs.' (Olsen 1998)	'A sustainable health system has three key attributes: affordability, for patients and families, employers, and the government [.....]; acceptability to key constituents, including patients and health professionals; and adaptability, because health and health care needs are not static (i.e. a health system must respond adaptively to new diseases, changing demographics, scientific discoveries, and dynamic technologies in order to remain viable).' (Fineberg 2012)

[a]An intervention, innovation, project or programme.

[b]A health service organization, community-based organization, institution, partnership or coalition.

Crisp 2004; Hanson *et al*. 2005). These benefits (i.e. 'what is to be sustained') are defined as improvements in health (Hanson *et al.* 2005), or continued control over a health problem through maintaining sufficient levels of effectiveness, accessibility, acceptability or coverage of interventions (WHO 2002; Nelson *et al*. 2007).

Early concepts within international assistance discourse focused on the continuation of interventions or benefits brought about by a donor's project, with an emphasis on financial self-sufficiency (Bossert 1990; Lafond 1995a). The only focus on a post-project financial mechanisms and an overemphasis on quick results have been criticized as doing little in promoting sustainability (Brown 1998). Subsequently, there has been a shift towards sustaining institutional capacity generated by donor aid (Brinkerhoff and Goldsmith 1992; Sarriot *et al*. 2004; Bennett *et al*. 2011).

Several researchers view the sustainability of a health intervention as a multidimensional concept, which includes several aspects of 'what to sustain' outlined above including: continuing benefits to stakeholders, institutionalization of interventions within organizational settings and maintaining capacity of implementing entity (e.g. a community or an organization) (Shediac-Rizkallah and Bone 1998; Johnson *et al*. 2004; Sarriot *et al*. 2004; Cassidy *et al*. 2006; Edwards *et al*. 2007; Nelson *et al*. 2007; Scheirer and Dearing 2011).

Sustainability of health organizations.

The 'what' to sustain in concepts of sustainability of health organizations includes the organization's longevity or viability (Rog *et al*. 2004; Cassidy *et al*. 2006), maintenance of organizational capacity, goals and philosophy (Stroul and Manteuffel 2007) and bringing benefits to users of services or meeting population needs and demands (Knippenberg *et al*. 1997; Olsen 1998; Alexander *et al*. 2003; LaPelle *et al*. 2006; Humphreys *et al*. 2008).

Definitions from perspectives of organizational learning, organizational sociology and systems theories view an essence of sustainability as continuously meeting the changing needs of stakeholders or the ability to perform in a changing contextual environment. This perspective emphasizes notions of alignment, connectivity, adaptability or responsiveness to change (Olsen 1998; Whittaker *et al*. 2004; Gruen *et al*. 2008). Several authors do not separate conceptually the sustainability of a certain intervention from the organization's sustainability (Nilsen *et al*. 2005; Cassidy *et al*. 2006). Others argue that the aim of sustainability should be to sustain the ideas, cultures, beliefs or principles underlying innovation or overall organizational goals rather than an intervention per se (Virani *et al.* 2009).

Sustainability of health systems.

There have been few conceptual developments related to the sustainability of an overall health system. A central focus of policy debates has historically been on financial sustainability (Lafond 1995b; Stuart and Adams 2007; Thomson *et al*. 2009; Fineberg 2012; Pammolli *et al*. 2012). However, most authors acknowledge that the 'what' of sustainability in any health system includes attaining the health system's goals, which are improved health status of the population, protection against health-related financial risks, responsiveness to needs and satisfaction of consumers' expectations (Frenk 1994; Murray and Frenk 2000; Atun and Menabde 2008; de Savigny and Adam 2009; Shakarishvili *et al*. 2010). Several authors also agree that among intermediate objectives are notions of effectiveness, efficiency and equity (Shakarishvili *et al.* 2010). From an economic perspective, for example, a health system's financial sustainability has been defined as 'maximizing the attainment of a health system's goals subject to constraints of aligning revenue and expenditure' (Thomson *et al.* 2009).

Frameworks for analysis of sustainability in health systems

Through the literature review, we identified 29 conceptual frameworks for analysis of sustainability in health systems (Table 2, Supplementary Appendix S2). All conceptual frameworks identified address questions of 'what' is being sustained and what factors might determine sustainability. Twenty were frameworks related to the sustainability of a health intervention (or an innovation, programme); six were aimed at analyses of sustainability of health organizations, and three were frameworks for the analysis of health system sustainability. Eighteen frameworks draw on theoretical perspectives to guide the analysis. The majority of frameworks broadly apply perspectives from organizational theories (Table 2, Supplementary Appendix S2), including propositions to utilize complex system theories to study sustainability in health system (Olsen 1998; Greenhalgh *et al*. 2004; Nelson *et al*. 2007; Gruen *et al*. 2008; Humphreys *et al*. 2008). The remainder was based upon researchers' experience and/or literature review.

Ten frameworks were proposed within the international assistance discourse (Bossert 1990; Brinkerhoff and Goldsmith 1992; Stefanini and Ruck 1992; Berman 1995; Lafond 1995a; Knippenberg *et al*. 1997; Sarriot *et al*. 2004; Stephenson *et al*. 2004; Torpey *et al*. 2010; Bennett *et al*. 2011) (Table 2). These conceptual frameworks focus particularly on the operational and/or financial self-sufficiency of local organizations or institutions after the exit of international assistance. With few exceptions (Brinkerhoff and Goldsmith 1992; Berman 1995), these frameworks are not explicitly guided by theory.

A number of frameworks for analysis of sustainability of health programmes or organizations have included notions of integration as one of the determinants, or a dimension, of sustainability (Bossert 1990; Olsen 1998; Shediac-Rizkallah and Bone 1998; Alexander *et al*. 2003; Mancini and Marek 2004; Sarriot *et al*. 2004; Hanson *et al*. 2005; Gruen *et al*. 2008; Humphreys *et al*. 2008; Scheirer and Dearing 2011). In these sustainability frameworks, definitions of what integration entails differ (e.g. collaboration, co-ordination, supporting relationships, alignment). With few exceptions (Stefanini and Ruck 1992; Berman 1995; Lafond 1995a; Knippenberg *et al*. 1997; Olsen 1998), identified frameworks do not prioritize questions of efficiency, a cornerstone in sustainability discourse.

We found most frameworks proposed tend to be deterministic in nature where sustainability is viewed as an end goal, one that is dependent upon processes that are assumed to be a somewhat linear and predictable. The broader contextual environment was included in most frameworks as determinants of sustainability. A limitation of identified frameworks for the analysis of a programme's sustainability is the lack of an explicit

Table 2 Identified frameworks for sustainability in health systems

Level/component of a health system	Theoretical underpinnings or background[a]	Framework/authors	Specific research area
Health intervention[b]	Diffusion of innovations theory	Bowman *et al*. (2008)	Quality assurance initiatives in health-care settings
		Goodman *et al*. (1993)	Health promotion programmes
		Shediac-Rizkallah and Bone (1998)	A community-based health intervention
		Edwards *et al*. (2007)	Patient safety and quality improvement projects
	Theories of organizational change and innovation	Greenhalgh *et al*. (2004)	Innovations in health service delivery and organization
		Johnson *et al*. (2004)	Health prevention innovations
		Slaghuis *et al*. (2011)	New clinical practices in health-care settings
	Organizational learning theory	Pluye *et al*. (2004b)	Public health programmes
		Virani *et al*. (2009)	New practice in health care
	Sociological research, normalization process model	May and Finch (2009)	Complex innovations in health care
	Ecological systems theory	Gruen *et al*. (2008)	A health programme
		Hanson *et al*. (2005)	Safety promotion interventions
	Organizational theory, formation of inter-organizational relationships	Nelson *et al*. (2007)	Tobacco control programmes
	International development initiatives[c]	Bossert (1990)	A health project
		Sarriot *et al*. (2004)	NGO-supported child survival projects
		Stephenson *et al*. (2004)	Family planning programmes
		Stefanini and Ruck (1992)	A health project
		Bennett *et al*. (2011)	HIV/AIDS programme
	Researchers' experiences, literature review	Mancini and Marek (2004)	Community-based family programmes
		Scheirer and Dearing (2011)	Public health programmes
Health organization[d]	New institutional theory	Brinkerhoff and Goldsmith (1992)	Various areas, including development in health
	Organizational theory, open systems	Olsen (1998)	Health services
	Organizational theory, formation of inter-organizational relationships	Rog *et al*. (2004)	Community coalitions/partnerships for health
		Alexander *et al*. (2003)	Community health partnerships
	Researchers' experiences, literature review	Humphreys *et al*. (2008)	Health services in rural or remote areas
		Torpey *et al*. (2010)	HIV/AIDS service organizations
Health system	Health system's framework by Frenk (1994)	Berman (1995)	Health system reform
	International development initiatives[c]	Lafond (1995a)	Health system
		Knippenberg *et al*. (1997)	Primary health-care/health system reform initiative

[a]Detailed background is outlined in the Supplementary Appendix S2.

[b]An intervention, innovation, project or programme.

[c]Guides or experiences of donor agencies, e.g. United States Agency for International Development (USAID), United Nations Joint Programme on HIV/AIDS (UNAIDS), World Bank.

[d]A health service organization, community-based organization, institution, partnership or coalition.

conceptualization of what a health system is. Moreover, although the context is acknowledged, sustainability of health interventions or programmes tends to be analysed in isolation from the overall health system. Consequently, frameworks developed thus far cannot fully provide explanations on what role the different health system's functions, including integration of programmes with the health system's components, may play in sustainability of interventions or programmes.

Empirical studies on sustainability in health systems

One hundred and eight empirical studies met eligibility criteria and were accessible for our review (Supplementary Appendix S3). Seventy-three studies were conducted in industrialized countries and 35 in low-middle-income countries. Most studies ($n = 70$) focused on an assessment of the sustainability of health interventions. Thirty-six explored the sustainability of organizations. We identified only two studies that analysed the

sustainability of a health system (Lafond 1995a; Pammolli *et al.* 2012). The majority of studies were concerned with the continuation of interventions, programmes, health reform initiatives or functioning of established organizations (e.g. community-based coalitions or non-governmental organizations (NGOs)) after the conclusion of external funding, technical assistance or a research study.

Table 3 presents a summary of study designs. Broadly, studies were case studies, descriptive narratives of experiences, evaluation studies (including economic evaluations), surveys or of quasi-experimental design (before and after intervention, or exposed and not exposed to an intervention). Several studies developed quantitative indicators or indices for measuring benefits or outcomes produced by the programme as a proxy for sustainability (McDermott *et al*. 2003; Mancini and Marek 2004; Stephenson *et al*. 2004; Amazigo *et al*. 2007; Glisson *et al*. 2008; Sarriot *et al*. 2008).

Table 3 Characteristics of included empirical studies on sustainability in health systems

	Country setting		
	All	High income	Low-middle-income
All studies reviewed	108	73	35
Level of health system			
Intervention[a]	70	52	18
Health organization[b]	36	20	16
Health system	2	1	1
Research area			
Health promotion	29	29	0
Chronic diseases management	9	9	0
Tobacco control	3	3	0
Mental health	7	7	0
Communicable diseases control	19	1	18
Maternal and child health	5	1	4
Reproductive and family health	2	1	1
Primary care services	13	8	5
Patient safety and quality of care	4	4	0
Health system reform initiatives	10	4	6
Other	7	6	1
Study design			
Quasi-experimental	10	6	4
Survey	19	16	3
Case study	17	10	7
Multiple case study	18	15	3
Multiple methods evaluation	13	6	7
Qualitative methods evaluation	11	9	2
Economic evaluation	7	3	4
Description (narrative)	8	2	6
Other	5	5	0

[a]An intervention, innovation, project or programme.
[b]A health service organization, community-based organization, institution, partnership or coalition.

Synthesis: main attributes of a sustainable health programme and role of health system in programmatic sustainability

In our analysis, five broad characteristics of a sustainable programme (or an organization) have emerged: (1) capability to govern, lead and manage; (2) resources and capability to plan and implement activities; (3) ability to adapt to changing internal or external institutional environment; (4) capability to build relationships and interactions inside/outside programmes and (5) ability to bring about results or attain goals. Additionally, health system and contextual factors emerged as important determinants of programmatic sustainability.

Capability to govern, lead and manage (we term this 'leadership').

Leadership has been conceptualized as one of the central capabilities and skills of stakeholders, which unites other aspects of sustainability. Included here are competencies such as setting attainable organizational goals, strategic financial and organizational planning, resource mobilization, community mobilization, strategic use of monitoring and evaluation (Bossert 1990; Brinkerhoff and Goldsmith 1992; Knippenberg *et al*. 1997; Olsen 1998; Alexander *et al*. 2003; Mancini and Marek 2004; Hanson *et al*. 2005; Gruen *et al*. 2008). Leadership is also conceptualized as commitment, taking responsibility and ownership for actions, engaging others and handling conflicts (Olsen 1998; Alexander *et al*. 2003; Johnson *et al*. 2004). Leaders also have a role in creating an environment for continuously supporting the development of the skills of those working in an organization (Mancini and Marek 2004; Hanson *et al*. 2005).

The majority of empirical studies emphasized the importance of leadership. Some studies found that the presence of individual charismatic leaders ('champions') was important (Goodson *et al*. 2001; Scheirer 2005; Crone *et al*. 2006; Edwards and Roelofs 2006). Other studies concluded that sustainability depends on the leadership's competencies as related to collective efforts, norms and organizational culture. These competencies included managerial expertise in strategic and financial planning, fundraising, building trust and strategic relations outside the organization and generating political support (Bossert 1990; Jana *et al*. 2004; Mancini and Marek 2004; Baum *et al*. 2006; Plochg *et al*. 2006; Stevens and Peikes 2006; Nelson *et al*. 2007; Stroul and Manteuffel 2007; Toledo Romani *et al*. 2007; Savaya *et al*. 2008). Other traits of leadership found in the studies include a long-term vision for how to address population's health problems (Alexander *et al.* 2003; Feinberg *et al.* 2008), a vision on the value of innovations (Evashwick and Ory 2003; Barnett *et al*. 2004; Whittaker *et al*. 2004; Bradley *et al*. 2005), the ability to avoid competing objectives and to provide clarity in the roles and responsibilities of subordinate personnel/departments (Wakerman *et al*. 2005; Bailie *et al*. 2006).

Resources and capability to plan, implement and evaluate activities ('capacity').

All frameworks included 'capacity'; however, definitions of what capacity encompasses varied. In general, capacity included

structures and processes (e.g. planning, execution, evaluation) related to financing, human resources (including managerial), medicines and technologies, physical infrastructure, and monitoring and evaluation capabilities (Bamberger and Cheema 1990; Stefanini and Ruck 1992; Knippenberg *et al*. 1997; Olsen 1998; Shediac-Rizkallah and Bone 1998; Johnson *et al*. 2004; Pluye *et al*. 2004a; Nelson *et al*. 2007; Humphreys *et al*. 2008; Bennett *et al*. 2011). Funding was defined as essential for sustainability in several frameworks. This aspect of capacity included stakeholders' abilities to analyse funding needs, mobilize sufficient funds, evaluate and use funds efficiently (Stefanini and Ruck 1992; Lafond 1995a; Knippenberg *et al*. 1997; Mancini and Marek 2004; Sarriot *et al*. 2004; Torpey *et al*. 2010; Scheirer and Dearing 2011).

The availability of adequate funding, infrastructure and commodities, and qualified and trained staff were identified as factors influencing sustainability in a number of empirical studies (Prasad and Costello 1995; Gruen *et al*. 2002; Evashwick and Ory 2003; McKenzie *et al*. 2003; Hoelscher *et al*. 2004; Mihalopoulos *et al*. 2005; Nilsen *et al*. 2005; Scheirer 2005; Wakerman *et al*. 2005; Edvardsson *et al*. 2011; Gloppen *et al*. 2012; Walsh *et al*. 2012). In both settings (high-income and low-/middle-income), authors concluded that the sustainability of health programmes requires long-term funding. Studies suggest that chances for sustainability are higher in those organizations that use available funds efficiently (Higgins *et al.* 2008), regularly assess and plan present and future financial needs (Israel *et al*. 2006; Casey *et al*. 2009) and are capable of securing diverse funding streams (Bratt *et al*. 1998; Evashwick and Ory 2003; Stevens and Peikes 2006). Diversified and sufficient funding in contrast to funding earmarked for a specific intervention was found to improve the chances of sustainability (Rog *et al.* 2004; Stroul and Manteuffel 2007).

Ability to adapt, renew or be flexible ('flexibility/adaptability'). 'Flexibility (adaptability)' has been conceptualized as an attribute of the sustainability of development projects (Bamberger and Cheema 1990; Stefanini and Ruck 1992); innovations in health-care settings (Greenhalgh *et al.* 2004); and organizations (Olsen 1998; Alexander *et al*. 2003; Johnson *et al*. 2004; Mancini and Marek 2004; Pluye *et al*. 2004a; Hanson *et al*. 2005; Bowman *et al*. 2008; Gruen *et al*. 2008; Humphreys *et al*. 2008). There are two aspects. The first is the ability to identify and recognize changes in contextual environment, organizational setting, in a health problem or its determinants or in performance. In response, sustainable organizations possess a willingness and ability to change or modify strategy, priorities, or functioning whilst retaining overall organizational mission and performance (Bamberger and Cheema 1990; Olsen 1998; Alexander *et al*. 2003; Mancini and Marek 2004; Pluye *et al*. 2004a; Hanson *et al*. 2005; Gruen *et al*. 2008; Humphreys *et al*. 2008). The second aspect is the capability of stakeholders to value, learn, assimilate and apply new knowledge (Olsen 1998; Greenhalgh *et al*. 2004; Johnson *et al*. 2004; Pluye *et al*. 2004a; Gruen *et al*. 2008; May and Finch 2009; Slaghuis *et al*. 2011).

Several studies concluded that continuous adaptation to societal changes, community needs and population demands is a driving factor of sustainability (Wakerman *et al*. 2005; Nordqvist *et al*. 2009; Greenhalgh *et al*. 2012; Van Acker *et al*. 2012). Important for sustainability of organizations was the flexibility to change the organization's strategy or operations in response to changes in the regulatory or fiscal environment (Bratt *et al*. 1998; Jana *et al*. 2004; Israel *et al*. 2006; Plochg *et al*. 2006; Wright 2009; Singh *et al*. 2010; Buykx *et al*. 2012). These included, for example in the case of funding cuts, redefining services and staffing patterns or changing strategies for creating demand for services (LaPelle *et al.* 2006). Organizations with cultures open to new knowledge and with emphasis on a high level of proficiency were more likely to sustain innovations (Glisson *et al.* 2008).

Capability to build relationships and interactions inside and outside an organization ('interactions'). 'Interactions' are included as a determinant of sustainability in several frameworks. Definitions of what these relationships imply differed and are often vague. For interventions, these relations were defined as their integration into domestic or routine administrative structures and functions (Bossert 1990; Goodman *et al*. 1993; Shediac-Rizkallah and Bone 1998). Others defined interactions as building a broad political support base from the government or influential stakeholders (Bamberger and Cheema 1990; Alexander *et al*. 2003; Mancini and Marek 2004). In community-based research, interactions were referred to as linkages and support from community members (Alexander *et al*. 2003; Mancini and Marek 2004; Sarriot *et al*. 2004; Nelson *et al*. 2007; Bowman *et al*. 2008). Some authors outline how interactions likely influence sustainability. Co-ordination or collaboration with various stakeholders was defined as important for effective implementation of health interventions (Bossert 1990; Greenhalgh *et al*. 2004; Johnson *et al*. 2004; Mancini and Marek 2004; Sarriot *et al*. 2004; Scheirer and Dearing 2011), ensuring efficient use of health system resources or resource inputs to an organization (Olsen 1998; Hanson *et al*. 2005; Gruen *et al*. 2008; Humphreys *et al*. 2008).

Relationships within and with other organizations were also found to be a determinant of sustainability in all studies that included this component in the assessment (Supplementary Appendix S3). Pilots or innovations that were not integrated into domestic policy and legal frameworks, formal domestic health services, and ongoing roles and responsibilities were at substantial risk of being discontinued at the end of external support (Bossert 1990; Gruen *et al*. 2002; Harpham and Few 2002; Fuller *et al*. 2005; Amazigo *et al*. 2007; Milne *et al*. 2007). Collaboration, building alliances, gaining support and involvement of various stakeholders (both political and in the communities) were critical for sustainability in a number of studies (Knippenberg *et al*. 1997; Bratt *et al*. 1998; Wong *et al*. 1998; Eliason 1999; Sivaram and Celentano 2003; Jana *et al*. 2004; Nilsen *et al*. 2005; Wakerman *et al*. 2005; Edwards and Roelofs 2006; Minkler *et al*. 2006; Jacobs *et al*. 2007; Nelson *et al*. 2007; Higgins *et al*. 2008; Nordqvist *et al*. 2009; Singh *et al*. 2010; Greenhalgh *et al*. 2012). Co-ordination in implementation between actors (e.g. government, NGOs, international actors) was found to be an important determinant for the sustainability of complex health programmes (Mancini and Marek 2004; Greco and Simao 2007; Rosenberg *et al*. 2008; Le Loup *et al*. 2010; Torpey *et al*. 2010).

Ability to bring about results or attain goals ('performance'). 'Performance' is included as an attribute of the sustainability of health programmes (Stefanini and Ruck 1992; Brown 1998; Shediac-Rizkallah and Bone 1998; Johnson *et al*. 2004; Pluye *et al*. 2004a; Sarriot *et al*. 2004; Stephenson *et al*. 2004; Nelson *et al*. 2007; Bowman *et al*. 2008), institutions (Brinkerhoff and Goldsmith 1992), health services or organizations (Knippenberg *et al*. 1997; Olsen 1998; Mancini and Marek 2004) and health systems (Berman 1995; Lafond 1995a). This dimension of sustainability was defined as adequate service coverage (Nelson *et al.* 2007), adequate level of care quality, accessibility, acceptability (Olsen 1998) or performance that encompassed notions of effectiveness, equity and efficiency (Berman 1995; Knippenberg *et al.* 1997; Olsen 1998).

In empirical studies, achieving results or bringing benefits (either observable or perceived) was found to be an important prerequisite of sustainability of a programme or an organization (Bossert 1990; Streefland 1995; Rashed *et al*. 1997; Kachur *et al*. 1999; Scheirer 2005; Amazigo *et al*. 2007; Jacobs *et al*. 2007; Toledo Romani *et al*. 2007; Wang *et al*. 2008). In a number of studies, the strategic use of monitoring and evaluations systems in planning, refining operations and disseminating results have been particularly important for building credibility and reputation, gaining political and financial support, and consequently sustainability (Knippenberg *et al*. 1997; Alexander *et al*. 2003; Evashwick and Ory 2003; Fuller *et al*. 2005; Minkler *et al*. 2006; Stevens and Peikes 2006; Milne *et al*. 2007; Nelson *et al*. 2007; Stroul and Manteuffel 2007; Torpey *et al*. 2010; Parand *et al*. 2012).

Role of health system and broader environment in programmatic sustainability.
Contextual factors as determinants of sustainability were included in most frameworks. Among components of contextual environments included in the frameworks are broad political, socio-cultural and economic factors (Bossert 1990; Olsen 1998; Greenhalgh *et al*. 2004; Mancini and Marek 2004; Sarriot *et al*. 2004), including the concept of human development (Sarriot *et al.* 2004). We did not identify any frameworks for sustainability in health system (i.e. interventions, programmes, organizations) that build on explicitly outlined health system conceptualizations. Notably, Blanchet and Girois (2013) proposed a methodological approach to allow context-sensitive conceptualization and measurement sustainability of health systems. The approach uses participatory methods, involving stakeholders in defining sustainability indicators. Only a few authors included the prevailing health system's characteristics into their frameworks. These were, for example, financial resources available for health, or social and health-care financial mechanisms (Olsen 1998; Mancini and Marek 2004; Hanson *et al*. 2005); regulatory and legislative base (Greenhalgh *et al*. 2004; Nelson *et al*. 2007; Humphreys *et al*. 2008) or organizational arrangements of the health system (Olsen 1998).

A number of empirical studies concluded that the overarching health system characteristics, economic conditions, political climate, policies of funding agencies and country's history may influence the sustainability of health interventions or organizations (Amazigo *et al*. 2002; Dasgupta and Priya 2002; Atun *et al*. 2005; Sibthorpe *et al*. 2005; Israr and Islam 2006; Jacobs *et al*. 2007; Nelson *et al*. 2007; Stroul and Manteuffel 2007; Williams *et al*. 2007; Higgins *et al*. 2008; Humphreys *et al*. 2008; Rosenberg *et al*. 2008; Le Loup *et al*. 2009; Nordqvist *et al*. 2009; Ashwell and Barclay 2010; Druss *et al*. 2011). Among external factors, several studies pointed out a key role of donors' investment policies. This was shown to be important in both high-income and low-middle-income settings. In a low- and middle-income context, investment strategies that support vertical programmes and 'value for money' may draw attention away from a unified strategy for health sector development, thus compromising sustainability of the health system (Lafond 1995a). Furthermore, uncertainty in funding negatively affects relations in complex organizations, creating tensions for sharing/competing for resources (Stroul and Manteuffel 2007). Inflexibility of donor funding and project implementation policies was found to be an impediment to sustainability (Wakerman *et al*. 2005; Israel *et al*. 2006; Ashwell and Barclay 2010; Humphries *et al*. 2010).

Sustainability of a communicable disease programme: proposed conceptual and analytical approach

Our perspective on sustainability draws upon theoretical insights of complex adaptive systems that view a system's resilience as a critically important element of sustainability (Fiksel 2003; Kemp *et al*. 2005; Fiksel 2006; Folke 2006). We define a sustainable communicable disease programme as continuously effective in reducing a disease problem, and responsive and adaptive to changes in the nature of disease epidemics (actual or perceived), population needs or contextual environment. In this definition, the 'what' of sustainability (i.e. what should be sustained) is a continued reduction of a communicable disease problem, which includes interruption of infection transmission and reduction of morbidity and mortality associated with an infection or disease.

Figure 1 offers a representation of the framework for analysis of a programme's sustainability (i.e. a potential for sustainability). 'Health systems' are viewed as complex adaptive systems (Checkland 1981; Plsek and Greenhalgh 2001). 'Disease control programmes' are components of health systems. 'Health system and disease programmes' comprise a set of critical interacting functions that include governance, financing, planning, service delivery and evaluation and are designed to achieve specific objectives (Atun and Menabde 2008). Fundamental goals of the health system are increased health, protection from financial risk and responsiveness to users (Frenk 1994; WHO 2000; Hsiao 2003), while intermediate goals include equity, efficiency, choice and effectiveness (Atun and Menabde 2008). 'Health systems' and 'disease control programmes' are embedded within a broader context. 'The context' denotes economic, political, regulatory, social-cultural (including historical legacy), epidemiological, regulatory and technological environments (i.e. systems), within which a health system operates and interact with (Atun *et al*. 2004; Atun and Menabde 2008).

'Programmes' are comprised of all organizations and individuals, whose purpose and activities are principally directed

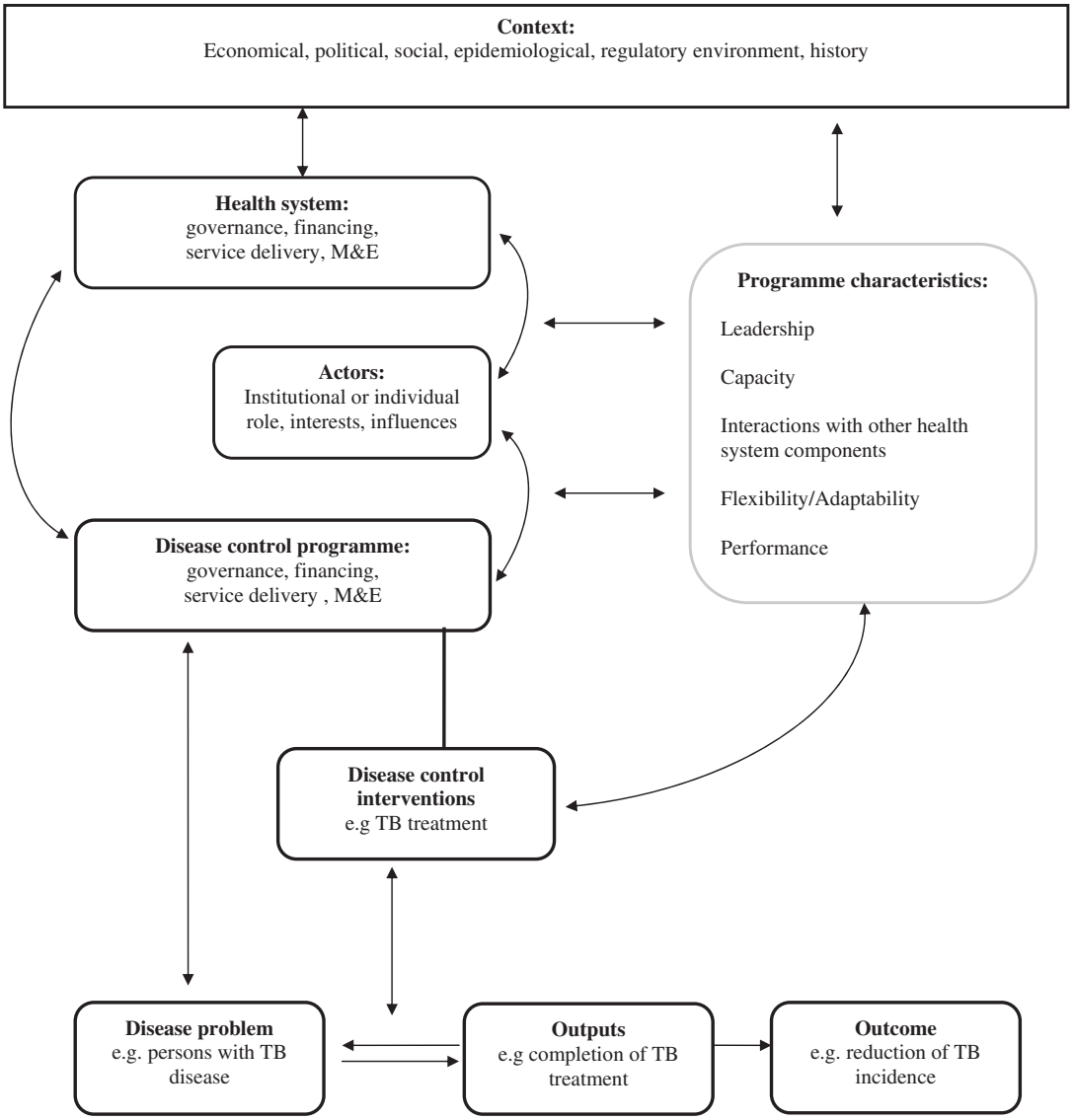

Figure 1 The framework for the analysis of sustainability of a disease control programme.
Note: Modified following Atun *et al.* (2004); M&E = monitoring and evaluation; TB = tuberculosis

towards the prevention and control of a defined 'disease problem'. Our analytical framework emphasizes a key role of 'actors' and relations among them in establishing, changing and sustaining health programmes. 'Actors' may be funders, policy makers, managers, community leaders, groups voicing the needs of patients and users of services, providers of services, professional associations, religious authorities, civil society organizations and other groups who are directly or indirectly affected by a health problem (Gruen *et al*. 2008; Atun *et al*. 2010). 'Intervention' refers to a programme's components aimed at control of 'disease problem' through service delivery or public health action (e.g. diagnosis, vaccination, treatment). 'A disease problem' refers to the nature of an infection or disease caused by a pathogen, character of transmission and scope and magnitude of an epidemic. A disease problem also relates to its changes such as emergence of drug resistance or co-epidemics with other health conditions.

We propose that leadership, capacity, adaptability/flexibility, interactions and performance are the 'programme characteristics' (capabilities) that may explain the potential for sustainability (i.e. precursors for sustainability). Proposed definitions for each characteristic are presented in Table 4. The notion of integration (which we have chosen to call 'interactions') is one of the conditions necessary for sustainability. Our conception of integration builds on Shigayeva *et al*. (2010).

Whether proposed precursors for sustainability exist, act and affect the delivery of interventions and consequently contribute to the reduction of a disease problem depend on several factors, including the interrelationships among them. These factors are the nature of the disease problem, interrelationships among 'actors' and their institutional roles and interests, structural and functional arrangements of a 'health system' and 'disease control programme', and 'context'. Historical paths of health system, disease control programmes and disease itself may play

Table 4 Programme characteristics for sustainability assessment

	Definition/explanation
Leadership	The capabilities of programme's actors to lead, govern, and manage. Leadership concerns the willingness and ability of actors to commit to disease control efforts; have a clear and long-term vision for disease control efforts, gain political and financial support, build a programme's credibility, build trust and engage with various stakeholders, mobilize resources and implementation efforts, taking ownership of reforms and innovations.
Capacity	Managerial, technical, financial, physical (organizational structures), communication and human resources capabilities, which enable a programme to function over time[a]. These include both structures (resources) and processes involved in generating, allocating, maintaining and evaluating the use of resources.
Flexibility/ Adaptability	The willingness and ability of actors to adapt or change disease control strategy (strategic objectives and priorities), policy (strategy, legislation, regulations), or a programme's structures or functions (e.g. approaches to funds mobilization, resource allocation mechanisms, service provision, re-training of personnel, reporting and evaluation approaches) in response to external pressures, changes in nature of a disease or introduction of innovations. This aspect also refers to openness to learning and orientation towards innovations.
Interactions	This characteristic relates to the notion of integration[b]. Interactions may occur at any of the health system's structural or functional components: governance, financing, service delivery, and monitoring and evaluation A range of functional relationships may exist between health system's components or stakeholders, along a continuum that ranges from: no formal interactions when no integration exists; linkage, co-ordination, and full integration. Across this continuum of interactions, there is increased formality in governance, sharing of responsibilities for joint activities, and pooling of resources.
Performance	The capability of a programme to operate effectively, equitably and efficiently in order to increase the likelihood of reducing a disease problem. Important for sustainability is the presence of monitoring and evaluation systems that can provide sound measurements of the programme's (or its intervention's) effectiveness, efficiency and equity.

[a]Definition by (Lafond *et al.* 2002).
[b]This conception of integration is published in Shigayeva *et al*. (2010).

an important role in determining the programme's leadership, capacity (i.e. dedicated resources), flexibility, interactions and performance. Additionally, the proposed framework suggests that political and economic environments, institutional interests of actors and health system's arrangements may directly affect the existence and functioning of a disease control programme, choice and continuous implementation of interventions. Consequently, the aforementioned programmatic factors may influence the scale and actions of interventions on a disease problem, leading (or not) to a reduction of disease incidence or associated mortality and morbidity (i.e. 'outcomes').

Limitations of the proposed framework

The framework presented in this article is an initial 'programme theory', which may need to be refined through additional theoretical specifications and/or through empirical studies. A framework approach to studying complex social systems has its limitations as frameworks include selective constructs, putting emphasis on some information and minimizing the other (Coker *et al.* 2010). We particularly focused on formal structural and functional arrangements of health systems. The framework does not fully address 'informal' interactions and relations between providers and patients, national and international policy makers and others. Informal interactions, on the other hand, indeed may play one of the key roles in the evolvement of complex social systems (Atkinson 2002; Gilson 2003; Gilson 2006; McPake *et al*. 2006; Schneider *et al*. 2008; Blanchet and James 2011). In future developments of constructs such as 'flexibility' and 'interactions', there is a need to incorporate theoretical perspectives from sociology, organizational learning and organizational psychology, including theories explaining dynamics within interests groups such as neo-institutional theory.

Participatory research approaches that engage stakeholders could be used in refining programme theories on sustainability, as recently proposed (Blanchet and Girois 2013; Schell *et al*. 2013). Empirical studies are required to inform understanding of the relative importance of each proposed precursor to sustainability, which likely differ in different contexts and/or may influence each other in complex ways. Research is needed to gain insights on the relative importance of each level of interaction (i.e. linkages, co-ordination or full integration) (Shigayeva *et al.* 2010) in ensuring sustainable outcomes. Another important aspect that we did not address was the dynamics of biological systems. Studies on the sustainability of communicable diseases programmes may be extended through methodologies to encompass dynamic relations in biological and human systems such as non-equilibrium statistics, network analysis, agent-based modelling or scenario modelling (Ajelli *et al.* 2010; Blanchet and James 2011).

We relied on published literature for proposing programmatic characteristics that may explain sustainability. Literature review approach has inherent limitations. Some publications may have been missed due to search limits. As other authors (Scheirer and Dearing 2011; Wiltsey Stirman *et al.* 2012), we found that the empirical evidence base on sustainability in health systems is emerging. This particularly concerns the limited application of theoretical or conceptual models in empirical studies on sustainability.

Conclusion

In this review, we aimed to clarify the conceptual understanding of what constitutes sustainability and the link between

notions of sustainability and integration. Despite limitations, our proposal is rooted in explicit theoretical foundation. Though our research is focused on communicable diseases control, our proposal could be applied to other public health problems. Our contribution to the development of theories explaining programmatic sustainability highlights the suggestion that integration of a programme with other health system components is likely one, but not the only, determinant of a programme's sustainability. Though integration of elements of a programme with other system components is important, its role in sustainability is context specific and difficult to predict. Given the very substantial sums being invested in Global Health Initiatives, we believe that the conceptualization and analysis of programme sustainability are a critically important issue to support funding decisions as well as ensure lesson learning and knowledge dissemination of best programmatic practices.

Authors' contributions

All authors were involved in critical revision of the manuscript and read and approved the final manuscript.

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Supplementary Data

Supplementary data are available at *HEAPOL* online.

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