Why We Should, and How We Can, Reduce the Climate Toxicity of Cancer Care

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We are practicing in the Anthropocene era: one in which our activities are substantially altering the earth's surface, atmosphere, oceans, and systems of nutrient cycling. In the past year, 2.5 million American individuals were displaced by climate change–related events, such as wildfires, resulting from how we live.[1] For our patients and their families, climate change previously known as an inconvenient truth[2] has become a devastating reality. This reality is compounded by three interlinked related issues that humanity currently faces: climate change, pollution, and biodiversity loss.[3] Today, air pollution, comprising both particulate matter pollution, household air pollution from solid fuels, and ambient ozone pollution, is the largest cause of disease and premature death in the world.[4] Growing anthropogenic impacts on biodiversity have contributed to outbreaks of emerging infectious diseases, increasing the risk of future pandemics. Resolution of this triple planetary crisis is needed if we are to have a viable future on this planet. If we do not intervene, in the lifetime of a child born today, summers will have extended to 10 months, and winters will have shortened to 2 months.

As health care professionals in Ireland and the Netherlands, we are concerned about what these changes mean to our patients and also how we might inadvertently be contributing to the crisis. As clinicians, our daily reality of dealing with acute issues promotes clinical tunnel vision in which chronic issues are deprioritized. This is compounded by a lack of knowledge and skill in sustainability integration.[5] How do we reconcile our duty of care to patients with our duty of care to the planet? What would reconciliation look like? Would our efforts make any difference? The magnitude of the problem appears overwhelming, but in our professional lifetimes, we have witnessed transformational positive change in cancer care that would have been inconceivable previously. This was achieved by a combination of both individual and collective action. The current crisis is more multifaceted and nuanced, but the longer we wait to address it, the greater its effects. Analogous to cancer care, the larger and more diverse the community that is engaged in sustainability integration, the greater will be its benefits. If we keep admiring or ignoring the crisis, we will fail our patients and our families, particularly our children's generation and beyond.

To date, our Anthropocene era has seen significant advances in modern health care and, consequently, improvements in life expectancy. It is clear now that these advances come at great collateral cost to the environment and paradoxically to human health. As highlighted by the ASCO's Climate Change Task Force, modern health care's climate impact is substantial.[6] It is a major polluter, responsible for more than 5% of all global emissions and accounting for 4.4% of greenhouse gases, 2.8% of particulate matter emissions, and 3.4% of nitrogen oxides. Health care's climate toxicity extends from manufacture to transport to procurement to infrastructure and to data storage. Our modern health care advances would not be possible without plastics, which is the signature material of our age. However, the manufacture of all plastics accounts for 8% of global oil production, as oil is used as a feedstock for plastic and as a fuel in the manufacturing process.[7] The negative impacts of this enterprise include environmental injustice to those involved in plastics manufacturing who develop higher rates of cancer and to children living in fenceline communities near manufacturing facilities who suffer higher rates of leukemia.[8] Globally, 2% of plastics by value are used in health care, a rate that is rising by 6% annually. Current and future pandemics will accelerate this trend.

Where the need for sustainability integration in health care has been acknowledged and embraced, it has been shown to be effective. Similar to how we have transformed cancer care,

a unifying theme in these initiatives has been both interdisciplinary and patient involvement. The UK's National Health Service was the first to commit to net zero emissions and has demonstrated that positive disruptive change is feasible and successful.[9] Contemporaneous with these sustainability developments has been the growth of the Choose Wisely campaign,[10] which has focused on reducing unnecessary tests and treatments. Patient and public engagement was integrated to determine what drives demand for these interventions. This campaign resonates with the need for improved stewardship of health care use as a climate responsive strategy and serves as an exemplar for multistakeholder engagement. An additional unifying theme of all of these initiatives is that they have cascade effects in that less climate toxicity also leads to less time and financial toxicities for patients and society.[11]

As oncologists our most significant sustainability touch point is prescribing systemic anticancer therapy (SACT). To create a more environmentally sustainable clinical environment we need to reduce, reuse, recycle, and reflect. Where the evidence justifies a switch, the oncologist should consider less frequent visits and longer treatment intervals, switching from intravenous to subcutaneous or oral options when available, and ensuring that we are only treating when this is consistent with evidence of benefit and the patient's informed preferences. To integrate climate engagement into medical oncology practice, Lynch et al[12] reviewed 333 SACT protocols in a national formulary for impact reduction strategies such as tests and investigations, premedications, de-escalation, and clinical benefit. More than 700 opportunities were identified through, for example, consolidation or switching to oral equivalents, vial sharing, dose banding, or extending treatment intervals. Substituting oral for intravenous therapy is one of the most impactful interventions in this analysis. The production, administration, and disposal of intravenous medication has a considerably increased carbon footprint over oral medication, including single-use plastics required for administration and staff time to administer.[13] A UK-based study found that oral paracetamol (acetaminophen) had an almost 70 times smaller carbon footprint than intravenous paracetamol in glass packaging and 45 times smaller than intravenous paracetamol in plastic packaging.[14] This does not include the emissions associated with the manufacture, storage, or associated equipment required to administer intravenous medications. Replacing subcutaneous with intravenous formulations and extending treatment intervals has similar benefits. An additional 507 opportunities were identified by coordinating ancillary testing.[12] Integrating telehealth in lieu of in person visits also represents an additional sustainability touch point. An infographic was developed to prompt these and other sustainability measures and facilitate their dissemination on social media platforms, in e-newsletters, and as computer monitor wallpapers in the hospital (Fig 1, and Data Supplement, online only).

Our current prescribing practices are linear rather than circular. Unused agents are disposed of with no potential for reuse. Drug wastage accounts for 4%-18% of all cancer drug spending in the United States[15] and mitigation strategies have been shown to reduce drug spending by up to 17% and reflect a significant, potentially modifiable, climate touch point. Smarter formulations to facilitate dose adjustments and increasing product stability would also reduce waste. For patients who receive oral anticancer therapy, drug wastage is experienced by 25%-41% of patients and in those who discontinue treatment unexpectedly, 46%-85% have leftover doses.[16] Drug repositories, such as the Wexner Medical Center Oral Oncology Drug Repository Program, are now being established to facilitate the donation of leftover medications to uninsured or underinsured patients.

In considering the choice of SACT, the potential value of systemic therapy should also be considered. For patients with advanced malignancies, overtreatment can result in reduced quality of dying.[17] Deprescribing and reducing polypharmacy has been demonstrated as an opportunity to improve patient quality of life, reduce health care costs, and therefore also limit climate impact of patient care.[18] The European Society of Medical Oncology Magnitude of Clinical Benefit scale is a framework developed to grade the degree of clinically meaningful benefit associated with anticancer therapeutics.[19] In the noncurative setting, scores of 4 or 5 on a scale of 1-5 are considered to have a substantial benefit, and in the curative setting an A or B rating, with ratings A-C, is considered to be of substantial benefit. The addition of such information to SACT protocols could prompt the prescriber to reconsider their approach in such cases and integrate greater therapeutic humility into our practices. Incorporating sustainability measures into accreditation programs such as ASCO's globally established quality programs would facilitate their wider integration.[20] These guidelines emphasize co-ordination and integrating care pathways and consequently reduce the time and climate toxicities of cancer care.

For patients, a cancer diagnosis is often a time to reflect and readjust. As clinicians, many of the lifestyle medicine recommendations that may be timely for them to receive which is included in health guidelines[21] have added climate benefits. Our food consumption is one of the most important touch points for impact on climate change. Food systems are the single largest driver of environmental degradation.[22] They produce 30% of all greenhouse gases, use at least 70% of the Earth's freshwater, and are the leading driver of biodiversity loss and nutrient pollution. Meat-centric diets account for 14.5% of greenhouse gases. Shifting to a plant-based diet is one of the single largest climate change impacts we could integrate into both our professional and personal lives. It would also align meat, dairy, and egg consumption in line with health guidelines.

At an institutional level, leadership is required. A unifying theme of successful initiatives such as Choose Wisely has

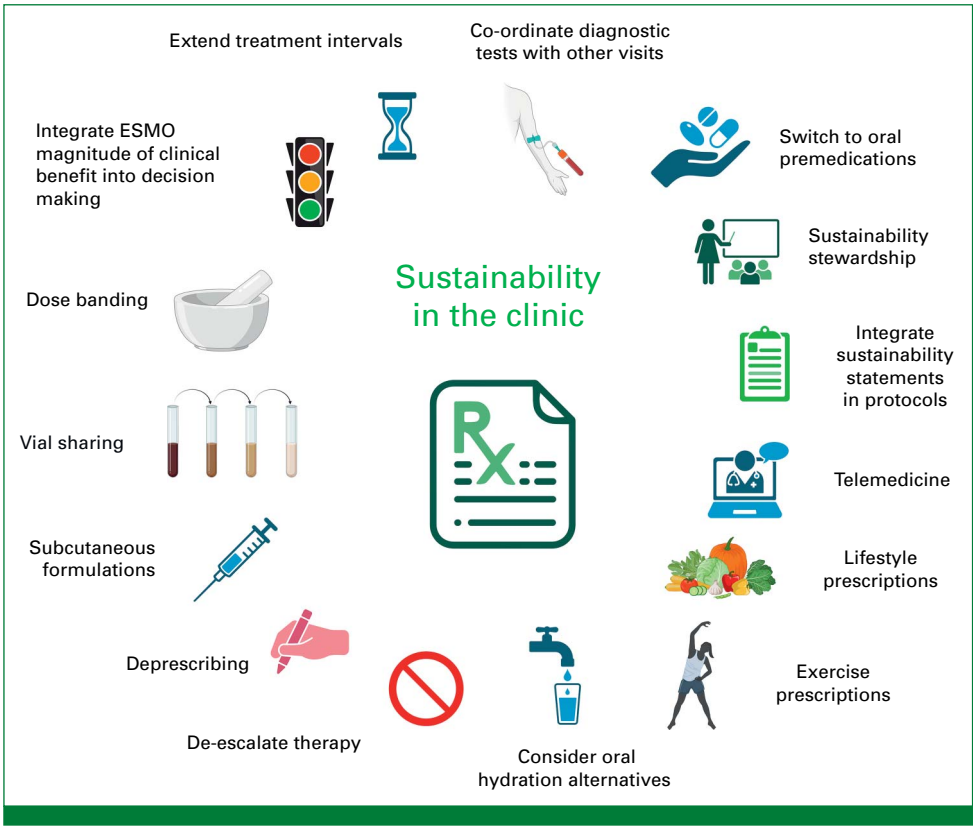

FIG 1. Green prescribing in oncology. ESMO, European Society for Medical Oncology.

been the stewardship of resources, the presence of champions who have promoted these initiatives, and patient and provider engagement. In health care antimicrobial stewardship, pharmacists and infection control officers reflect the threat to patients of infectious diseases. The reality of our Anthropocene era is that we need similar sustainability officers employed at our institutions to steward how we practice and facilitate integration of initiatives.

Biomedical cancer research guides cancer care. Grant applications associated with research projects routinely include a forensic assessment of the financial cost of the proposal. By contrast, the environmental cost is usually not assessed. A recent workshop forum, jointly hosted by the Academy of Medical Sciences, the Medical Research Council, and the National Institute for Health and Care Research, has highlighted four key challenges to enabling greener biomedical research. These include prioritizing sustainability, generating and disseminating evidence on environmentally sustainable research practices, accelerating the introduction of environmentally sustainable practice in research, and promoting behavioral change.[23] The development of a carbon foot print calculator for clinical trials allows investigators to assess the magnitude of trial interventions and activities, identify the key drivers, and identify opportunities for foot print reduction.[24] Such studies have demonstrated that fully decentralized digital trials can reduce the carbon foot print of a clinical trial by up to 90%.[25] The decentralized clinical trial model arose out of necessity during the COVID-19 pandemic and significantly reduced travel to major centers by treating the patient close to their home.[26] These developments are concordant with initiatives to streamline clinical research, reducing the over 3 million data points collected in an average randomized clinical trial to more pragmatic and affordable designs.[27] They also resonate with research focusing on less intense, but equally effective, treatment schedules. Cancer clinical trial organizations are critically placed to take a leading role in mitigating the climate change impact of health care. Their focus on interdisciplinary work such as translating laboratory-based discovery into clinical care integrates them with a community where climate smart initiatives such as My Green Lab are already successfully embedded.[28] If significant progress is to be made in climate toxicity mitigation, Institutional Research Boards and funders should also consider requiring environmental impact reduction measures in protocol documents analogous to how funding organizations mandate gender equality statements in grant applications.

Life is led looking forward but appreciated looking backward. In 2014, the Nobel Laureate Daniel Kahneman described climate change as a problem the mind is not equipped to deal with, a distant problem that requires sacrifices now to avoid uncertain losses far in the future.[29] Today, a decade later the problem is no longer distant. The magnitude of our losses are

clearer and nearer. The inconvenient truth is that while *what* we prescribe can positively transform lives, *how* we prescribe is negatively transforming the environment, compounding patient suffering. We are not observers in the climate change equation. We are integral parts of it. Our North Star as a caring profession is improving cancer care for our patients. We will not reach this star for them unless we integrate climate awareness into their care.

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