As understanding grows of the scale of health care’s environmental impacts, so too does interest in measuring and reporting on sustainability as a facet of health care system performance. This article examines important lessons from health care’s long experience with performance and quality measurement and reporting that can be applied to the creation of health care sustainability metrics. Although some large health systems such as Kaiser Permanente have invested heavily in environmental stewardship, in the US the focus of health care sustainability measurement and reporting has typically been on corporate social responsibility and climate risk disclosure. The ability of health care organizations to generate data on and control environmental impacts can be limited by legacy infrastructure and complex supply chains. However, just as in other domains of performance, health care sustainability measurement and reporting must proceed from a clear conceptual framework and statement of purpose. Measurement must reflect strategic goals, instead of letting goals become dictated by ease of measurement. Health system leaders now need to set clear and compelling sustainability goals, invest in internationally comparable metrics by which to measure their success, and embed them in their core business.

The health sector’s contribution to damaging and degrading the natural environment has become increasingly clear in recent years. A 2019 estimate places health care’s global carbon footprint at 4.4 percent of the world’s total greenhouse gas emissions, whereas health expenditure accounts for some 10 percent of global economic output. Health care generates 1–5 percent of total global environmental impacts in the domains of greenhouse gas emissions, particulate matter, nitrogen oxides, sulfur dioxide, increased malaria risk, nitrogen runoff, and use of scarce water. Pollution from health care directly damages human health, with estimates suggesting that it causes a substantial burden of disease. National-level estimates suggest that the health care sector is responsible for between 7.9 percent and 9.8 percent of national greenhouse gas emissions in the US. Some countries are now moving to include their health care systems in their plans to meet their commitments under the Paris Agreement on climate change mitigation. For example, the UK recently announced its commitment for the National Health Service (NHS) in England to become carbon “net zero” by 2040.

Interest is therefore growing in how health care organizations and systems might better measure and report on their sustainability and environmental performance. Health care sustainability reporting aims to build a safe, low-carbon health system through the use of effective metrics. We consider the growing need for better
Health Care Performance And Quality Improvement

EVOLUTION AND APPROACHES Although “performance” measurement and reporting in health care may cover various aspects of health services (for example, patient access, costs and efficiency, and so on), in recent decades there has been an explosion in the use and reporting of measures of clinical and service quality.8 Two principal approaches to the use of performance and quality measures in improving health care have been identified:7 using quality indicators as summative measures of performance for purposes of external accountability or using them as formative mechanisms to support internal processes of quality improvement. There are two basic goals for any performance measurement instrument in health care: promoting accountability and improving health system performance.10 Performance and quality measurement serves many stakeholders with different needs: governments, regulators, funders, purchasing organizations, provider organizations, physicians, patients, and citizens. Objectives for reporting on health care performance and quality have included accountability and transparency (to the public, health care funders, and regulators), supporting improvement within organizations, aligning the objectives of stakeholders and “normalizing” desired behaviors and priorities, supporting and spurring improvement through provision of comparative or benchmarking data across organizations, and incentivizing improvement and value through linking payment to performance. Reporting performance measures may lead to change and improvement through four different pathways:11 change, in which providers use information to improve their own performance; selection, where users or purchasers switch providers based on information; pay-for-performance, where providers are financially rewarded for superior measured performance; and reputational damage, or “naming and shaming” poor performers. Measurement and reporting are two distinct activities: Not everything that is measured should necessarily be reported.

EXPERIENCE AND LESSONS Although a vast literature now exists on health care quality and performance measures, data sources, and statistical techniques, perhaps the most influential conceptual approach to measurement remains one of the oldest: Avedis Donabedian’s typology of measurement across structure, process, and outcome measures.12 Donabedian’s framework concerns the structural context (for example, physical, organizational, and institutional) of care delivery; process, or the actions undertaken by all parties; and outcomes, or the ultimate effects on patients and populations. Years of experience in applying these approaches have yielded important lessons on how best to design and implement quality and performance measurement systems. Tension exists between the use of performance measures for external assessment and for internal quality improvement purposes8 and between the approaches most suited to each of the four pathways of change.11 Performance and quality information is a public good that will not evolve spontaneously without active stewardship and guidance by governments and that requires careful investment and attention.10 System-level performance measurement requires a clear conceptual framework that not only covers all major domains of the health system but also aligns with its objectives, integrates with its information technology systems and data collection infrastructure, captures high-priority but hard-to-measure areas, and is designed for international comparability.10

The Environmental Sustainability Of Health Care

PURPOSE, CONTEXT, AND GOVERNANCE The technical ability to measure the environmental impacts of health care has also grown rapidly. A fast-growing research literature explores the carbon footprint of different aspects of health services ranging from global and national health systems,1 hospitals and hospital services,13 and anesthetic gases14 to individual devices and consumables.15,16 More broadly, a recent study of the global environmental footprint of health care2 for the first time estimated worldwide greenhouse gas emissions, particulate matter, NO2 and SO2 emissions, malaria risk, nitrogen to water pollution, and the use of scarce water by national health systems. Yet this literature is heavily skewed toward greenhouse gas emissions; although several other environmental harms (for example, pollution from the release of pharmaceuticals into the environment) are significant,2 analysis of them lags far behind.17 Moreover, the availability of technical measures (especially those developed for research purposes) should not be confused with their suitability for use as performance reporting metrics. A health care sustainability metric needs to fulfill functions analogous to those laid out above for health care quality measures if it is to be useful, which many technically exact measures might not be capable of supporting meaningfully.

A number of different approaches to environ-
mental reporting in health care already exist internationally, reflecting underlying differences between health systems and the purpose that environmental reporting seeks to fulfill (see online appendix table 1 for a summary).18

**CLIMATE RISK DISCLOSURE** Corporate climate-related risk disclosure has grown rapidly in recent years as key investors have demanded greater disclosure of corporations’ vulnerability to a range of climate change risks. Some large health care providers and insurers and many pharmaceutical, medical device, and supply firms already participate in voluntary disclosure initiatives such as the Carbon Disclosure Project.19,20 The Bank for International Settlements’ Financial Stability Board established a Task Force on Climate-Related Financial Disclosures21 recommending that organizations in all sectors of the economy voluntarily undertake routine disclosure of their climate risk governance, strategy and risk-management activities, and relevant metrics and targets. The International Monetary Fund has recently gone further, recommending the development of global, mandatory disclosures on material climate change risks for corporations in all sectors.22 This approach seeks explicitly to make organizations identify their vulnerabilities to climate risk in the widest sense, not just to report on carbon dioxide-equivalent (CO2e) emissions.

**CORPORATE SOCIAL RESPONSIBILITY REPORTING** US health care may be behind the curve in reporting on sustainability. Emily Senay and Philip Landrigan have described the extent to which large US health care corporations undertake sustainability reporting through their corporate social responsibility reports or activities;7 they found that health care lagged substantially behind other economic sectors in terms of the proportion of corporations (whether for profit or nonprofit) publishing sustainability data. This is important because in the US health care setting, most attention to date has focused on the inclusion of environmental impacts within corporate social responsibility reporting by large health care organizations’ and on corporate participation in sustainability initiatives such as the Healthier Hospitals Initiative.23 Various organizational arguments (for example, the absence of shareholder pressure on health care organizations) have been suggested to explain this finding.7 Others have suggested the existence of a form of “moral offset”—that is, health care organizations’ obviously beneficial healing mission may reduce their sense of obligation to undertake corporate social responsibility or sustainability reporting.24 Yet more than 1,200 US hospitals had enrolled in the Healthier Hospitals Initiative by 2018.25 Jodi Sherman and Robert Lagasse argue that this level of participation in benchmarking and sustainability improvement activities shows a growing level of commitment on the part of health care organizations.25

**PUBLICLY MANDATED REPORTING** One of the most comprehensive approaches to health care environmental sustainability reporting in the world is NHS England’s new Sustainable Health Dashboard.26 This dashboard provides performance data for every NHS provider, clinical commissioning group, and region in England on a range of indicators in the domains of governance; carbon; resources, water, and waste; air pollution; plastics; and adaptation. Unified accountability and funding mechanisms make it possible for NHS England to mandate collection and reporting of these data, with central investment and support provided to establish this system. More typical of international efforts are the more modest reporting requirements for public health services in the Australian state of Victoria. All public health services are required under state government funding policy27 to report a standardized set of environmental impact measures,28 either in their annual report or on a standalone sustainability report.29 Measures include energy use, greenhouse gas emissions, water use, and waste generation, both totals and rates (for example, per square meter of floor space or per patient separation or admission). Clearly, the UK and Australian health care systems display deep structural differences from the US health care system, yet their experience is significant, not least because there have been calls for sustainability metrics to be integrated into Medicare’s Quality Payment Program,30 shifting health care sustainability from a private corporate concern into one of public policy. Perhaps the most salient lesson from the English and Victorian experience is that progress on health care sustainability reporting has grown over time, supported by an organic web of legislation, strategy, and preparatory activities and driven by strategic purpose.30 Appendix figure 1 briefly summarizes some of this supporting legislation and regulations in the case of Victoria,31 showing how the specific public health care reporting framework grows out of the state’s Climate Change Act, which itself is motivated by the Paris Agreement’s international commitment to net zero emissions by 2050.

**ORGANIZATIONAL LEVEL AND UNITS OF REPORTING** The specific objectives of performance reporting have important implications for selecting measurement and reporting approaches. Health care quality reporting, for example, requires quite different approaches at different levels, ranging from whole health systems down to individual services, wards, or clinicians. A
whole health service might generate internal benchmarking reports or performance league tables across multiple units or services, whereas public accountability, pay-for-performance, or corporate social responsibility reporting might be more likely to take place at the level of the whole organization. Health care environmental reporting must consider systematically and logically the most appropriate approach to the scope and level of reporting, driven by a clear strategy.

**Scope Of Measurement And Control**

Measuring greenhouse gas emissions for performance purposes is complicated by the differing ability of individual health care providers or teams to affect emissions incurred along the entire value chain of health care products. Following the guidance of the Greenhouse Gas Protocol, greenhouse gas emissions are divided into three categories: Scope 1, Scope 2, and Scope 3 CO₂e emissions. Each Scope refers to categories of emissions emitted directly by the health service (Scope 1), indirectly from purchased energy (Scope 2), or indirectly from other points in the supply chain (Scope 3). Exhibit 1 describes the allocation of emissions across these Scopes.

The ability to influence different CO₂e emissions Scopes varies significantly between and within health care organizations. For example, an individual clinical service (for example, cardiology) may have little direct influence over Scope 1 or 2 emissions, but they might have significant opportunity to influence decision making over the purchasing of clinical equipment and drugs (Scope 3 emissions). The anesthesiology division might be expected to have considerable say in the choice of anesthetic gases purchased (Scope 1), operating room energy use (Scope 2), and the use of certain supplies (Scope 3). The importance of Scope 3 emissions through procurement (particularly of pharmaceuticals) has been repeatedly emphasized, and clinical services (and even key individual clinicians) might exert significant control over procurement decisions over specific clinical supplies. If control can reasonably be exercised, then the inclusion of Scope 3 emissions from procurement could be measured and reported at the service level, not just the institution level. Yet the measurement of Scope 3 emissions involves the complex aggregation of many products and services across the whole supply chain and presupposes sourcing relevant supplier data.

Electricity is typically the main component of Scope 2 emissions, and most health services purchase their electricity from a local utility grid. Health services could install their own renewable generation capacity or seek to purchase renewable generated electricity from alternative grid suppliers. The sheer size of the health sector (17 percent of US gross domestic product) means that it has the potential to exert significant leverage on energy providers if health systems act in concert. However, the generation source of the local electricity grid is frequently not directly under an individual hospital’s control. In Australia in 2019, only 14 percent of electricity generation in Queensland was from renewable sources, rising to 23.9 percent in Victoria; in contrast, fully 95.6 percent of electricity generation in Tasmania was from renewable (hydro) sources. Thus, a hospital in Tasmania that was identical in every other respect to a counterpart in Queensland would record Scope 2 emissions that were six times lower.

**EXHIBIT 1**

**Sources of greenhouse gas emissions from the health care system, by Scope**

| Greenhouse gas emissions Scope | Definitions and covered activities |
|-------------------------------|-----------------------------------|
| Scope 1                       | Direct emissions from combustion of fossil fuels by the health service to provide energy, including health facility operation (natural gas, liquefied petroleum gas, diesel), fuel use by leased or owned corporate and patient transport vehicle fleet, refrigerants, and medical gases |
| Scope 2                       | Indirect emissions from consumption of purchased energy generated upstream from the health service, including electricity supply, purchased steam, purchased chilled water, and district heating and cooling |
| Scope 3                       | Indirect emissions that are a consequence of the health service but are not directly controlled by it, including upstream: capital works; purchased or leased equipment; purchased consumables, devices, and pharmaceuticals; and purchased services (for example, linen, pathology, data centers); upstream and downstream: buildings leased from private sector (energy use), business travel, staff and visitor transport, emergency and nonemergency patient transport, and embedded retail operations; and downstream: aids and appliances for home-based care and waste management |

**SOURCES** Victorian Health and Human Services Building Authority; Victoria Department of Health and Human Services. Sustainability in Healthcare [Internet]. Melbourne: Department of Health and Human Services; 2019 [cited 2020 Oct 19]. Available from: https://www2.health.vic.gov.au/hospitals-and-health-services/planning-infrastructure/sustainability. **NOTE** Greenhouse gas emissions in Scope include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.
simply by the good fortune of its location. Clarity on what health care sustainability reporting seeks to achieve is essential, as is a clear purpose on the relative priority assigned to improvement or accountability goals. If the purpose of reporting on greenhouse gas emissions performance is to capture a “like for like” comparison of factors under the control of the health service, statistical adjustment for the renewables content of the local electricity supply would be appropriate; doing so would be analogous to using risk or case-mix adjustments in clinical measures to control for differences in risk in underlying populations. If the purpose of reporting is to drive improvement, statistical adjustment for such factors would not be appropriate, in order to sharpen incentives for health services to decarbonize their energy supply.

Priorities For Developing Health Care Sustainability Reporting

The most important lesson from the history of health care quality reporting is not technical but concerns the essential need for reporting to align with and support the strategic goals of the health system.10 Perhaps the best example of strategically aligned environmental reporting to date lies in the explicit nesting of sustainability goals and reporting within the 2019 NHS Long-Term Plan.34 This approach builds on a track record of systematic gains, with the English NHS having reduced carbon emissions by 18.5 percent between 2007 and 2017 and water use by 21 percent between 2010 and 2017.35 These reductions were achieved in no small measure through ongoing central support over a decade for national policy design, local implementation, and consistent measurement practices, driven by the national NHS Sustainable Development Unit. Similarly, Kaiser Permanente has achieved significant success over a long period (including a 29 percent reduction in greenhouse gas emissions between 2008 and 2018)36 and has built on past momentum by establishing explicit strategic goals supported by performance measurement. Tonya Boone37 provides an extremely useful set of case studies on how individual US health care organizations have used local performance measurement to support their sustainability efforts. More broadly, exhibit 2 explores some potentially important areas for the future development of health care sustainability metrics. The exhibit suggests a number of areas that should be high on the agenda of those considering how better to develop systemwide sustainability reporting to support both accountability and improvement.

Exhibit 2 emphasizes the importance of achieving better integration of health care environmental sustainability reporting with reporting on quality and performance. The intimate relationship between poor-quality care, waste, overuse, and poor environmental outcomes is becoming increasingly clear.38 Meanwhile, the moral and public health imperatives for the health care system to minimize the harm to hu-

| EXHIBIT 2 |

Future directions and priorities for developing health care sustainability metrics

| Target areas                              | Areas to prioritize                                                                 |
|-------------------------------------------|-------------------------------------------------------------------------------------|
| Greenhouse gas emissions                  | Clearer framing of strategic purpose and goals for reporting at national, state, health system, and organizational levels and of health care system contributions to overall emissions reduction targets; assessment of highest-priority areas for advancing Scope 3 emissions measurement for both reporting and improvement purposes |
| Health-damaging pollutants                | Identification and quantification of those health care environmental impacts that have the most severe impacts on human health to guide prioritized development of measures of harm reduction |
| Reducing overuse                          | “Double duty” measures that capture the improvements to patient outcomes and environmental impacts from reducing health care overuse |
| Simplified Life Cycle Assessment methods  | Invest in the development of simplified, low-cost Life Cycle Assessment methods and capabilities, allowing rapid and economical expansion of Life Cycle Assessment to support health care environmental impact measurement at all levels |
| Pharmaceutical pollution and waste       | Development of system- and local-level measurement techniques to capture the scale and impacts of pharmaceutical pollution, including manufacturing, distribution, use, and wastage |
| Composite measures                        | Investigate the feasibility and design of composite measures or indices to capture multiple dimensions of health care environmental impact (for example, greenhouse gases, air pollution, chemical pollution, resource depletion) |
| Absolute versus relative measures         | Balanced metric sets that support improved efficiency (relative measures) while also reducing overall environmental impacts (absolute measures) to support “absolute decoupling” of health care from environmental degradation |
| Single-use versus reusable consumables    | Rigorous and comprehensive measures of environmental impacts of single-use versus reusable consumables, drawing on experiences from COVID-19 |

SOURCE Authors’ analysis.
man health it causes through pollution are unambi-
guous. The idea that environmental sus-
tainability should be incorporated as an explicit aspect of quality is not new. The Royal College of Physicians argued that sustainability should be included as a domain of quality in 2011, others have suggested that sustainability is a key dimen-
sion of the population health component of the “Triple Aim” or even that it should be incorpo-
rated as a “Quadruple Aim.” The recent Sustainability in Quality Improvement framework develops the integration of environmental sustain-
bility as a core element of quality and value in health care. Yet these approaches appear to have gained traction primarily in the UK, and the link to sustainability seems not yet to have been accepted as “core business” by the health care quality improvement community elsewhere.

Emerging Lessons For Health Care Sustainability Reporting

**CONSISTENCY AND COMPARABILITY** The development and adoption of measures of health care quality has evolved in a diverse and disparate landscape over the course of several decades. The mandatory reporting approaches emerging in the UK and other jurisdictions with largely public health care systems show great promise, not least because common and consistent standards for data and reporting can be enforced centrally. Yet nonmandatory approaches (such as corporate social responsibility reporting or Healthier Hospitals) can also deliver substantial benefits, especially if stakeholders come together to work toward using consistent and compa-
rable standards and measures. At the same time, national and international comparability is important. The World Health Organization has played an important role in harmonizing data standards and classifications in key measurement infrastructure, most notably the *International Classification of Diseases* and the system of national health accounts. Internationally compa-
rable, validated, and standardized sustainabil-
ity indicators need to be agreed to and imple-
mented by all nations. Whether or not the US remains a member, the World Health Organiza-
tion is best placed to lead this work.

**MEASUREMENT CHALLENGES** An important technical challenge for sustainability and measurement involves measurement techniques, and especially the extent to which it is possible to directly measure key environmental impacts or whether estimation techniques must be used. The rapid growth in health care quality and performance measurement has been possible because of burgeoning digital health care data. Vast quantities of data from health care records, pa-
tient administration systems, and clinical data registries are now available. Life Cycle Assessment techniques (the mainstay for undertaking detailed assessment of environmental impacts at the service or product level) are demanding in terms of expertise and are relatively expensive; environmental impact data across the health care value chain cannot yet be generated organi-
cally. Building management systems, procure-
ment and inventory management systems, fleet management systems, and pharmacy systems all represent sources for automated environmental reporting data, but their full use will require careful, systematic investment in design, stand-
ardization, and verification. System leaders and policy makers need to work together to achieve and invest in this standardization.

**AVOIDING PERVERSE OUTCOMES** Measurement and reporting have been essential components of management and public policy since the nine-
teenth century. Much accumulated experience exists regarding what can go wrong in efforts to measure performance in many sectors. Most important, truisms along the lines of “you can’t manage what you can’t measure” form only part of the story. Equally true is the aphorism attributed to Gen. James Willbanks (referring to the Vietnam War): “If you can’t count what is important, you make what you can count im-
portant.” There is no intrinsic reason why sustain-
ability metrics will not run the same risk; health care systems have proved themselves more than capable of “hitting the target but missing the point.” The potential for unintended consequences exists in all aspects of health care improvement. It is important to include hard-to-measure health care priority areas, ensuring that measurement focuses on greenhouse gas emissions and on other environmental impacts, such as pharmaceutical pollutants.

**POLITICAL CONTEXT** Although this article has highlighted successful examples of sustainabili-
ity reporting in public health care systems, con-
straints of ideology, climate denialism, and ob-
fuscation affect many nations’ public policies. Despite significant achievements by several Aus-
tralian states and territories, the authors en-
countered unwillingness at the federal level to incorporate sustainability during the design and negotiation of the current Australian Health Per-
f ormance Framework. The feasibility of incor-
porating environmental reporting into US feder-
al health care programs and mandates also may remain highly politically dependent.

**Conclusion** We have discussed how sustainability reporting builds on successes and experience in health
care performance and quality measurement. There are always two possible aims for reporting in health care systems—accountability and improvement—but different measures and approaches may achieve one of these aims better than the other. For a performance measurement reporting system to be meaningful or effective, it requires a clear conceptual framework and purpose. The choice of appropriate technical measurement approaches must proceed from this purpose, instead of allowing measurement availability to drive and distort goals. Avoiding undue focus on more easily measurable greenhouse gas emissions at the expense of other environmental impacts is integral. Maximum impact will be achieved by clearly demonstrating how measures of population health, clinical quality, and environmental sustainability complement and reinforce one another.

Health care sustainability measurement and reporting are two decades behind efforts to improve health care quality through measurement. Given the urgency of achieving real improvements in sustainability, health systems must learn rapidly from the best evidence from decades of quality measurement and reporting. Large-scale change must be achieved in a small fraction of the time that has elapsed since Donabedian began studying quality improvement. To make good this deficit, health system leaders need to focus urgently on the following actions: setting out clear and compelling strategic goals for health care sustainability (perhaps guided by the NHS Net Zero approach); devising, adopting, and implementing internationally comparable, standardized metrics (in partnership with other nations and health systems) that are driven by these goals; and firmly embedding these goals and measures within the mainstream infrastructure of quality improvement, performance, and accountability.

The views expressed in this article are those of the authors and do not necessarily reflect the positions of their employers, past or present. No funding was received for this work.

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