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Article

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Applying the triple bottom line of sustainability to healthcare research—a feasibility study

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ABSTRACT

Objective: The triple bottom line (TBL) of sustainability is an important emerging conceptual framework which considers the combined economic, environmental and social impacts of an activity. Despite its clear relevance to the healthcare context, it has not yet been applied to the evaluation of a healthcare intervention. The aim of this study was to demonstrate whether doing so is feasible and useful.
Design: Secondary data analysis of a 12-month randomized controlled trial.
Setting: Community based mental health care.
Participants: Patients with chronic psychotic illnesses ($n = 333$).
Intervention(s): Community treatment orders.
Main Outcome Measure(s): Financial and environmental (CO_2 equivalent) costs of care, obtained from healthcare service use data, were calculated using publicly available standard costs; social sustainability was assessed using standardized social outcome measures included in the trial data.
Results: Standardized costing and CO_2e emissions figures were successfully obtained from publicly available data, and social outcomes were available directly from the trial data.
Conclusions: This study demonstrates that TBL assessment can be retrospectively calculated for a healthcare intervention to provide a more complete assessment of the true costs of an intervention. A basic methodology was advanced to demonstrate the feasibility of the approach, although considerable further conceptual and methodological work is needed to develop a generalizable methodology that enables prospective inclusion of a TBL assessment in healthcare evaluations. If achieved, this would represent a significant milestone in the development of more sustainable healthcare services. If increasing the sustainability of healthcare is a priority, then the TBL approach may be a promising way forward.

Key words: health system reform, health care system, quality improvement, quality management

Introduction

Healthcare delivery is resource-intensive. Current prospects for sustaining high-quality healthcare are diminishing as interventions become more expensive, patient expectations increase, and resources become more constrained [1]. Healthcare quality evaluations typically focus on patient outcomes against economic costs but this is increasingly recognized as insufficient [2, 3]. A more structured approach to evaluating healthcare that considers its full costs is therefore required so that saving can be made without compromising quality and long-term sustainability. The 'sustainable triple bottom' line (TBL) is an emerging conceptual framework that considers not just the financial costs, but also the environmental and social costs of an activity [4].

The TBL was introduced by John Elkington in 1994 as a novel business accounting framework. Elkington argued that for an organization to be sustainable it must go beyond the traditional first 'bottom line' of profit vs. loss and consider the environmental and social impacts of doing business. In other words, to be sustainable, an organization must balance its books, measure and manage its environmental impacts (e.g. air pollution, CO_2 emissions), and consider its social obligations such as the health and wellbeing of employees and clients. Since its introduction, TBL assessments have been employed by many organizations to evaluate institutional performance, enhance environmental and social responsibility, and increase organizational value. Application of the TBL is especially pertinent in the healthcare context because of the healthcare sector's mandate to promote health and wellbeing, which is directly and indirectly determined by ecological and social factors.

Applying the TBL to healthcare

Healthcare delivery is economically burdensome. In Australia, the United Kingdom, and the United States, for example, healthcare expenditure for 2016 amounted to 9.3%, 9.8%, and 17.1% of GDP spending respectively [5]. But there are good reasons why the environmental and social costs generated from healthcare activity must be considered alongside economic costs.

The healthcare sector has large environmental impacts that include land, water, and air pollution, and is also a significant contributor to global greenhouse gas (GHG) emissions. In the United Kingdom, the National Health Service (NHS) has a larger carbon footprint than some medium-sized European countries, such as Slovenia [6]; while, if the U.S. healthcare sector were ranked as a nation, it would be the world's 13th-largest emitter of greenhouse gases, more than the United Kingdom's combined emissions from all sectors [7]. Most of this so-called carbon footprint derives from clinical factors, such as the manufacture of pharmaceuticals, medical equipment and clinically-related travel, while buildings' energy use is less than 20% of the total [8]. There is growing public awareness about the risks that climate change poses to human health and wellbeing [9] and reducing GHG emissions has become a flashpoint in debates about environmental sustainability within the healthcare sector. In 2008 the NHS signed up to the Climate Change Act, committing to an 80% reduction in GHG emissions by 2050 [10].

If the sustainability of healthcare is to be improved, it is important to also consider the effects of social factors on health outcomes. Socially sustainable services are services that, alongside improving clinical outcomes, also tackle the social determinants of health [11]. The social determinants of health are factors found in a person's living conditions – such as whether they have work, social networks, and suitable accommodation – rather than individual risk factors (such as genes, lifestyle) that influence health outcomes [12, 13]. In the healthcare context, social sustainability implies going beyond the narrow focus on immediate health (i.e. presence or absence of symptoms) to consider a wider range of social factors that bear on long-term resilience, health and wellbeing [14, 15].

In the nearly 25 years since Elkington introduced the TBL framework, the term sustainability has become ubiquitous within the healthcare sector [16]. NHS England and other health authorities have strongly supported efforts to improve the sustainability of healthcare [16, 17]. Each component of the TBL has been independently assessed and debated: health economics research abounds; knowledge about the environmental impact of healthcare is increasing; and measuring the social consequences of healthcare delivery is now common. However, to the best of our knowledge, no academic publication has brought these three components together for the evaluation of a healthcare intervention or service. There have been no suggestions in the literature for how these different components should be measured, combined or reported. Further, there has been little discussion about how the results should be interpreted against other evidence, such as clinical effectiveness or cost-effectiveness alone.

Aims

The aim of this study was to evaluate the feasibility of applying the TBL to a healthcare intervention. We used secondary analysis of data from a 12-month randomized controlled trial of community treatment orders for patients with psychosis to calculate the (1) financial cost in Pound Sterling, (2) environmental costs in CO_2 equivalents, and (3) the social sustainability (i.e. patient well-being, substance use, employment, etc) of the intervention. Financial and environmental costs were calculated using service data (i.e. days spent in hospital and contacts with health professionals in the community during follow-up) while social sustainability was estimated using data obtained from social outcome instruments included in the trial.

Methods

Background and context

Service use and social outcomes data for this study were obtained from a randomized controlled trial (RCT) of community treatment orders (CTO) [18]. CTOs are a social-legal intervention for patients with a severe mental illness and a history of relapse and readmission to hospital. A patient subject to a CTO can be required to accept treatment while living outside of hospital, and, if they are believed to be relapsing, can be rapidly recalled to hospital for assessment and readmission. Patient eligibility and inclusion criteria are reported elsewhere [18]. Patients (n = 333) were randomized to either the CTO or control arm (voluntary status via brief absence of leave) and followed up for 12-months. Patients were interviewed by trained researchers at baseline and 12-months while socio-demographic and clinical details were collected from medical records. The study was granted ethical approval [REC ref. 08/H1204/131] and all patients gave informed consent prior to interview [18, 19].

Economic and environmental sustainability

We calculated the number of nights spent in hospital and the number of contacts with community mental health professionals (e.g. at home, day centre, café, community mental health team) for each

patient across the 12-month follow-up. Inpatient costs were calculated from the total number of days spent in hospital from randomization to 12-month follow-up (including the index admission), while community contacts were defined as the total number of successful patient contacts (i.e. not including cancellations, non-attendance, etc.) in the community with a mental health professional, without specifying the discipline of the professional (i.e. nurse, support worker, psychologist, psychiatrist). To calculate the economic and environmental costs from the service-use data, we obtained publicly available standardized national data [8, 20] to generate an economic and environmental 'footprint' for each patient. Economic footprints were taken from a recognized health economics dataset that provided average national costs of UK healthcare activities from 2016 data [20]. The environmental footprints were estimated using a technique called input-output analysis [21]. This method draws on organizational-level financial data to convert financial costs of care into kilograms of CO_2 equivalents ($kgCO_2e$) using accepted carbon conversion rates published by the Department of Food and Rural Affairs [22]. The carbon footprints of individual clinical activities were subsequently estimated by scaling down from these organizational estimates, creating attributions based on cost and number of clinical activities (further information about how these factors are calculated is available at: http://www.ukconversionfactorscarbonsmart.co.uk). Based on 2016 figures, the economic cost of one bed-day in a psychiatric hospital was £373 (US$490) and the cost of community appointment £121 (US$159); the CO_2 equivalent (e) environmental impact for these activities was 97 $kgCO_2e$ and 59 $kgCO_2e$ respectively [8, 20]. These figures represent averages for each patient contact with a health professional, irrespective of the health professional's discipline or location.

Social sustainability

An organization that is socially sustainable seeks to address social factors that may impact on the healthy development of society [23]. In this study, social sustainability was conceptualized as the social factors that affect health, that is, the social determinants of health [11]. A 2003 World Health Organization (Europe) report on the social determinants of health identified ten relevant dimensions including the social gradient in health (health inequalities related to social status), stress, early life disadvantage, social exclusion, poor work conditions, unemployment, lack of social support, addiction, food insecurity, and poor access to transportation [24]. Based on the availability of social outcomes data in the OCTET RCT, and further work carried out by Marmot and Bell [11], the following four social domains were assessed: unemployment; lack of social support and social exclusion; stress (overall functioning); and addiction. Social outcomes were assessed using standardized instruments spanning the following domains: (1) employment; (2) objective social outcomes; (3) overall functioning (stress); (4) health-related quality of life; and (5) alcohol and substance misuse. Social outcomes assessments focused on the 2-4 weeks preceding the patient interview. The following instruments were used; instrument scope of measurement and references are provided in the Supplementary material:

(1) Employment. Patients were asked about their employment status (unemployed, voluntary or sheltered work, part-time or full-time employment).

(2) Objective social outcomes. The Objective Social Outcomes Index (SIX) is a brief index used for benchmarking social outcomes by capturing objective information about an individual's social situation in the domains of employment, living situation and social contact in the last week.

(3) Overall functioning (stress). The Global Assessment of Functioning (GAF) is a widely used clinician- or researcher-rated measure of overall functioning in the two weeks prior to interview.

(4) Health-related quality of life. The EuroQol EQ-5D is a self-complete questionnaire that assesses health-related quality of life in the two weeks preceding the interview.

(5) Substance misuse. The CAGE is a four-item screening questionnaire for alcohol and other drug misuse over the preceding 30 days.

Linear regression models were used to assess changes between baseline and follow-up scores for continuous variables (days in hospital, number of successful community contacts, SIX, GAF, EQ-5D) and logistic regression models for categorical variables (Employment, CAGE). Previous analyses that compared outcomes for the intervention and control group found no significant differences for the outcome listed above [18, 25] and we consequently report our results descriptively for each group.

Data were analysed using SPSS version 24. All significance tests were two-tailed and significance was set at 0.05.

Results

Sociodemographic and clinical characteristics of patients included in the study are presented in Table 1. During the 12-months follow-up, patients spent a mean of 86.3 days (SD = 103) in hospital (median = 42, IQR = 8–126, range = 0–365). While in the community, participants had a mean of 40.9 contacts with community-based mental health professionals (median = 42, IQR = 8-126, range = 0–328) (Table 2).

Table 3 shows the economic and environmental costs of the community and hospital care and social outcomes at 12-months follow-up. The mean (SD) financial cost for contacts with mental health professionals in the community was GBP£4 092 (4 163), while the mean cost of inpatient care was £37 121 (44 418). The mean (SD) environmental impact was 2 415 $kgCO_2e$ (2 456) for community care and 8 374 $kgCO_2e$ (10 020) hospital admissions. For all three TBL criteria, there were no differences between the trial groups.

Table 1 Baseline socio-demographic and clinical characteristics of the sample ($n = 333$)

	N or Mean	(%) or (SD)
Age	39.6	(11.4)
Sex		
Male	224	(67%)
Female	109	(33%)
Years of education	11.9	(1.9)
Ethnic origin		
White British	204	(61%)
Other	129	(39%)
Clinical diagnosis		
Schizophrenia	283	(85%)
Other psychoses	50	(15%)
Duration of illness (years)	14.3	(10.3)

Note: the intervention and control group were matched on baseline socio-demographic and clinical characteristics [18].

Table 2 Service use during 12-month follow-up

Service use	Total (n = 333)		Intervention (CTO[a]) (n = 166)		Control (n = 167)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Days in hospital during follow-up	86.3 (103.3)	42 (8–126)	81.7 (102.2)	40 (7–113)	90.7 (104.5)	45 (10–133)
No. of face-to-face contacts in the community	40.9 (41.6)	30 (15–49)	40.9 (42.6)	32 (14–48)	41.0 (40.8)	30 (15–49)

[a]Community treatment order. No significant differences between groups.

Table 3 Economic, environmental and social outcomes for 12-months follow-up

Outcome	Intervention (CTO[a]) (n = 166) Mean (SD) or N (%)	Control (n = 167) Mean (SD) or N (%)
Financial cost in GBP (£)		
Face-to-face contacts (community)	4 950 (5 152)	4 954 (4 936)
Days in hospital (inpatient)	30 460 (38 123)	33 930 (38 968)
Environmental		
GHG emission in kg/CO_2e (community)	2 414 (2 512)	2 416 (2 407)
GHG emissions in kg/CO_2e (inpatient)	7 921 (9 914)	8 823 (101 034)
Social		
Employment		
Baseline		
None	166 (99%)	160 (98%)
Voluntary/protected/sheltered	2 (1%)	1 (1%)
Regular employment (including part-time)	0 (0%)	2 (1%)
Follow-up	117 (94%)	105 (92%)
None	6 (5%)	3 (3%)
Voluntary/protected/sheltered	1 (1%)	6 (5%)
Regular employment (including part-time)		
Objective social outcomes		
Baseline	2.46 (1.1)	2.53 (1.1)
Follow-up	2.56 (1.0)	2.65 (1.3)
Overall functioning (stress)		
Baseline	39.84 (9.4)	39.04 (9.9)
Follow-up	38.98 (11.0)	39.69 (13.1)
Health-related quality of life		
Baseline	0.74 (0.27)	0.71 (0.30)
Follow-up	0.71 (0.34)	0.74 (0.28)
Alcohol misuse		
Baseline	12 (7%)	4 (2%)
Follow-up	9 (5%)	10 (6%)
Street drug misuse		
Baseline	14 (8%)	14 (8%)
Follow-up	14 (8%)	10 (6%)

CTO = community treatment order; GHG = greenhouse gas; No significant differences between groups. kg/CO2e = kilograms of carbon dioxide equivalent; Details of instruments used, including scoring and scope of measurement are reported in the supplementary material.

Discussion

Principal findings

This is the first study to apply the TBL framework to the evaluation of a health intervention. Using secondary data from an RCT, referenced against national standardized costing figures, we were able to calculate the financial and environmental impacts of the intervention, while the social outcomes were assessed using data obtained from the trial. The study demonstrates that a TBL assessment of a health intervention can be feasibly calculated, even retrospectively, to provide a more complete assessment of the intervention costs.

The financial costs of care for patients in this study were high—around £40 000 per patient per year—but unsurprising given their high level of disability and need. The mean environmental impact per patient in terms of CO_2e, was 2 415 kg CO_2e for contacts with health professionals in the community and 8 374 kg CO_2e for in-patient care. For comparison, a flight from London to New York amounts to 860 kgCO_2e while annual per capita CO_2 emissions are around 7 130 kgCO_2e for a person living in the UK and 16 400 kgCO_2e per person in the United States [26]. Viewed another way, the annual (minimum) environmental cost of care for an average patient in this study is equivalent to flying London to New York return six times.

The social outcome measures included in this study show that patients generally fared poorly. Most were unemployed, had low levels of overall functioning and diminished health-related quality life. That patients had poor social outcomes, despite high economic

and environmental costs, likely reflects severe and enduring character of chronic psychotic illnesses. The finding raises important questions about service provision for this group. For example, what are the functions and objectives of secondary mental health services? Should social outcomes be given greater priority in intervention and service use outcome evaluations as is frequently called for by patients and carers [27]? Could service innovation or redesign lead to improved social outcomes at equal or reduced cost? Such reflections, raised in the context of a TBL assessment, and incorporated into health service design and delivery, can help to improve service sustainability and positively impact patient outcomes.

Strengths and limitations

The null result of the RCT on which the present analysis is based is an unfortunate limitation of the study since it does not allow us to examine differences in TBL outcome criteria. The aim of the study was not, however, to provide a universal methodology—or blueprint—for applying the TBL to healthcare interventions. Rather, it was to provide a proof of concept showing that, through the inclusion of carefully selected variables, it is possible to broaden the theoretical evaluative space and scope of measurement and thereby increase the sustainability and quality of health services. Future work should concentrate on identifying and prioritising relevant indicators and measurement tools across the TBL domains so that they can be prospectively incorporated in the evaluation of health interventions.

A major challenge of the TBL approach is the absence of 'common currency' between the three components. Although it might be possible to convert environmental externalities and even social impacts into monetary terms, it is conceptually in tension with a TBL assessment, which emphasizes the value and unique contribution of each component to sustainability. Rather, it would be helpful to identify, within each of the three components, common domains of measurement that could be applied across healthcare settings.

The economic and environmental evaluations generated in this study should be understood as approximations since they are based on conversions from national averages. Greater accuracy could be achieved through a full health economic analysis together with bottom-up carbon footprint analysis. Additionally, not every aspect of the TBL was exhaustively evaluated. The financial analysis focused on nights in hospital and contacts with community health professionals. It did not include other costs, such as medications or visits to emergency departments. The study also had only one indicator of environmental sustainability: CO_2e emissions. Other potential downstream environmental costs, such as medications, medical waste, air pollution from motor vehicles [28], or the impact of waste pharmaceuticals on ecosystems [29] were not assessed. The environmental assessment therefore represents a conservative estimate of the impact.

The retrospective nature of this study means that several other potentially relevant domains were not assessed including social gradient, transport, food, and social outcomes for staff [11]). No attempt was made to calculate the social return of investment. This parallel and conceptually linked framework should be considered in future studies that aim to refine and apply the TBL methodology within the healthcare context [30].

Study implications

This study used data from a national RCT to provide a proof of concept for applying the sustainable TBL to a health intervention with the aim of improving healthcare sustainability and quality. By including the TBL in trial reporting, the approach takes us beyond a narrow economic analysis and provides a more complete assessment of the true costs— as well as opportunities—generated by a healthcare intervention. The application of the TBL sustainability framework to health interventions is in its infancy and further theoretical and methodological work is necessary. A key objective of this study was to stimulate debate and advance methodological thinking around TBL accounting methods, with the longer-term aim of enhancing the efficiency and sustainability of healthcare service design and delivery.

Unanswered questions and future research

Any attempt to implement the TBL as a part of quality evaluation in a healthcare research context faces considerable conceptual and methodological hurdles. The TBL framework currently offers no means of prioritizing among the requirements of different stakeholder groups and much discussion could be had about which of the three components are most relevant to the evaluation of sustainability within given healthcare contexts. For example, how should the sustainability of an intervention be judged if it performs well on clinical and social outcomes but poorly on environmental indicators? What about an intervention that performs well on environmental metrics but poorly on social outcomes? While these questions remain unanswered, we suggest that environmental and social sustainability metrics should be viewed as supplementary to clinical and cost-effectiveness evaluations, helping to provide a broader assessment of the cost of an intervention. The aim of the TBL assessment, at least in this first iteration, should be to engage doctors and health professionals in thinking more broadly about the costs and opportunities generated by health interventions.

Conclusions

As global resources diminish and healthcare costs rise it is vital to improve the sustainability of healthcare services. This study shows that the TBL is conceptually and empirically meaningful and could feasibly be deployed to evaluate future as well as previously evaluated health services. The application of the TBL to healthcare evaluation represents a promising opportunity to increase healthcare sustainability while simultaneously enhancing the quality of healthcare delivery. If the TBL is a useful concept within the healthcare context then further work to advance and refine its application is urgently needed.

Supplementary material

Supplementary material is available at *International Journal for Quality in Health Care* online.

Contributors

FV and DM designed the study. FV analysed the data. FV and DM drafted the article, and all authors were responsible for revision of important intellectual content and final approval of the manuscript. FV and DM are the guarantors.

Declaration of interest

Francis Vergunst, Helen Berry, Jorun Rugkåsa and Daniel Maughan have no conflicting interests to declare. Andrew Molodynski has participated in

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