Abstract

Medical professionals are often on the front lines of the complex interaction between climate change and health, putting them in a unique position to be intermediaries in interventions using a co-benefits approach. A 2017 study conducted by Wynes, Kimberly, and Nicholas provides a framework to explore four specific individual actions that have the greatest decrease of carbon emissions: 1) having one fewer child, 2) living car-free, 3) avoiding air travel, and 4) eating a plant-based diet. This paper explores the environmental drivers, health benefits, and barriers of these actions to provide doctors with the tools to identify patients who may be more open to these recommendations and how to approach the topics. The impact physicians have on individual behavior has the potential to scale these actions to a level that will have significant impact. Implementation of climate and health identification strategies into medical school curriculums, in conjunction with physician advocacy, would create a bottom up approach that could promote social and political change through community education.
Introduction

Health has been a rising concern as the interest in climate change spreads. Global cooperation on the subject has led to the creation of both the 2018 IPCC Report and the 2019 Lancet Commission Report which discuss economic and health issues impacted by rising sea levels, increased temperatures, and increased frequency of extreme weather events. There has been a large public knowledge gap when it comes to drawing ties between climate and how it affects personal health. In a 2016 survey, 62% of people recognized a longer lasting allergy season, but fewer attributed it to climate change. Only around 25% were aware of climate and health risks, but few could correctly identify links between climate and specific health outcomes and even less could correctly identify links.

For example, rising temperatures would put more people at risk for heat related illness, or sometimes even heat related death. Longer lasting warmer seasons will prolong pollen in the air, increasing upper respiratory diseases. Temperatures and rainfall patterns affect ecosystems and agricultural seasons, in turn affecting food accessibility leading to malnutrition for certain populations. An increase in the frequency of natural weather events can cause severe destruction to countries, forcing immigration around the globe and increasing the prevalence of infectious diseases, injury, and mental stress. If not addressed, these seemingly long term problems will exacerbate each other and stress the health system beyond capacity simultaneously with the rise of chronic diseases.

The lack of association between climate and health in the public sphere has increased studies on behavioral shifts and risk perceptions of climate change in teenagers since they are more likely to deal with climate change consequences throughout their lives. Focusing on educational guidelines for adolescent individuals does show potential in providing a bottom up intervention,
however it is important to look at how the parent-child relationship plays a large role in childhood perception and motivation in seeking out information on climate change. This means educators’ opportunities to recommend climate actions to students can also translate into education for their parents and other adults in the community to influence personal behaviors of all members of a household. To reach that audience, it may be beneficial to look at interventions that can be carried out by those in the medical field through investments in comprehensive medical school curricula and educating doctors on co-benefit approaches. Studies have uncovered that a majority of people trust health information from their primary care physician, which puts health professionals in a unique position to work on a local level to mitigate climate change through influencing their patients’ personal and social behaviors for the benefit of the future.

**Background**

Concerns about climate change have been around since the beginning of the 19th century. It is only in the past forty years that advocacy has gained exponential momentum, encouraging countries to work together in various ways, such as the formation of the United Nations Framework Convention on Climate Change in 1992, Kyoto Protocol in 1997, and the Paris Agreement signed in 2014. On an international level, many have praised this movement’s efforts in lowering greenhouse gas (GHG) emissions through extensive regulation. In this new decade, however, few countries have actually achieved their target goals. The global reliance on fossil fuels and rollback on current climate policies remain key barriers, especially when trying to scale interventions for these problems in more densely populated countries. Dissemination of information and misconceptions also challenges the effectiveness of these agreements, evident in the rise of natural gas fields being built despite them not being compatible with the climate goals. It may be time to
take a step back from the global comparative approach and revisit public health priorities that are better suited towards specific geographical regions and populations.

On a national level, leaders have taken steps in creating more comprehensive policies that are better suited for their own areas. However, climate response plans tend to focus only on emissions in regard to mass transportation, land use, building codes, and attempts to lower reliance on cars.\textsuperscript{8,9,10} It seems that over time the heavy association between climate and policy has diminished the root of the problem: the fact that the environment is inextricably linked to human health. In order to reinstate health as the focal point, it makes sense to gain insight from doctors as expert witnesses on the topic. A more local movement within local healthcare institutions would deepen public understanding of climate change effects on health.

Organizations like ecoAmerica have created guides like \textit{Let's Talk Health & Climate: Communication Guidance for Health Professionals} to discuss the influence physicians have in the words they use to talk about climate change.\textsuperscript{3} The problem arises that while patients might have more trust in their doctors, the doctors themselves are not always prepared to convey such messages or may not know how to frame the link between climate and health. While the ecoAmerica guide focuses on the technical language used, physicians still need the means to identify which recommendations, key words, and phrases should be utilized for specific patients, which is where studies on adolescent educational materials come into play.

\textbf{Individual Behavior}

A challenge for many people with regard to being more environmentally conscious is the plethora of recommendations coming from a multitude of sources, sometimes conflicting with each other or given without prioritization. In a study done by Wynes et al., a majority of the recommendations given by current educators and educational tools to a rising generation are not
enough to curb the rise of the Earth’s temperature below 2 degrees celcius. The paper is an analysis of several high school textbooks from the U.S., Australia, Canada, and the European Union (EU), examining which individual behaviors were mentioned and gauging their impact by the amount of CO2 reduced. The actions are then labeled as either low, moderate, or high impact. Lower impact actions included minimizing waste and planting a tree, while moderate included use of solar panels and conserving energy.

High impact recommendations include purchasing green energy and reducing effects of driving or buying a more efficient car. These two are the only ones in this category that are mentioned in all four textbook groups. The other high impact recommendations, and the ones focused on in this review, are the following:

1. Having one less child
2. Living a car-free lifestyle
3. Avoid air travel
4. Taking up a plant-based diet

Despite the sense of urgency to lower global carbon emissions, it is obvious that these actions come with mental, physical, and socioeconomic challenges that make them difficult to follow. Although low impact actions may be mentioned more due to frequency and convenience, the ‘positive spillover’ of environmental concern through simple actions is still barred by limited uptake on a large scale. In order for carbon emissions to be significantly lowered by individual choices, higher impact actions by more people would be needed to overhaul the compliancy of green movements that society has been lulled into, such as the continual use of the phrase ‘reduce, reuse, and recycle’. While this motto is helpful for creating environmental awareness, the higher impact actions have much more measurable outcomes.
By educating medical professionals on the benefits of these actions, this intervention goes to a more personable source of public knowledge outside of educational or government issued textbooks. However, for this intervention to last, the importance of trust must be stressed. The trust that has been placed in doctors for medical advice is very nuanced; any advice outside a patient’s personal expectations may cause negative outcomes. As patients are not required to reciprocate the same level of trust, this asymmetric information system means that there is no incentive for patients to maintain a practical physician-patient relationship. In the field of climate science, this makes recommendations a complicated issue as physicians may not wish to take the risk of alienating their patients by referencing climate change in ways that do not align with patient beliefs. Educating medical professionals while they are in medical school would provide interdisciplinary support and investment from both policymakers and climate scientists that would strengthen public knowledge. Along with the recommendations, the change in curriculum could include advocacy training to prepare them for integrative preparation in being the voice of the medical professionals and the communities they serve.

Although the Wynes article was limited to school textbooks only offered in the EU, U.S., Canada, and Australia, other studies have been included in this review. Doctors may be dealing with adults of different cultural and economic backgrounds, so having broader knowledge of the recommendations would better support their capacity to identify and advise patients. Cultural, social, and economic differences are also factors that may influence adherence to recommended changes in individual behavior. However, the climate actions are intended to be broad enough to be relevant in other countries, not only in the U.S., since international cooperation will be needed to scale these behavioral changes enough to make significant impacts.

**Recommendations**
Wynes’ high impact recommendation study is more focused on educating younger generations about changes they can make in their lives to mitigate individual carbon emission levels. However, physicians offer another point of intervention since they have the opportunity to communicate with patients about how their health is impacted by the environment and the responsibility required to take care of bodily and natural systems. Although knowledge on climate is not normally expected of a medical professional, it may be more well received by the patient if advice is given through a co-benefits approach. Through this method, patients would be informed how key changes in their daily lives can improve their health status while simultaneously benefiting the planet.

This review looks at the climate impact, health benefits, and barriers in order to provide physicians with a resource to identify adult patients who may be open to these kinds of recommendations. There may also be moments where physician advocacy could supplement the educational suggestions. The threat of climate change is becoming more severe, so it is time for doctors to take the next step in talking to patients about more challenging climate change actions. There are many factors that influence a patient’s decision, but physicians should have the training and background to properly promote these measures.

*Having One Fewer Child*

Wynes explores the concept of carbon emissions through reproduction using a study conducted by Murtaugh and Schlax (2009) which claims that carbon emissions extend past an individual lifetime through generations in what is defined as ‘carbon legacy’. This concept has garnered critical response about whether offspring should be held accountable for their parents actions and whether the calculations are appropriate for the situation. Even the term ‘having one fewer child’ raises questions about what constitutes one less child as that can change between
cultures and may even harm mental health due to the troubling, often racist and classist, history of population control.\textsuperscript{14} This also disregards couples who may feel pressure to have no children at all. While this might not have been the intention in using this particular phrasing, on a global scale there may be more interested individuals if the issue is framed as reproductive health and family planning in relation to climate.

In terms of carbon emission measurements between child and childless households, a 2020 Swedish study concluded that a childless household has significantly lower carbon emissions compared to ones with children, although this may look different in other countries.\textsuperscript{15} This result was attributed to the effect children have on household emissions as parents tend to use carbon-demanding goods out of convenience, such as using meat based premade dinners due to higher prices of meat substitutes or higher transportation emissions in order to get more people where they need to be.\textsuperscript{15} The Swedish study also factored in that adults who have children are adding to population increase which can stress environmental resources and increase future carbon emissions.

Another factor that doctors should consider is that unplanned pregnancies are a problem in countries where women do not have access to proper contraceptives.\textsuperscript{16} This then contributes to the increase in populations which is a driver for climate change.\textsuperscript{17} A 2010 review conducted by the Lancet proposed strategies to reduce GHG emission by investing in policies supporting education for women and access to contraceptives.\textsuperscript{18} This interdisciplinary issue is where physicians play an important role in being able to disseminate knowledge to provide adults with proper counseling in reproductive health and emphasizing how a cleaner planet through responsible contraception use is beneficial for future generations.
Family planning is a vital aspect of reproductive health, especially for women of childbearing age. In several studies, shorter birth spacing has been correlated with increased mortality rates for neonatal, infants, and children. Contraception use is also valuable for positive outcomes in life expectancy and dependency ratios of maternal and newborn health. These health risks are important for patients to know, as women with lower birth spacing tend to be from the poorest wealth quintile and have lower education.

It is imperative that with this specific topic, doctors are careful to keep human rights in mind as it should be the patient’s decision whether or not to have children. Birth spacing is a simple way to talk to patients, especially in lower income groups, and may not necessarily need to include climate co-benefits as the health benefits may be enough to support this advice. Patients who may be more open to discussing reproductive health and climate are those interested in family planning. Physicians may be able to talk about how parenting can potentially influence attitudes on climate as most people would be interested in conserving a healthy future for their children. Doctors can also adapt this recommendation to educate women about the proper use of contraceptives, although this may have more political and mental barriers where more research is needed.

While patient knowledge is important, better access to contraception is a policy that doctors could work on to generate support for social shifts from both the general population and health professionals. This could help sway policymakers to both improve maternal and child health and mitigate future burdens from climate change. The action of having one less child is by far the most complex of the four high impact recommendations studied by Wynes, but a humane approach, broaching the subject with interested patients and providing professional support for birth control, may be the catalyst needed to create a more sustainable health system.

Living a Car-Free Lifestyle
Personal car use bears a significant amount of blame for contributing to GHG and pollution through the use of fossil fuel. This has led to more cooperation between public health workers and urban planners in attempts to create mutually beneficial areas for both the public and their environment.\textsuperscript{21} In the educational textbook circumstance proposed by Wynes, this recommendation may influence adolescents and their future energy and transportation decisions. However, the role of doctors is not quite as clear.

Car-free living has attracted a growing audience over the years, with more studies exploring how this lifestyle could be implemented on a city scale.\textsuperscript{22,23} Data has shown that in areas of cities with less to no cars, there are a host of environmental benefits such as decreases in GHG, noise pollution, and air quality.\textsuperscript{21} These environmental arguments for a car-free city have gained strong support for policymakers to make this a reality, which some European cities have already begun.\textsuperscript{22} The international prioritization of cities examining this recommendation as a factor to mitigate climate change also has added health benefits, making it more appealing.

In a 2016 review conducted by Nieuwenhuijsen and Khreis, car-free literature in cities around the world showed potential to promote mental, social and physical health.\textsuperscript{22} One of the major environmental impacts on health is air pollution, which has been a rising public health problem known to exacerbate health issues including respiratory diseases, infections, allergies, and pregnancy disorders.\textsuperscript{21,24} Noise pollution has also been associated with adverse birth outcomes as well as high blood pressure and cognitive effects in children.\textsuperscript{21} Car-free open areas also increase physical activity which can lead to more social cohesion.\textsuperscript{21}

Car-free areas have the potential to improve health outcomes and social change, especially in neighborhoods of marginalized populations.\textsuperscript{21} The problem is that most of these studies are mostly written for an audience of politicians, to inform and maybe sway potential laws and city
regulations. This is where doctors can step in to help educate the general public on the co-benefits of a car-free lifestyle to initiate possible grassroots movements that could garner political support for such policies.

The most challenging barrier to a car-free lifestyle, however, comes up when socioeconomic status is taken into account. When giving out recommendations like this, it is important to understand the difference between car-free and car-less, something distinctly separated by income level and prioritized differently in urban and rural communities. There may also be significant cultural and political differences in attitudes towards governmental regulations between countries that could be a topic for further research.

Demographically, car-free lifestyles are clustered in urban populations, which may not make this recommendation feasible for rural patients. It is also important to note that alternative options for car-less people, like public transportation, still pose adverse health outcomes from environmental exposures in the air, especially in enclosed transit stops. This shows a need for better air policies, but it may also present an opportunity for open dialogue with lower income communities as to how they can play a role in advocating for car-free areas to improve their own health. Since car-related health issues like pollution impact a wide variety of acute and chronic diseases, doctors could include a recommendation to seek out car-free areas into their checkups or appointments to introduce such ideas to the general public. Physician advocacy can also have huge influence on policies which, along with the ability to educate more people about the co-benefits, can spur movements in cities to make a car-free lifestyle more accessible.

Avoid Air Travel

With the rise of globalization there is an increase in the use of transportation technologies like airplanes. Planes have been shown to have high carbon emission levels and are estimated to
contribute up to 22% of global emissions by 2050. The elevation of these emissions can also lead to damaging effects such as increased smog and cloud formation, trapping higher levels of GHG. These long term environmental consequences have often been minimized or even disregarded due to economic progress. Less flying could postpone these complications, also decreasing acute problems such as the noise pollution in communities surrounding airports. While these environmental impacts have struggled to sway policies, recent studies are looking at combining climate and health benefits to create stronger drivers to alter individual flying behaviors.

Due to the confined space and proximity of passengers during air travel, there are much higher risks of increased transmission of waterborne, foodborne, vector borne, and zoonotic infectious diseases. Through various case studies of past flight-related outbreaks, modes of transmission such as airborne, droplet, vehicle, and fecal-oral pathways have played significant roles in spreading disease. Flying less would decrease these risks, as well as lower the anxiety that passengers may feel about potentially contracting a disease.

Positive social and mental health outcomes are also being studied in hopes of deterring excessive flying. As a large portion of the demographic for frequent flyers is those traveling for work, studies have shown that an increased number of nights away from home is associated with feelings of depression and anxiety that may be alleviated with less air travel. If workers choose to stay home, this could also provide important social bonding between families and strengthening of interpersonal relationships. These health benefits extend beyond personal health and wellness and may strengthen motivation for a patient to consider flying less.

One distinct difference in this recommendation compared to the others is that economic status plays a much larger role in the target population. Frequent flying is positively associated with higher income. Studies have already revealed an unwillingness to fly less, even among those
with high levels of environmental awareness. The convenience of air mobility makes it hard to change attitudes for environmental reasons, as travel time with flights is much faster than other forms of surface transportation like cars or trains. These advantages, alongside income factors, may have higher mental barriers when recommending less air travel and would require more research into the drivers of air mobility.

The growing potential for planes to contribute to climate change and health outcomes is a unique chance for doctors to take a co-benefit approach to connect the long- and short-term effects of flying. It may be to the physician's advantage to specifically target patients who frequently fly for work, as there is more literature on this group. While environmental reasons may have lower risk perception in the minds of frequent flyers, the addition of health co-benefits may appeal more to their self-interests. There may also be opportunity to work with environmentalists in advocating for flight regulations, however this may encounter more economic challenges.

*Eating a Plant-based Diet*

Increased population and more people to feed have led to studies like the EAT-Lancet Commission, which attempts to calculate the effects of diet on the surrounding environment and whether current food production practices are sustainable for long term consumption. Environmental concerns in relation to food processes are often focused on the role of the meat industry. Cows have been shown to release large quantities of methane, which is more dangerous for warming the climate than carbon. People can have complex reasons for choosing a diet, as ethical concerns for animal treatment or environmental drivers have led to people following a variety of diets. Some of these include vegan and ovolactovegetarian, vegetarians who choose to consume eggs and dairy, which have been shown to lower individual GHG from ~50% and ~35% respectively.
As a biological necessity, what is eaten unquestionably impacts human health. A variety of health issues such as obesity, cholesterol levels, diabetes, and cancer have had improvements in prevalence and incidence in populations with vegan or vegetarian diets.\textsuperscript{33} Other studies have recommended a plant-based diet to lower risks of hypertension, as long as meat is not needed for other medical reasons.\textsuperscript{34,35} Health benefits of eating a plant-based diet are highly numerous in nutritional scientific studies, which makes it more interesting that Wynes found little to no mention of it in school textbooks. Food and food processes are inexplicably tied to health and environmental factors. However, even knowledge of both has not been enough for some people to even reduce meat intake which means there might be other outside forces that impact how people determine their diet.

Cultural, demographic, and socioeconomic barriers play significant roles in deterring people from not eating meat, or at least lowering its consumption.\textsuperscript{4,36} In many countries, meat eating is encouraged since it is considered a status symbol.\textsuperscript{4} Demographics such as gender showed clear trends that males ate significantly more meat and were unwilling to try plant-based diets.\textsuperscript{36} Education was another factor as those with more education showed more adherence to plant-based diets.\textsuperscript{36} Socioeconomic status may limit access to certain foods and less nutritious foods may be more convenient for either their budget or time constraints.\textsuperscript{36}

Media and other knowledge resources are also contributing factors to general attitudes towards trends, diet or otherwise. A recent controversial study, conducted by Johnston et. al. for an independent study group called NutriRECS, concluded that adults could continue their current red meat consumption without health repercussions.\textsuperscript{37} Other sources responded in saying that the recommendations given were unfounded due to inappropriate methodologies, misinterpretation of nutritional evidence, and lack of environmental assessment.\textsuperscript{38,39} The advocacy for nutritional
information has been highly volatile in the past, which propagates the barriers of inconclusive scientific consensus in relation to nutrition undermining carefully built trust between patients and medical professionals.40

The recommendation to take up a plant-based diet is different from the others as the co-benefits approach does not seem to be enough to motivate behavioral change. The problem seems to lie in that beliefs and political ideologies make this a challenging topic for medical professionals, as it extends past usual patient expectations. It seems that the best approach is to have the knowledge of co-benefits ready in case there are patients who express potential motivations towards this kind of change.

Conclusion

Given the slow political response to implementation of climate policy, especially on the international level, there seems to be a need to switch up how recommendations on climate change are disseminated and which population groups should be targeted. Although Wynes proposes interventions at a high school level, other opportunities for investment lie in placing emphasis on the link between climate science and health in higher educational curriculums. If identification methods, co-benefits, and advocacy approaches are taught in medical schools, it would better prepare future healthcare workers in improving the lifestyles and environment of the communities they work with. This investment in preventative measures has long term benefits that can improve overall global health and, with an increase in adherence to these recommendations, a decrease in overall global carbon emissions. Doctors could play a huge role in formulating new social norms through bottom up actions that could have positive and transformative outcomes for the benefit of people and the planet.
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