



Health care, overconsumption and uneconomic growth: A conceptual framework

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ABSTRACT

Concerns have grown in recent decades that economic growth in many rich countries may, in fact, be *uneconomic*. Uneconomic growth occurs when expansion in economic activity causes environmental and social costs that are greater than the benefits of that additional activity. Health care has enjoyed a close historical relationship with economic growth, with health care spending consistently growing faster than GDP over the long term. This paper explores the possible relationship between health care and uneconomic growth. It summarises the rapidly growing evidence on the harms caused by poor quality health care and by the overuse of health care, and on the environmental harms caused by health care systems. Further, it develops a conceptual framework for considering the overconsumption of health care and the joint harms to human health and the natural environment that ensue. This framework illustrates how health-damaging overconsumption in the wider economy combines with unnecessary or low-quality health care to create a cycle of “failure demand” and defensive expenditure on health care services. Health care therefore provides important sectoral insights on the phenomenon of uneconomic growth. There are rich opportunities for interdisciplinary research to quantify the joint harms of overconsumption in health and health care, and to estimate the optimal scale of the health sector from novel perspectives that prioritise human and planetary health and well-being over GDP and profit.

Credit author statement

Martin Hensher, Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing, Visualization. Ben Canny, Conceptualization, Writing - review & editing. Craig Zimitat, Conceptualization, Writing - review & editing. Julie Campbell, Conceptualization, Writing - review & editing. Andrew Palmer, Supervision, Conceptualization, Writing - review & editing.

1. Introduction

The idea that economic growth may not always improve human welfare has a long history (Ruskin, 1909 [1862]). Mishan (1967) decried the “growthmania” (p3-8) that simplistically collapsed the aims of economic policy and measurement to maximising growth in GNP, while ignoring the many “disamenities” that accompanied growth in already

affluent societies. The case against GDP (and hence GDP growth) as a meaningful measure of human welfare has been made repeatedly over the years since (e.g. Kubiszewski et al., 2013; Stiglitz et al., 2010; Waring, 1988). Since the 1970s, worries have grown regarding the existence of “limits to growth” (Meadows et al., 1972) and growth’s incompatibility with remaining safely inside “planetary boundaries” (Rockstrom et al., 2009; Steffen et al., 2015). Yet the perceived tension between ensuring ecological security and continuing GDP growth has remained deeply controversial, with “growth” often seen as a talisman of progress, not only by corporate interests but by political parties of most ideological persuasions.

Bringing together many of these themes at a macro level has been the work of Herman Daly on “uneconomic growth” (Daly, 1999, 2006). He noted that, after a certain point, continuing to increase the scale of the economy may cause the social and environmental costs of growth to outweigh its benefits. He argues (Daly, 2006) that population growth and

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expanding economic activity have moved humanity from inhabiting a historically “empty” world (in which economic growth could be absorbed without harm by the ecosystem), to an increasingly “full” world. This “full world” requires ever more remedial and defensive activity (Daly, 2014), as social and ecological limits increasingly convert *economic* growth into *uneconomic* growth (Daly, 2002).

Healthcare constituted close to 10 per cent of global GDP in 2014 (World Bank, 2017a), and health care expenditure is tightly linked to GDP growth (Hensher et al., 2020), while emerging estimates suggest that healthcare might be responsible for some 5 per cent of global greenhouse gas emissions (Pichler et al., 2019). Any examination of growth or of uneconomic growth needs to include healthcare, given its sheer scale and economic importance. The purpose of this paper is therefore to explore how the overconsumption of health care might contribute to the macro phenomenon of “uneconomic growth”, and to develop a conceptual framework by which to illustrate the relationships between overconsumption, health and health care.

2. Objectives and methods

This paper builds on the methods used in an earlier review of the economics of the overconsumption of health care (Hensher et al., 2017), to undertake a scoping review of the rapidly-growing literature on i) the likely scale of non-beneficial or low value health care; ii) the potential harms arising from overconsumption of health care; and iii) the ecological impacts of health care systems. The paper briefly reviews the phenomena of uneconomic growth and overconsumption in the wider economy, and how these can impact negatively on human health. It then summarises quantitative estimates of the scale of the harms of poor quality care, overconsumption, and the negative environmental externalities of health care systems. This approach allows these phenomena to be viewed in the context of the overall economic scale of health care. It examines in more detail two especially problematic case studies of negative externalities related to health care – the problem of antimicrobial resistance (AMR), and the evolution of the US opioid epidemic. These cases studies not only provide insights on the scale of two important negative phenomena closely linked to health care, but also on the incentives which can drive such negative outcomes. The interactions between these various phenomena are then explored and synthesised to produce a conceptual framework for considering the overall social and environmental costs and disutilities generated by modern health care systems.

3. Uneconomic growth, overconsumption and human health

Daly’s concept of uneconomic growth (Daly, 1999) is concerned fundamentally with humanity’s passing that point at which we are consuming (or producing) “too much”. “Overconsumption” therefore describes this situation – where the harms generated by our consumption, collectively or individually, start to have negative impacts that outweigh that consumption’s overall benefits (Princen, 1999). Many of the harms of uneconomic growth and overconsumption have, in recent years, become increasingly visible in accelerating change and damage to the environment, climate and planetary system. Yet overconsumption and harmful misconsumption (Princen, 1999) in the wider economy have long been understood to be powerful drivers of ill-health, and hence as important drivers of demand for healthcare. Smoking and alcohol are uncontroversial examples of consumption harmful to both the consumer and to others around them, while obesity represents another grave health consequence of overconsumption. Meanwhile, pollution of all forms caused an estimated 9 million premature deaths in 2015, more than AIDS, tuberculosis and malaria combined (Landrigan et al., 2018). Anthropogenic climate change – the direct consequence of unrestrained (un)economic growth – risks catastrophic impacts on the health of billions of people if not checked (Watts et al., 2015).

The societal-level mechanism of health-damaging impacts from

other forms of consumption and overconsumption has become increasingly clearly stated (e.g. Lalonde, 1974; Sanders, 1985) and well-analysed (Freudenberg, 2014), via the “commercial determinants of health” (Kickbusch et al., 2016; West and Marteau, 2013). Friel (2020) calls this the “consumptagenic system” – the dominant economic model “... that encourages and rewards the exploitation of natural resources, excess production, and hyperconsumerism, and which results in climate change and health inequities.” By this view, overconsumption damages health not just through ill-informed or poor individual choices, but through the very structure of the economy, from which individuals cannot readily exit. Pretty et al. (2016) examine this issue from a perspective explicitly grounded in environmental and ecological economics, considering the scale of health-damaging negative externalities from a range of consumption areas, and generate large estimates of the likely burden these externalities place on the United Kingdom National Health Service through the demand for health care that results from them. This kind of demand for healthcare is an example of “failure demand” (Trebeck and Williams, 2019, p66-69). Failure demand occurs as a consequence of failures to fix preventable problems elsewhere in the system. Failure demand for healthcare is also a “defensive expenditure”, the costs of trying to clear up the damage of harmful consumption as growth becomes uneconomic (Daly, 2013). When failure demand manifests through a response to health damages, it has three features: it represents ill-health that could potentially have been avoided entirely; it therefore consumes healthcare resources which could have been put to other uses; and it also exposes individuals to the risks of healthcare in response to illnesses that could have been prevented.

4. Iatrogenic harms and overconsumption in health care

4.1. Health care and iatrogenic harm to patients

Health care necessarily deals with those who are already sick, for many of whom cure or recovery is not possible, and for some of whom death is a likely outcome. There is intrinsic risk in many medical procedures, which can be minimised but not eliminated; and, when we are seriously ill or injured, accepting quite significant risks from treatment may be entirely preferable to the more certain outcomes of refusing treatment. However, in recent decades, the scale of *avoidable* iatrogenic harm caused by modern health care has become increasingly well understood and quantified.

An early alarm on the scale of iatrogenic harm caused by poor quality health care was sounded in the United States by the seminal report of the Institute of Medicine (IoM, 2000). Extrapolating from two 1991 studies, the IoM concluded that between 44,000 and 98,000 Americans died each year from adverse events occurring in hospitals. Subsequent US studies have reported higher values than these early estimates. Makary and Daniel (2016) reviewed the literature on estimates of deaths due to medical error in the USA, finding estimates in the range of 210,000 to 400,000 deaths in the US each year amongst hospital patients. Based on their own point estimate of 251,454 deaths annually, they argue that medical error may, in fact, constitute the third most common cause of death in the United States after heart disease and cancer. Stone (2009) estimated that around 2 million Americans suffer a health care-acquired infection (HCAI) every year, of which some 90,000 die – making HCAIs potentially the fifth-largest cause of death in US hospitals.

Baines (2018) recently reviewed the international literature, identifying studies of the prevalence of adverse events. Estimates across fourteen high income countries ranged from 2.9% to 16.6% of all hospital admissions incurring an adverse event; between 22% and 72% of all these adverse events were assessed as preventable. Meanwhile, the OECD has estimated that up to 15% of hospital expenditure and activity in member countries can be attributed to the costs of dealing with adverse events and safety failures – a “defensive expenditure” incurred because of harms caused to patients (OECD, 2017).

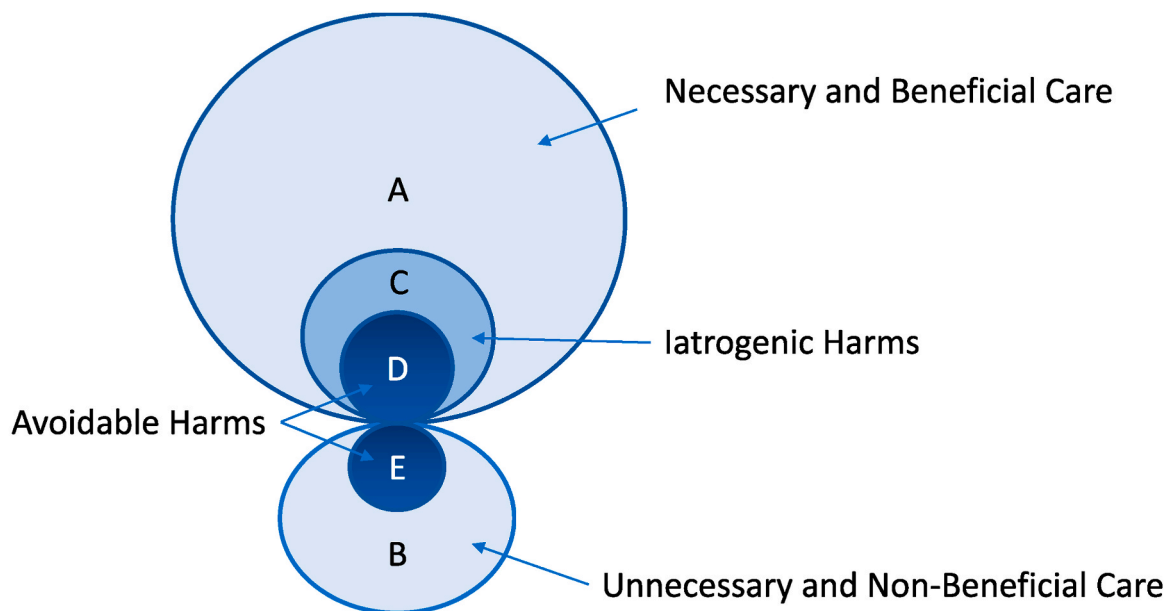
Attempts to quantify the overall global burden of adverse events

4.2. Evidence on the overconsumption of health care

overtreatment (Moynihan et al., 2014), overuse or overutilization (Brownlee et al., 2017), low value care (Schwartz et al., 2014), medicalisation and pharmaceuticalisation (Gabe et al., 2015; Illich, 1976). A survey of relevant concepts and terminology is provided in Hensher et al. (2017). While these concepts refer to different instances and settings, and provide different specific examples, all encompass aspects of the following general problems: patients are inappropriately diagnosed and labelled as “sick” when their underlying conditions will not actually progress to cause significant illness or death; these patients are then exposed to the inherent risks of iatrogenic harm from health care treatments and interventions unnecessarily and without benefit; normal aspects of the human condition are increasingly pathologised and therefore opened up as business opportunities for medical and pharmaceutical “treatment”; and limited health care resources are wasted on interventions that could never have delivered benefit to patients.

“Overuse” is, by its nature, a relative concept. At any given point in time, there are relatively few clinical procedures in widespread use which are unambiguously ineffective or wholly harmful (Duckett et al., 2015). Rather, there are interventions which are beneficial in some patients with some conditions, but which will be less effective, useless or even harmful for other patients and conditions. Meanwhile, for many people (especially in low income countries), the greatest health care challenge demonstrably remains *underuse* – the inability to access effective care. The concept of “Right Care” (Brownlee et al., 2017; Glasziou et al., 2017) seeks to capture this continuum of appropriateness, and to allow for the coexistence of both under- and overuse simultaneously (see Box 1).

Evidence for inappropriate and non-beneficial overuse of healthcare necessarily accumulates from a large number of studies of specific interventions and procedures, with a rapidly growing research literature in this area (Morgan et al., 2017). Aggregate estimates of the scale of overuse across different countries have suggested that some 10–30% of all health care activity might represent overuse (Morgan et al., 2015).



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The most notable effort to summarise the available international evidence on the incidence and scale has been undertaken by Brownlee et al. (2017), while other attempts to produce country-level estimates are currently under way. Brownlee et al. present extensive data on the prevalence of overuse in a wide range of interventions, settings and countries: for example, between one quarter and one third of total knee replacements may be inappropriate in Spain and the US respectively, while 13–33% of endoscopies in European countries and as many as 60% in the USA are unnecessary (Brownlee et al., 2017). Cardona-Morrell et al. (2016) found that 33–38% of patients approaching the end of life had received “non-beneficial treatments” that could not possibly have benefitted them, while Carter et al. (2017) showed that 12% of patients who died in three Australian hospitals had received “futile care”.

While the evidence shows that overuse is real and significant, it is, of course, important to note that it is not a purely objective phenomenon. A recent survey of US physicians (n = 2106) found a range of views on the necessity of medical care, with approximately 5% believing that no care was unnecessary, and more than 10% believing that at least 45% of all care was unnecessary (Lyu et al., 2017). On average, US physicians believed that just over 20% of all medical care is unnecessary. Similarly, different patients, faced with the same prognosis, information and treatment options, may legitimately make quite different choices about their care, reflecting different risk tolerances, values or priorities. Care must be taken to distinguish between non-beneficial care and legitimate subjective differences in patient perceptions of risk/benefit trade-offs for interventions which may add genuine value.

Fewer studies have yet been undertaken which directly quantify the harms of overuse, but efforts are now underway in this regard. A recent study of Australian public hospitals (Badgery-Parker et al., 2019a) considered 27 procedures for which evidence of low value care is clearly available, finding that 11–19% of episodes of these procedures met the definition of being “low value”. The same team then investigated seven of these low value procedures to identify the recorded incidence of hospital-acquired complications, to provide direct observational data on the prevalence of patient harms in individuals who had received low value (i.e. unnecessary) care (Badgery-Parker et al., 2019). They found high rates of harm from procedures that “... probably should not have been provided” (Badgery-Parker et al., 2019).

Table 1
Estimates of the costs of waste and unnecessary healthcare expenditures.

Description	\$	% Total Health Expenditure	Reference
Overall cost of waste in United States healthcare system (2019) including:	\$760 - \$935 billion	20%–25%	Shrank et al. (2019)
Failure of care delivery	\$102–\$166 billion	3%–4%	
Failure of care coordination	\$27 - \$78 billion	1%–2%	
Overtreatment	\$76 - \$101 billion	2%–3%	
Overall cost of waste in United States healthcare system (2011)	\$558 - \$1263 billion	21%–47%	Berwick & Hackbarth (2012)
- to which overuse contributes:	\$158 - \$226 billion	6%–8%	
Proportion of health spending across OECD countries which could be better spent (“waste”)		~20%	OECD (2017)
Proportion of total hospital expenditure across OECD countries that is driven by correcting previous harms to patients		~10–15%	OECD (2017)

The estimates of overuse reported above represent a potentially significant level of inappropriate resource use. Table 1 summarises a number of estimates of the cost of overuse and inappropriate care in financial terms, alongside broader estimates of the costs of waste and unnecessary health expenditure. While the estimates currently available are significantly skewed towards the United States, they are striking. In the USA, at least 20% of healthcare expenditure is wasted, perhaps significantly more; and this 20% waste estimate seems also to apply in other OECD countries.

5. Environmental and societal costs of health care

5.1. Health system environmental impacts

As a large component of all modern economies, health care clearly accounts for a non-trivial share of the consumption of non-renewable resources, while also polluting atmospheric and natural sinks with a range of by-products. Fig. 1 provides a stylised picture of the key pathways by which different types of pollutants enter natural sinks from the health care system. Currently, the most-studied aspect of pollution from health care systems involves health care-related greenhouse gas emissions (GHGs). At the aggregate level, estimates of the total carbon footprint of the health care sector have now been produced for high-income and OECD countries, all using broadly similar economic input-output life cycle assessment models and national health accounts. Table 2 summarises the results of these studies for the most recent years available, showing health care GHG emissions as a proportion of total national emissions. The input-output life cycle assessment methods used in these studies also point consistently to hospitals and pharmaceuticals being the expenditure categories which drive the largest GHG emissions in each of the health care systems studied (Eckelman et al., 2018). Indeed, a recent estimate of the aggregate GHG emissions of the global pharmaceutical manufacturing sector suggested that, in 2015, the pharma sector generated more emissions (52 million metric tons of CO₂e) than the global automotive manufacturing sector (46.4 million metric tons) (Belkhir and Elmeli, 2019).

A particularly important contribution has been made by the recent work of Eckelman and Sherman (Eckelman and Sherman, 2018; Eckelman et al., 2018), who have also generated estimates of the damages to human health that US health care emissions are likely to cause. They estimate that, in the USA, health care associated pollution causes the loss of some 405,000 DALYs annually, mainly through respiratory disease related to particulate matter. They project that between 123,000 and 381,000 annual DALYs could be lost globally from the climate change impacts of the US health care system alone, primarily due to malnutrition, diarrhea and malaria (Eckelman and Sherman, 2018).

Another area of health care associated pollution which has attracted research and policy attention in recent years concerns the release into the natural environment of pharmaceutical compounds (e.g. Pencheon and Dalton, 2017; Straub, 2016; Zuccato et al., 2006). Fig. 1 shows some key points at which pharmaceutical compounds can enter the natural environment as pollutants, namely manufacturing, health care delivery, and ultimately via excretion from patients (and from livestock in the case of veterinary medicines); typically, between 30 and 90 per cent of an orally administered dose of most medicines will be excreted by human patients as an active substance (bioS, 2013). The overall risks and impacts of pharmaceutical pollution on the natural environment remain uncertain, but a variety of ecotoxicological impacts have been observed (Donnachie et al., 2016; Whitlock et al., 2018). Impacts on humans of environmental exposure to pharmaceutical wastes are as yet unquantified, but flagged as a substantial concern (Landrigan et al., 2018). However, the strongest impetus driving greater interest in this issue has been considerable concern over the role played by environmental release of pharmaceuticals in magnifying the prevalence of antibiotic resistance, with even low concentrations of antibiotic run-off allowing selection for drug-resistant bacteria (Lancet Planetary Health,

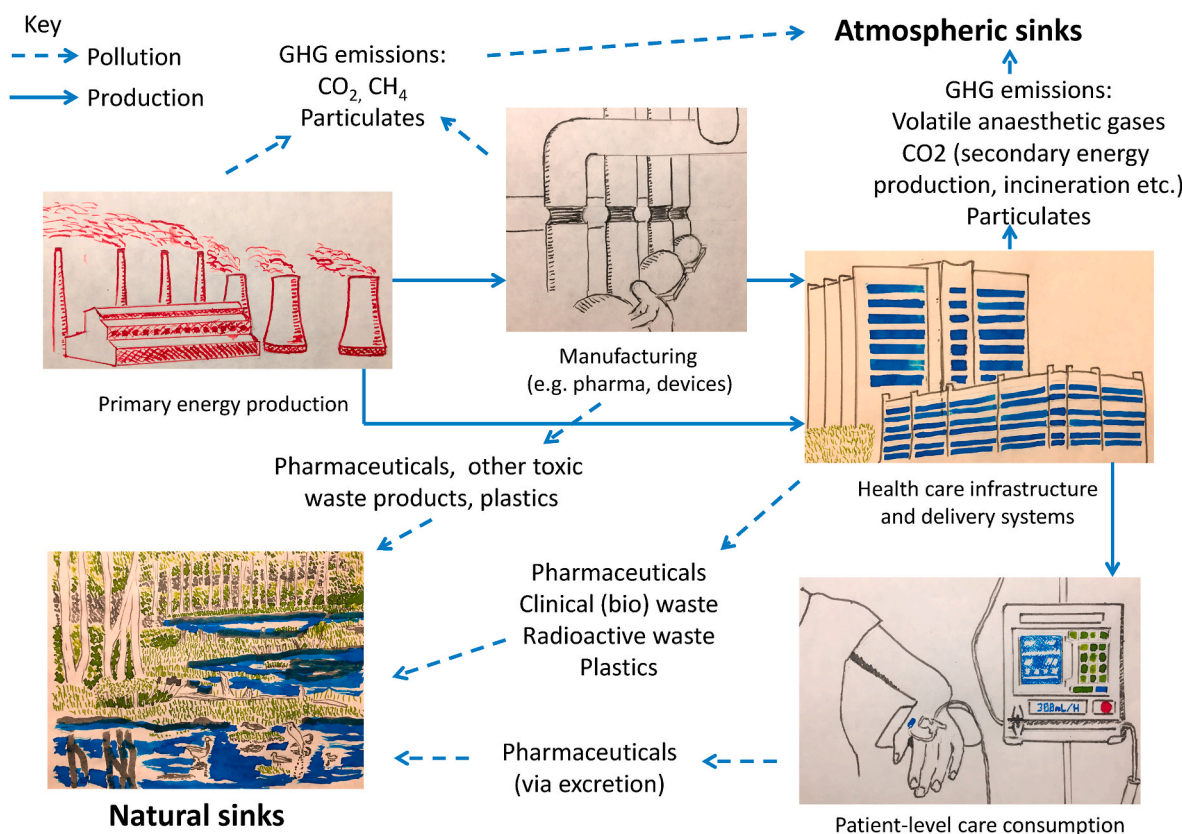


Fig. 1. Environmental impacts of health care production - main pollution pathways.

Table 2

Recent estimates of health care sectoral greenhouse gas emissions as a proportion of total national GHG emissions.

Country	Health Care GHG emissions as % of National Total	Reference
Global	4.4%	Karliner et al. (2019)
OECD plus China, India	5.5%	Pichler et al. (2019)
USA	7.9%–9.8%	(Eckelman and Sherman, 2016; Pichler et al., 2019)
Canada	4.6%–5.1%	(Eckelman et al., 2018; Pichler et al., 2019)
Australia	4.2%–7%	(Malik et al., 2018; Pichler et al., 2019)
UK/England	5.4%–5.9%	(Karliner et al., 2019; Pichler et al., 2019)

2018; UNEP, 2017).

5.2. Antimicrobial resistance

Antimicrobial resistance (AMR) occurs when infectious microorganisms acquire resistance to the drugs that are used to treat them (RoAR, 2014). Antimicrobial resistance has been observed in antibiotics, antiretrovirals, antimalarials and, most recently, against antifungals (Fisher et al., 2018). AMR already exacts a severe burden on human health. The UK Government's O'Neill Review (RoAR, 2014) estimated that, in 2014, some 700,000 people died worldwide from infections resistant to common drugs. Cecchini and Lee (2017) report that some 23,000 and 25,000 deaths have occurred annually in recent years from AMR infections in the USA and European Union respectively.

Yet concern over AMR is also focused on its future implications. Modelling for the O'Neill Review suggested that, by 2050, there might

be as many as 10 million deaths per year from AMR infections (RoAR, 2014) – although these projections were not without their critics (de Kraker et al., 2016). If correct, this would put AMR well in contention to become one of the most common causes of death globally. The World Bank (2017b) estimated that AMR could cause a global GDP loss of between 1.1% and 3.8% by 2050 (but with relatively greater impact on LMICs) – and that this impact would be sufficient to place in jeopardy the achievement of the Sustainable Development Goal of reducing absolute poverty. While harder to quantify, AMR also brings with it the spectre of a “post-antibiotic era”, in which medicine can simply no longer safely undertake many of the procedures which have become routine in modern times (Horton, 2019), gravely undermining even advanced health care systems' ability to offer surgical and cancer care in particular (Smith and Coast, 2013). A failure to counter AMR therefore risks not only direct loss of life, but a wider loss of optionality for the future of medical care, with significant intergenerational implications.

In their review of the evidence on inappropriate prescribing of antibiotics and antimicrobials, Cecchini and Lee (2017) found that up to 50% of all antimicrobials consumed in human health care may have been used inappropriately; across OECD countries, between 45% and 90% of all antimicrobials prescribed in general practice may have been inappropriately used, as were 22–73% of antimicrobials used in long-term care facilities. However, AMR and antibiotic resistance are also driven significantly by widespread agricultural use in livestock, with antibiotics widely used in intensively farmed species as therapeutics, prophylactics and (more controversially) as growth promoters (Woolhouse et al., 2015). In 2005, 760 tonnes of antimicrobials were used in human medicine and 1320 tonnes in veterinary medicine in France (Moulin et al., 2008). In the USA, some 80% of antibiotics are sold for use in animal agriculture, and about 70% of these are from classes of drugs deemed “medically important” for human health (Martin et al., 2015). Various major reviews have concluded that there is convincing evidence that AMR in animal settings is linked to the

development of AMR in human diseases (e.g. RoAR, 2014; Tang et al., 2017), and that any attempts to control AMR must reduce unnecessary use in both humans and animals (e.g. Australian Government, 2020).

AMR therefore clearly displays a combination of unfortunate characteristics. The consumption of antimicrobial drugs today by humans or in animals results in a negative externality – the development of resistant strains with the potential to harm other patients now or in the future (Cecchini and Lee, 2017); this negative externality is then magnified by the high levels of overuse and inappropriate use of these drugs observed in practice. The World Bank (2017b) goes further and describes AMR as a “tragedy of the commons”, whereby collective overconsumption has led to the squandering of a common pool resource (Ostrom, 2005). Containment of AMR represents a global public good to which all nations must contribute, and from which all will suffer if collective action is not taken. Indeed, the global response to AMR has been bedevilled by a further variety of market failure. Efforts to escape the “discovery void” for new antibiotics have been undermined by a number of large pharmaceutical firms exiting the market for antibiotic development (WHO, 2019), citing the high costs of R&D required when set against the limited revenues available from sales of inherently short courses of antibiotics in a market which will shrink if antibiotic overuse is successfully tackled. This market exit has occurred despite concerted efforts to incentivise antibiotic research through prizes, subsidies and special patent schemes (such as the recommendations of O’Neill, 2016).

5.3. The US opioid epidemic

In recent years, the United States has found itself in the grip of an epidemic of addiction and deaths caused by the use and abuse of opioid drugs. Ciccarone (2019) describes a “triple wave” epidemic; a first wave was driven iatrogenically by a tripling of physician prescribing rates for new opioid formulations through the 1990s and 2000s, and gave rise to an illicit second wave of heroin use, followed by a third wave centred on the illegal manufacture of synthetic opioids such as fentanyl (itself a prescription pharmaceutical). deShazo et al. (2018) describe how an initially well-intentioned attempt by concerned doctors to better manage chronic pain was hijacked by false marketing claims which downplayed the risks of addiction to new opioid drugs, and by aggressive direct to physician marketing by pharmaceutical companies. The manufacturer of one of these drugs, the Purdue Frederick Company pleaded guilty to “misbranding Oxycontin, a prescription opioid pain medication, with the intent to defraud or mislead ...” as long ago as 2007 (USDC, 2007). At the end of 2019, more than one thousand legal actions by state and local governments against prescription opioid manufacturers were pending (Siemaszko, 2019). Purdue (makers of Oxycontin) reached a \$270 million settlement with the state of Oklahoma despite denying wrongdoing (Sullivan, 2019), while generic manufacturer Mallinckrodt settled for \$1.6 billion with 47 US states and territories (Kaplan and Hoffman, 2020). A recent lawsuit has for the first time targeted large pharmacy chains for inappropriate actions over opioids (Hoffman, 2020).

The human cost of this iatrogenic epidemic has been enormous. The overuse of legal, prescription drugs within the formal health care system has given rise to a chain of consequences which have caused the deaths of hundreds of thousands of Americans over the last two decades (CDC, 2018). In 2017, an estimated 11.4 million Americans misused prescription opioids, while 2.1 million suffered an opioid use disorder (DHHS, 2019). Gomes et al. (2018) found that opioid-related deaths in the USA rose from 9489 in 2001 to 42,425 in 2016 – and that the burden of this opioid-related mortality in 2016 was equivalent to the loss of over 1.6 million years of life. Official figures showed that this death toll rose further to 47,600 in 2017.

6. Health Care’s contribution to uneconomic growth: A conceptual framework

6.1. Health care overuse and harm cycles

The preceding sections have summarised evidence on the existence and scale of harms from iatrogenic injury and infection, adverse events and poor quality in health care systems globally; on the scale of and the harms from inappropriate and unnecessary overuse of health care; on the environmental harms of health care-related pollution; and on the special cases of antimicrobial resistance and the current opioid epidemic. The incidence of iatrogenic harm and adverse events in health care is sufficiently high that overuse risks giving rise to non-trivial feedback loops. Unnecessary treatment carries with it a finite risk of patient harms; for those patients who suffer those harms, most will then receive further treatment by way of rectification, which will itself carry a non-zero risk of causing further harm, and so on. Fig. 2 illustrates this cycle of harm and consequent defensive activity and expenditure. Patients can enter the cycle either through overdiagnosis or through receiving unnecessary treatment; some proportion of these patients will suffer harm from this unnecessary treatment; treatments will be provided to address these harms, some of which will themselves cause further harm, and/or give rise to further investigations; some of these investigations will lead to overdiagnosis; and the cycle will continue. Welch draws particular attention to the risks of triggering such a “cascade” of diagnoses (Welch et al., 2011). Meanwhile, each point in the cycle generates further environmental costs from the provision of health care interventions. Figure 3 illustrates a similar cycle of reinforcement for antibiotic overuse and drug resistance: antibiotic overuse leads directly to the development of drug resistant strains, and indirectly via increased environmental releases; increasing incidence of drug resistant infections mean that health care acquired infections will become more difficult to treat; more antibiotics will be used to treat them, driving greater resistance etc. This cycle therefore simultaneously undermines the present and future benefits of health care, and inflicts environmental harms through manufacture and release into the natural environment.

6.2. Health care overconsumption and failure demand

The overuse of health care generates internal costs or disutility (harms) for patients, that in aggregate reduce the overall utility of necessary and beneficial health care. At the same time, all health care generates externalised environmental costs; but the component of these environmental costs driven by the unnecessary overuse of health care is wholly unjustified, as it is not offset by any health benefits to patients. Yet every dollar spent on health care counts as a positive increment to GDP. Thus, a perfectly executed knee arthroscopy adds several thousand dollars to GDP, even though it probably provided no health benefit to the patient (Duckett et al., 2015). Yet if that same knee arthroscopy caused a serious infection leading to an intensive care admission for the patient, GDP would have been increased by tens of thousands of dollars, despite having nearly killed the patient. At its most egregious, sales of opioids in the USA registered as positive benefits in US GDP figures, as did the costs of hospitalisation of their victims, and, indeed, the costs to the criminal justice system of dealing with the opioid epidemic as it moved into its illegal phase. When considered in this way, it is easy to see how health care in general, and overuse in particular, represents a specific sectoral contribution to Daly’s macro concept of uneconomic growth (Daly, 2006). Figure 4 sets out graphically a conceptual framework to help illustrate how the concepts and phenomena described thus far relate to each other. Health-damaging overconsumption causes avoidable harms to health, which drive failure demand for healthcare. Meanwhile, unnecessary and/or poor quality healthcare itself causes avoidable harm to patients, driving a further loop of failure demand to rectify iatrogenic injuries.

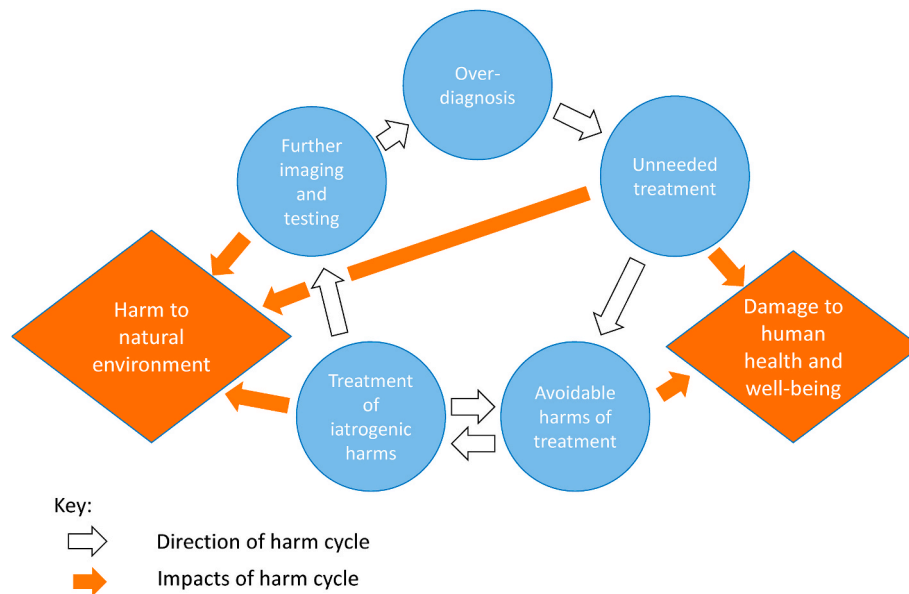


Fig. 2. Harm cycle of overdiagnosis and overtreatment.

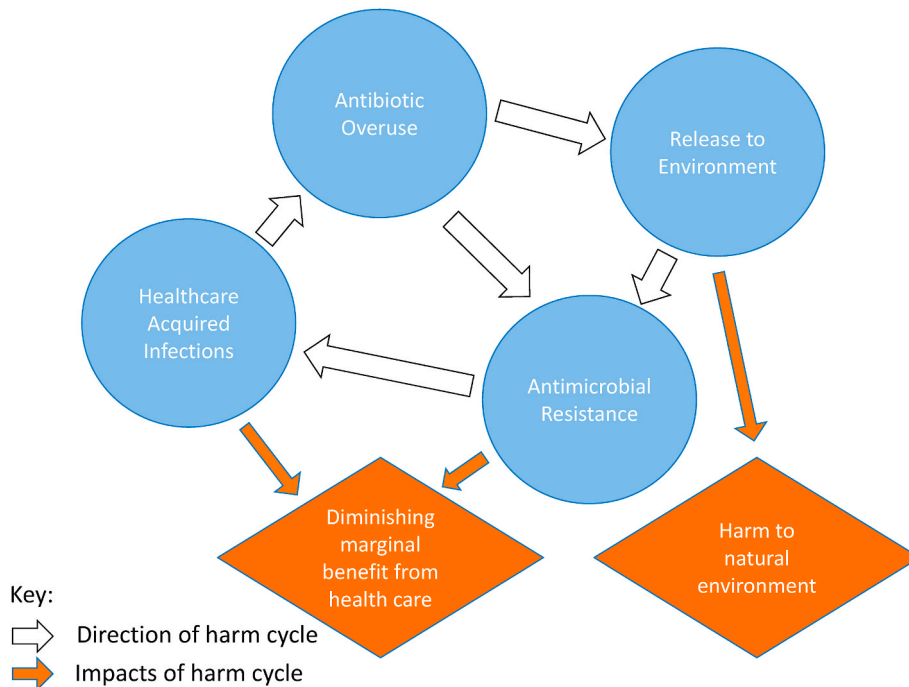


Fig. 3. Harm cycle of antimicrobial resistance in health care.

6.3. Combining the Human and Environmental Harms of Health Care

Finally, Fig. 5 completes the conceptual framework by providing a stylised representation of the relationship between the simultaneous human and environmental harms from health care overconsumption. It represents spending on health care on the vertical axis: with spending on beneficial care as positive quantities, and non-beneficial (welfare decreasing) spending as negative quantities. Meanwhile, the horizontal axis represents the “environmental harm of health care per \$ spent” – a stylised measure of all environmental harms, but analogous to carbon intensity per \$ spent. It is assumed that the environmental harm per \$ spent does not vary between beneficial and non-beneficial care. The total environmental impact of health care can be represented as [total

spending x environmental harm per \$ spent] (or volume x intensity). Total environmental impact of health care can be lowered by reducing the intensity of harms per \$ spent (moving from point A to point B); or by reducing the scale of non-beneficial consumption and spending (moving from point C to point D). The greatest reduction in avoidable environmental harms can be achieved by simultaneously minimising environmental impact per \$ spent and minimising the quantity of non-beneficial care, i.e. by moving inwards from both points A to B and C to D at the same time.

7. Strengths and limitations

This paper has brought together a number of traditionally separate

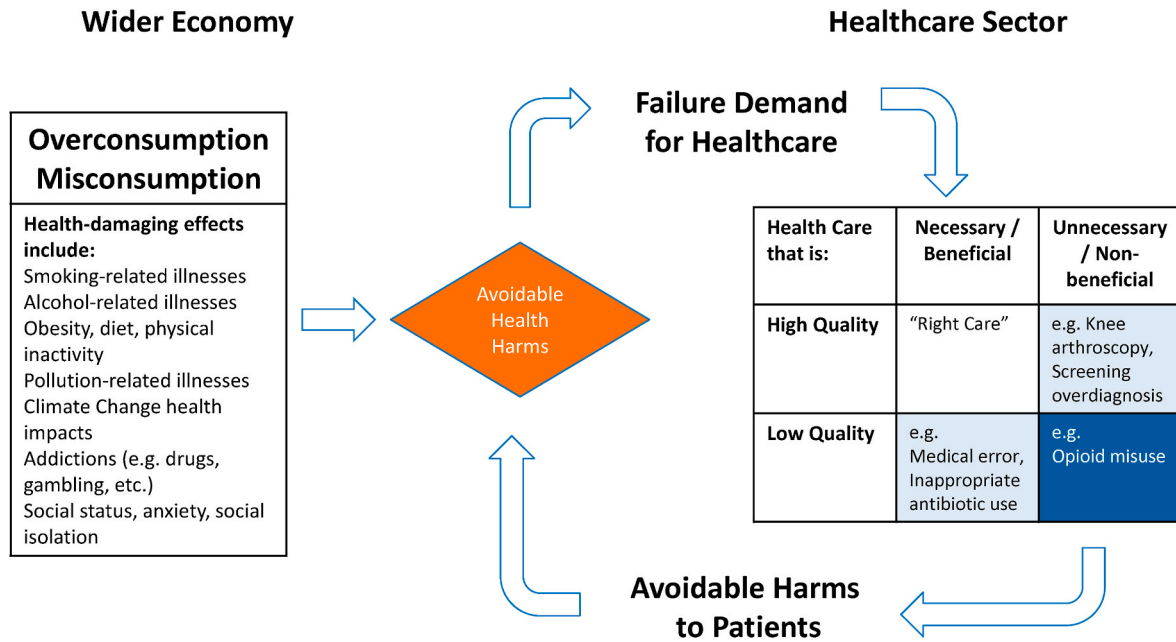


Fig. 4. Conceptual framework for considering overconsumption and failure demand for healthcare.

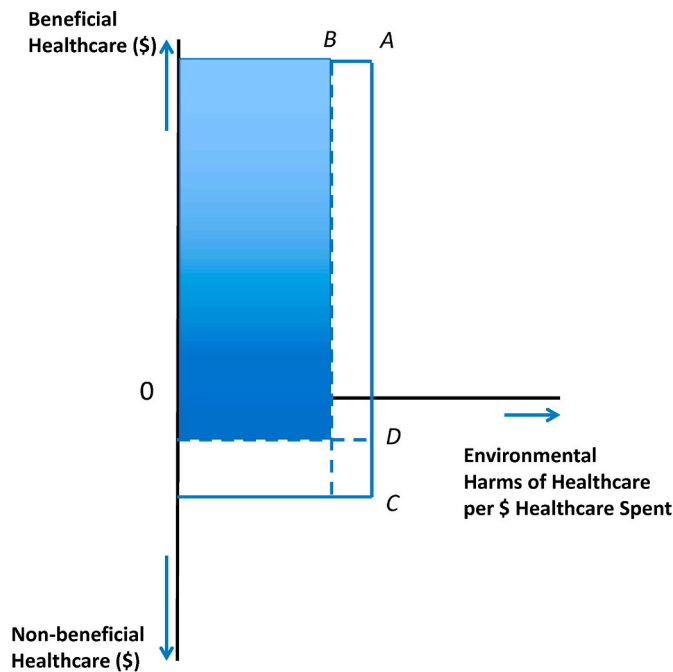


Fig. 5. Combining the human and environmental harms of health care.

streams of research on health care overuse; on poor quality care and its harms; on the environmental impacts of health care; and from the ecological economics and sustainable consumption research literatures on overconsumption and uneconomic growth. It draws them together to develop a novel conceptual framework which illustrates how these phenomena interact, and which provides a starting point for quantifying and, potentially, mitigating the joint harms of health care upon human and planetary health. This conceptual framework also makes clear the mechanisms by which health care contributes to the macro-scale problem of uneconomic growth. This synthesis of evidence from health care and ecological economics thus provides a distinct and novel theoretical contribution in both fields, and establishes a robust point of departure for further interdisciplinary research.

The key limitation of this paper is the fact that it has not undertaken a systematic review of the specific domains it has explored. The literature-based estimates of key variables presented in sections 3 and 4 must therefore be viewed as illustrative only, and not as the product of systematic review or meta-analysis. A further limitation is that, for reasons of space and focus, only limited attention has been paid to the negative health and health care impacts of overconsumption in other sectors of the economy. However, the primary purpose of the paper was to develop a conceptual framework on the overconsumption and harms of health care itself. The framework presented here should assist future research to address more explicitly the combined human and ecological harms of health care overuse. The framework also provides a more explicit logical framework by which to represent how overconsumption and uneconomic growth in the wider economy drive failure demand for health care, allowing a clearer linkage between work on the commercial determinants of health and their impacts on health care systems.

8. Discussion

The traditional culture of medicine in the modern era has essentially been to “do everything possible” for the patient, and often struggles with the idea of “doing less” (e.g. Gawande, 2014). Yet the concept that there is an optimal scale for health care consumption driven by its net benefits (benefits minus risks and costs), and that additional consumption beyond this point displays diminishing marginal benefits and increased exposure to harm, was formalised by Donabedian (1980) in the early days of the study of health care quality and safety. Donabedian’s observation is strikingly consistent with Daly’s overall concern that we refuse to apply any concept of “when to stop” to the overall scale of the economy – despite the fact that uneconomic growth similarly increases risks and harms beyond a certain point (Daly, 1999). Disciplinary boundaries and differences in terminology appear to have prevented the connection being made between health care overuse and the ecological economics and sustainable consumption literatures on overconsumption and uneconomic growth until much more recently (Hensher et al., 2017). Health economists, through the use of cost-effectiveness analysis in formal processes of health technology assessment in a number of countries, explicitly reject the assumption that we should “do everything possible”. Instead, they assume that society’s health budget is effectively fixed at any point in time, and that decision-makers should therefore

allocate this budget across interventions and populations in a way that maximises the overall health benefits to society (Drummond et al., 2015). Yet while health economists possess some of the necessary tools, they have not deployed them very deliberately in the pursuit of identifying overconsumption or in considering the optimal scale of health care consumption (Hensher et al., 2017). More broadly, it is fair to say that cost-effectiveness analysis (CEA) in health care has not typically attempted to account for environmental costs or negative externalities, although some work is now appearing on this topic (e.g. Hensher, 2020; Marsh et al., 2016).

This paper has attempted to synthesise quite disparate sources of evidence on the prevalence and consequences of health care overconsumption. In doing so, it has suggested that more rigorous approaches to estimating the scale of these phenomena might, in fact, be a realistic prospect in the near future. Estimates of the prevalence of health care overuse are becoming more widely available, and consistent methods should be applied to a wider range of countries and health systems. More tentatively, estimates of the scale of direct harm to human health stemming from overuse of health care are also beginning to appear; ideally, more work in this area would use DALYs and follow the framework of the Global Burden of Disease Project (IHME, 2019) to maximise comparability and utility across countries. The initial estimates of the carbon footprints of high income country's health care systems need urgently to be extended (using a common method) to a range of systems across the economic spectrum, including low, lower middle and middle income countries; at the same time, robust approaches to measuring non-GHG related pollution and environmental harms of health care systems need also to be developed and deployed internationally.

The two “special cases” of harmful health care overconsumption – antimicrobial resistance and the US opioid epidemic – also provide stark evidence on the misalignment of incentives which exists under current models of for-profit production by large corporations when evidence of harmful overconsumption arises. The opioid epidemic provides an especially egregious example of corporations continuing to produce and actively market products with very negative consequences for human health. Pharmaceutical companies' exit from the development of new antibiotics is also instructive. Antibiotics are not especially profitable drugs at the best of times, and effective AMR stewardship requires that any new drugs must be used very sparingly. The same challenge – incentivising modern capitalist corporations to invest in new innovation while also selling less of their products is, in some ways, at the very core of the “green growth” concept (Bowen and Hepburn, 2014). Yet if the decision of big pharma to exit the antibiotic market turns out to be the norm, then leaving “green capitalism” purely to market forces may prove to be misguided. Successful green growth – whether in pharmaceuticals or in renewable energy – is therefore likely to require careful and intelligent steering by the state through regulation, incentives and new approaches to open knowledge, intellectual property and innovation (Baker et al., 2017; Perez, 2017).

9. Conclusions

Health care provides a particularly rich set of insights into the phenomenon of overconsumption. The capability to measure the benefits and harms of health care at both the micro and macro scales has advanced to a stage where there is real potential to be able to quantify “overconsumption” quite explicitly. The conceptual framework elaborated in this paper provides a clearer picture of the ways in which health care systems are deeply embedded in a wider “consumptagenic system” and in the processes of uneconomic growth. It also shows how human health and well-being might potentially be improved by an overall reduction in health care consumption, at least in high income countries. Minimising failure demand for health care requires assertive action to tackle both societal overconsumption and the commercial determinants of health, and to tackle overuse and poor quality care within the health

sector itself. The estimates of the scale of harms from health care summarised in this paper are large, as are estimates of the harms from wider forms of consumption. This paper reinforces the conclusion that optimal scale remains a key issue for health care systems worldwide. Yet viewed through the conceptual framework developed here, the main reason to be concerned about societies consuming “too much” health care is not on affordability grounds, but because overconsumption of health care is undermining human and planetary health and well-being. This conceptual framework provides a scaffolding on which more systematic and comprehensive efforts to quantify the scale of avoidable health harms, failure demand and defensive expenditures can be constructed across health and health care.

These large and highly desirable reductions in harmful overconsumption are unlikely to be achievable in practice without significant reductions in income, revenue and profit for some current stakeholders. Other than instances in which resources can be redeployed towards providing essential care where it is currently lacking, reducing failure demand and overconsumption will leave some economic losers within the health care sector – as one person's “waste” (or failure demand) is always another's income (Berwick and Hackbarth, 2012). Yet the structural change to economies that will be required en route to a net zero emissions world will open a window of opportunity for parallel and fundamental structural transformation in health care systems. Reducing health care overuse and failure demand not only improves human health, but is arguably the simplest and cheapest way health care systems can minimise their environmental impacts. Health care systems should seize this emerging opportunity to drive down avoidable and needless harm. As in the transition from fossil fuels to clean energy, there will also be economic losers in the elimination of overuse and harmful care; and, just as with energy, they too should be offered a “just transition”. Yet health care systems should not be squeamish in their responses if some health care actors ultimately prove unwilling to transition away from causing harm and undermining human wellbeing. Once growth has become uneconomic, society's priority must be to reduce harm, whether or not that is convenient for the economic interests who profit from causing those harms.

Declarations of competing interest

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