Sustainable Healthcare In Medical Education: The Student Perspective

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Abstract

Background:
It is now a General Medical Council requirement to incorporate sustainable healthcare teaching (SHT) into medical curricula. To date, research has focussed on the perspective of educators and which sustainable healthcare topics to include in teaching. However, to our knowledge, no previous study has investigated the perspective of both undergraduate and postgraduate medical students in the UK regarding current and future incorporation of SHT in medical education.

Methods:
A questionnaire was circulated to clinical year medical students and students intercalating after completing at least one clinical year in a London University. The anonymous questionnaire consisted of sections on the environmental impact, current teaching and future teaching of SHT.

Results:
163 students completed the questionnaire. 93% of participants believed that climate change is a concern in current society, and only 1.8% thought they have been formally taught what sustainable healthcare is. No participants strongly agreed, and only 5 participants (3.1%) agreed, that they would feel confident in answering exam questions on this topic, with 89% agreeing that more SHT is needed. 60% believe that future teaching should be incorporated in both preclinical and clinical years, with 31% of participants preferring online modules as the method of teaching.

Conclusion:
Our novel study has stressed the lack of current sustainable healthcare teaching in the medical curriculum. From a student perspective, using online modules throughout medical school presents an attractive method of incorporating sustainable healthcare teaching in the future.

1 Background
Climate change plays an increasingly significant role in our daily lives. From a medical perspective, air pollution has been associated with 31 adverse health outcomes. Living near main or busy roads in London may increase the risk of lung cancer and stroke by 9.7% and 10.2% respectively[1, 2]. For every 1°C increase in temperature in England and Wales above the 93rd percentile of maximum daily temperatures, mortality increased by 2.1%[3]

91% of the global population are estimated to reside in areas of unsatisfactory air quality[4].

Poor air quality is a significant cause of annual mortality, with air pollution leading to 7 million deaths globally in 2018[5, 6]. Therefore, it is becoming increasingly evident that climate change is adversely
impacting health outcomes.

The healthcare sector also has a significant impact on the environment, with the National Health Service (NHS) having the largest carbon footprint in the UK public sector [7]. Therefore, the healthcare sector has a responsibility to improve its sustainability. Sustainable healthcare (SH) can be defined as “education about the impact of climate change and ecosystem alterations on health, and the impact of the healthcare system on the aforementioned“[8]. Between 2007–2017, carbon emissions from the health and social care sector reduced by 18.5%, despite increased demand for services, as stated by the NHS Sustainable Development Unit (SDU). The SDU have suggested that while this improvement is promising, we are unlikely to reach the 34% reduction target by 2020[7].

In addition, the ongoing COVID-19 pandemic has placed future environmental concern at the forefront of debate. A poll involving 15,951 adults from 16 countries investigated the importance of the environment in the governmental responses to COVID-19. Approximately 3/4 of those surveyed in the UK believed that the government should prioritise environmental protection post-pandemic[9].

Rume and Islam's literature review summarised the positive and negative effects on the environment that COVID-19 has had thus far. Positives are associated with lockdowns held in many countries worldwide and reduced economic activity, whereas negatives are associated with reduced recycling and increased demand for personal protective equipment (PPE)[10]. PPE is particularly pertinent for SH, the World Health Organisation (WHO) has estimated that 89 million medical masks have been needed each month during the COVID-19 pandemic. Furthermore, in March 2020, the WHO projected that PPE production would need to be increased by 40% to meet international demand[11].

Belesova and colleagues suggested that the COVID-19 pandemic could be used to introduce environmental and economic policies that can benefit long-term health outcomes[12]. Moreover, in May 2020, more than 350 organisations across 90 countries, representing over 40 million health professionals, wrote to G20 leaders endorsing a similar post-pandemic response to that of Belesova and colleagues[13]. Therefore, while undoubtedly a human tragedy, the COVID-19 pandemic has reiterated the importance of sustainable economic recovery and healthcare for our generation and generations to come.

Alongside current healthcare professionals, healthcare professionals in training are arguably best placed to be educated about SH relevant for current and future generations, thereby enabling them to actively contribute towards the UK target of reducing carbon emissions by at least 100% between 1990 and 2050[14, 15]. Reflecting this, the General Medical Council (GMC) have stated in Subsection 25 of their Outcomes for Graduates document that newly qualified doctors should understand and be able to utilise principles of SH in their medical practice, and that universities had until 2020 to put in the necessary teaching to support this[16, 17]. However, the 2020–2021 Planetary Health Report Card (PHRC) suggests that SHT may still be lacking on an international scale. The PHRC evaluated 62 medical schools worldwide in five broad categories, including the curriculum itself. Only two medical schools evaluated scored over 80% as their overall score. In comparison, at least 24 medical schools scored lower than 50%
Therefore, it appears clear that SH in medical education is still in its infancy, with relatively little published thus far [19, 20].

Tun's research gained the perspective of educators regarding the integration of SH teaching (SHT) in medical education [21]. She identified several obstacles to introducing SH in medical curricula according to educators, including the perceived lack of teaching time. Furthermore, several enablers were identified, with student interest being a particularly notable one. However, Tun's research did not consider the perspective of current medical students. She also identified a concern that medical educators may not be sufficiently informed to teach students well [21]. To address this, the use of peer teaching from fellow medical students has been proposed by Green and Legard. While they summarised the views of several medical schools, this included a relatively small cohort of 29 medical students [22]. Furthermore, Gandhi et al.'s paper suggested an approach for incorporating SHT in postgraduate medical education, based on Mortimer's 2010 paper. It discusses how applying five core principles can lead to an outcome of reducing carbon emissions without compromising healthcare services. This includes preventative medicine, encouraging patients to self-manage conditions more, lean pathways, low carbon alternatives and operational resource use [23, 24]. Additionally, Teherani et al. surveyed 52 SH experts, who identified that most teaching should be undertaken in preclinical years [19].

There does not seem to be a clear consensus regarding how to best integrate SH into medical curricula. Part of this lack of clarity may be explained by the fact that, to our knowledge, no previous study has investigated the perspective of both current undergraduate and postgraduate medical students in the UK regarding current and future incorporation of SH in medical education.

Therefore, gaining insight of the students’ perspective on SH will enable us to identify pitfalls in current medical education, and approaches to maximise the efficacy of teaching in the future. Therefore, we aim to identify:

- Whether current medical students have been taught what SH is.
- Whether current SHT is sufficiently incorporated into the medical curriculum.
- The importance of SH from the perspective of current medical students.
- Preferred approaches to include SHT in the medical curriculum.

We hypothesised that SHT is not sufficiently incorporated into the medical curriculum. We also hypothesise that while current medical students think that SH is important in daily clinical practice, they have not been adequately taught what it is in a formal setting.

### 2 Methods

#### 2.1 Participants
Inclusion criteria for choosing participants for this study involved current medical students in clinical years at a London University (years 3, 4 or 5 respectively) or students currently intercalating having completed at least one clinical year. Prospective students were invited via central emails and social media to complete the questionnaire, which was open over a 2 week period.

2.2 Materials and Design

The anonymous questionnaire consisted of four sections: demographics, environmental impact, current teaching and future teaching. Demographic data collected included gender, year of study and whether they were studying for an undergraduate or postgraduate medical degree. Questions asked regarding environmental impact, current teaching, and future teaching are summarised in Tables 1 and 2, and Figs. 2 and 3. Environmental impact and current teaching sections of the questionnaire were assessed via a Likert scale. Microsoft Forms was used to design the questionnaire and interpret the data collected. Microsoft Excel was also used to interpret the data. All questions had to be completed in order for the participant to be able to submit the questionnaire.

Table 1. Assessing the student perspective on environmental impact in relation to both current society as well as medical practice via Likert scale. Percentages to 2 significant figures.

| Statement                                                                 | Strongly disagree | Disagree       | Neither agree nor disagree | Agree       | Strongly agree |
|---------------------------------------------------------------------------|-------------------|----------------|----------------------------|-------------|---------------|
| I believe that climate change is a significant concern in current society. | 1 (0.6%)          | 2 (1.2%)       | 9 (5.5%)                   | 47 (29%)    | 104 (64%)     |
| I am conscious of my daily impact on the environment.                     | 1 (0.6%)          | 20 (12%)       | 19 (12%)                   | 88 (54%)    | 35 (22%)      |
| Daily medical practice adversely impacts the environment.                 | 0 (0.0%)          | 6 (3.7%)       | 39 (24%)                   | 82 (50%)    | 36 (22%)      |
| It is important for daily medical practice to be environmentally friendly. | 2 (1.2%)          | 3 (1.8%)       | 18 (11%)                   | 70 (43%)    | 70 (43%)      |
| HCP's should consider their impact on the environment in daily practice.  | 2 (1.2%)          | 8 (4.9%)       | 16 (9.8%)                  | 78 (48%)    | 59 (36%)      |
Table 2. Assessing the student perspective on current sustainable healthcare teaching in the medical curriculum. Percentages to 2 significant figures.

| Statement                                                                 | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---------------------------------------------------------------------------|-------------------|----------|----------------------------|-------|----------------|
| My course has made it clear that it is a GMC requirement for newly qualified doctors to understand and utilise the principles of sustainable healthcare in their medical practice. | 51 (31%)          | 79 (48%) | 17 (10%)                   | 13 (8.0%) | 3 (1.8%)       |
| I have been formally taught what sustainable healthcare is. This can be defined as “education about the impact of climate change and ecosystem alterations on health, and the impact of the healthcare system on the aforementioned” (CSH Networks). | 84 (52%)          | 63 (39%) | 13 (8.0%)                   | 2 (1.2%) | 1 (0.6%)       |
| I have been formally taught about environmentally friendly plans already established in the NHS. | 86 (53%)          | 64 (39%) | 9 (5.5%)                    | 4 (2.4%) | 0 (0.0%)       |
| I would feel confident in answering questions about sustainable healthcare in an exam setting. | 104 (64%)         | 46 (28%) | 8 (4.9%)                    | 5 (3.1%) | 0 (0.0%)       |
| More teaching is needed about sustainable healthcare in the medical curriculum. | 2 (1.2%)          | 5 (3.1%) | 10 (6.1%)                   | 51 (31%) | 95 (58%)       |
| There is time and space available in the curriculum to incorporate teaching about sustainable healthcare. | 9 (5.5%)          | 24 (15%) | 51 (31%)                    | 60 (37%) | 19 (12%)       |

3 Results

3.1 Demographics

163 medical students completed the questionnaire out of a possible 851 students. Demographics are summarised in Fig. 1.

3.2 Environmental impact

Answers to statements on environmental impact in relation to both current society as well as medical practice are summarised in Table 1.

3.3 Current teaching
Answers to statements on current SHT in the medical curriculum are summarised in Table 2.

3.4 Future teaching

When asked how SH should be incorporated into teaching, respondents voted for the following: 50 for online module/s (31%), 42 for lectures (26%), 39 for small group teaching (24%), 26 for ward-based teaching (16%), and 6 for ‘other’ (3.7%). For ‘other’ responses, students specified that teaching should be as ‘1–2 lectures online’, it should be ‘integral to part of all teaching rather than seen as an extra’, ‘ward-based teaching’, ‘don’t know’, ‘a combination of small groups, lectures, and ward-based learning’, and ‘all of the above are useful’.

41 students (25%) voted that teaching should be incorporated in preclinical years, 24 for clinical years (15%), 97 for both preclinical and clinical years (60%), and 1 for other (0.6%), with the latter specified as ‘all stages as spiral learning’.

Figure 2 summarises student responses when asked who would be best to give this teaching, and Fig. 3 summarises potential SH topics of student interest to be included in future teaching.

4 Discussion

4.1 Demographics

A total of 163 responses were received from a potential total of 851 respondents, which is a response rate of approximately 19%. Yale University conducted a similar study amongst healthcare students, receiving a response rate of 28%. Their paper describes the possibility of selection bias, as students who are already interested in SH were more likely to respond to the questionnaire compared to others[25]. This limitation could potentially apply to our study too. At Yale, it was shown that more women regarded SH as an important issue compared to men[25]. Our study showed that 70% of respondents were female. Females having stronger views towards SH could have caused this high response rate which again may have potentially caused selection bias. Out of our respondents, 76% were undergraduate students and 24% were postgraduate medical students, which reflects the proportion of students on the undergraduate and postgraduate courses respectively.

4.2 Environmental impact

“Climate change is the biggest global health threat of the 21st century”[26]. Costello et al’s quote from 2009 fittingly resonates to this day, with global warming estimated to cause 250,000 extra deaths globally each year between 2030–2050[27]. Therefore, it is unsurprising that 83% of participants agreed or strongly agreed that climate change was a significant concern in current society.

Furthermore, 86% of participants believed that daily medical practice should be environmentally friendly, and 72% felt that daily medical practice currently adversely impacts the environment. This reiterates the NHS Long Term Plan, which aims to halve its carbon footprint by 2025, improve its impact on air quality,
and reduce single use plastic in the NHS[28]. Moreover, our findings again reflect the Yale University study, which found that 90% of respondents felt that healthcare professionals should consider their impact on the environment in daily clinical practice[25]

4.3 Current teaching

One of the GMC outcomes for graduates is “newly qualified doctors must be able to apply the principles, methods and knowledge of population health and the improvement of health and SH to medical practice”[16]. Despite this clear statement, our results showed that 79% of students did not believe that their course had made this clear.

Our results highlight the lack of awareness of SH in medical education. 91% of students felt that they had not been formally taught what SH is. Similarly, 92% of students did not believe that they had been formally taught about environmentally friendly plans established in the NHS. This echoes El Omrani et al’s study, which identified that only 15% of 2817 medical schools internationally included teaching about climate change and its impact in a health context[29]. However, there is a demand to incorporate SH into their curricula, with 89% stating that this is required. This reinforces Tun’s findings, which state that medical educators describe the “demand from students” as an enabler to introduce further SHT[21]. A letter to the editor by a third year medical student reiterates the “social silence” surrounding the topic of climate change, and portrays the urge to raise awareness around this pertinent issue[20]. Our findings solely focus on the student perspective, and reinforce the lack of knowledge around SH despite student interest.

Tun mentions difficulty in assessing learning as a barrier to introducing SH into the curriculum[21]. We found that 92% of students would not feel confident about answering exam questions regarding SH. Therefore, our results highlight that perhaps the more important issue at hand is the lack of education amongst students rather than how student knowledge on SH can be assessed. Using formative but mandatory assessments has been suggested by Schwerdtle et al.[30]. This may help to transition students while incorporating SH topics in summative examination. Many medical schools have student selected components embedded in their curricula. These may also provide an opportunity to introduce such teaching to medical students. This could be linked to quality improvement, which forms its own section in the GMC Outcomes for Graduates[16]. Furthermore, if associated with a clinical supervisor, this may help to give a clinical insight in SH, alongside providing an opportunity for current healthcare professionals to learn about SH as well. Alternative methods of incorporating teaching that have been mentioned in literature include reflective writing, short answer questions in summative examination, and part of clinical placements[31]. The former could also be linked to Sect. 2 of the GMC Outcomes for Graduates: “Professional and ethical responsibilities”, specifically section 2t, which describes the importance of a professional development portfolio[16]

Methods of embedding SH into the curriculum has been discussed by many. Tun found that medical educators described the curriculum as being overcrowded[21]. One of the educators in Tun’s research mentioned how teaching students all relevant topics would in fact never allow them to graduate within 5
years of medical school. In contrast to this, Mortimer and Walpole found that educators were fascinated by the reach that implementing SH into the curriculum had for entire cohorts of students[32]. A solution to incorporating SH into the medical curricula may be to integrate it into topics already in the curriculum [21], instead of debating what to remove from the syllabus. By doing so, this will further embed the relationship between SH and current medical practice.

We found that the student perspective was divided on this, with 49% stating that there was space in the curriculum for SHT to be incorporated, and 31% neither agreed nor disagreed. While some educators believe the curriculum lacks space, the student perspective suggests that embedding SH may be feasible. Given the interest students have displayed to learn more about this topic, it may be that how SHT is implemented in future teaching will determine whether there is sufficient space in the medical curriculum, particularly for this 31%. This may not only be relevant for UK medical schools, but possibly on an international basis. Incorporating SH into teaching has been a topic of discussion in the US and Australia[25, 33, 34], suggesting that a lack of SHT in current medical education is not simply a UK-centric issue, but may in fact be an international issue in medical curricula, which therefore needs to be urgently addressed.

4.4 Future teaching

The student perspective suggests that online modules (31%) are the most popular method of incorporating SH into medical education. However, this was similar to lectures (26%) and small group teaching (24%), suggesting that students are not as certain about how they would prefer to be taught. The COVID-19 pandemic may have skewed this result however, as online modules were the only option which did not involve in-person interaction[35]. This uncertainty on how best to be taught SH is also reflected by educators, with an Australian university study finding that two-thirds of educators would not know the best way for their students to be taught[33].

Students were also asked to rank who would be best to teach SH. Healthcare professionals were the preferred option, followed by university non-clinical staff (44% and 28% as most appropriate choice respectively). Tun’s research identified that medical educators may not be able to effectively teach students due to a lack of knowledge[21]. This appears problematic given our findings suggest that students would prefer SHT from healthcare professionals and university non-clinical staff. Additionally, Green and Legard’s letter to the editor suggested that peer teaching would be beneficial. However, this contrasts with our findings, with only 9.2% preferring peer teaching as the best way to teach SH. While their findings included students from several medical schools, their suggestion was based on a relatively small sample size[22]. In comparison, while our study only included one medical school, the sample size was much greater (n = 163). Despite the Royal College of Physicians including sustainability as part of its definition of quality of best possible patient care[36], the lack of knowledgeable healthcare professionals in SH[21] provides an obstacle for effective teaching.

The use of shared online resources may provide an appealing method to overcome these obstacles, as reflected by our findings. It has been previously described that pooled resources across medical schools
can help to minimise the lack of SHT material available[20–22]. Online teaching in medical education has been an increasingly prevalent topic in literature over recent months due to COVID-19. There are several key benefits of online teaching highlighted in literature, including increased access to teaching resources from world leaders in their respective fields[37]. Online teaching has provided more flexibility in learning, with a systematic review arguing that the shift to online resources may boost students’ incentive to learn[38], and a study found 97.2% of students agreed with online teaching as an alternative teaching method during the pandemic[39].

But is online teaching only relevant as an alternative to in-person teaching? A recent systematic review and meta-analysis found that a combination of in-person teaching and online resources may be effective in medical education[40], with a 2014 systematic review stating that online teaching may be better than in-person teaching in respect to “knowledge and skills gained”[41]. Furthermore, Dost et al. conducted the first study to investigate the impact of this pandemic on online teaching across UK medical schools, with 39 of 40 medical schools responding. They found that there was a significant increase in time spent using online resources compared to before the pandemic, concluding that a combination of online resources and face-to-face teaching should be incorporated in the future[42]. It therefore makes sense for medical schools to continue utilising online resources for certain aspects of teaching post-pandemic, as highlighted by Cheng and Liu[43]. Our results suggest that SHT in medical education may be one of these areas to continue delivering online post-pandemic, which will help to disseminate material amongst medical schools. This may prove a particularly pertinent method of teaching, given that medical schools both nationally and internationally are concerned about SHT[44]

4.5 Strengths and Limitations

To our knowledge, no previous study has investigated the perspective of both current undergraduate and postgraduate medical students in the UK regarding current SHT in medical education. This is the first study that has investigated the preferred method of incorporating future SHT in medical education from a student perspective. Therefore, this study provides significant insight that should be taken into consideration when incorporating SHT. Although previous studies have asked students for opinions, the sample size for our study was much larger (n = 163).

Despite having a large sample size, we only collected data from one London medical school. Running this study amongst multiple medical schools across the UK will help us gain further insight into the student perspective in the future. Our questionnaire did not have many ‘open questions’, meaning that students could not entirely voice their opinion. Furthermore, we only distributed the questionnaire amongst students in their clinical years, which meant we did not gain the insight of students in preclinical years. We decided not to distribute the questionnaire to preclinical students due to their relative lack of exposure to a clinical environment. Use of a Likert scale for most of our questions meant that we did not obtain much qualitative data. Significance of our findings could also not be determined as we did not perform any statistical analysis.

4.6 Future Research
SH in medical education remains a relatively novel concept, with limited research thus far. Our study gained the perspective of medical students in clinical years from a London university. Distributing a questionnaire among medical schools across the UK in the future will allow us to gain further insight on the student perspective of SHT. Additionally, repeating this study in the future will allow us to longitudinally compare whether SHT has improved in medical education after medical schools have had more time to incorporate and develop such teaching in their curricula. Using small focus groups may allow students to further articulate their views on how to embed SH into the curriculum in a more qualitative manner, and enhance SHT.

While we only focussed on the perspective of medical students in clinical years, it may prove useful to gain insight from preclinical students, who may have a less medical perspective on SH, and provide a more generalised approach instead. Finally, to gain an updated insight into the medical educator perspective, distributing a similar questionnaire, but tailored to educators, across all UK medical schools will allow us to compare and contrast this to the student opinion, and identify an optimal method to implement SHT.

5 Conclusion

This is the first study to investigate the perspective of both undergraduate and postgraduate medical students in the UK regarding current and future incorporation of SH in medical education. Students believe that it is important for daily medical practice to be environmentally friendly, but currently isn’t. Most students do not feel that they have been formally taught what SH is, and would not feel confident on being examined on this topic, despite it being a GMC requirement. In the future, students identified that the optimal method of SHT would be online modules from healthcare professionals in both preclinical and clinical years. SHT in medical education is currently limited. Therefore, further research is required to identify the best way to inform the next generation of doctors about the importance of SH, and how to incorporate it in their daily medical practice.

Abbreviations

GMC = General Medical Council; NHS = National Health Service; PHRC = Planetary Health Report Card; PPE = Personal Protective Equipment; SDU = Sustainable Development Unit; SH = Sustainable Healthcare; SHT = Sustainable Healthcare Teaching; UK = United Kingdom; WHO = World Health Organisation.

Declarations

6.1 Ethics approval and consent to participate

St George’s Research Ethics Committee approved this study (REC: 2020.0222). Before completing the questionnaire, all participants gave informed consent, with all methods carried out being in accordance with relevant guidelines and regulations.
6.2 Consent for publication

All authors consent for publication of this research article.

6.3 Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

6.4 Competing interests

None.

6.5 Funding

None.

6.6 Authors’ contributions

Dhruv Gupta and Lahvanya Shantharam wrote the main manuscript text for this research article. Dr Bridget Kathryn MacDonald gave senior advice and reviewed the article.

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Figures
Figure 1

Demographics of respondents. A) Gender of all respondents. B) Type of medical course. Postgraduate medical students included transfer students from Biomedical Sciences to Medicine. C) Year of study. Respondents intercalating were asked to choose their last clinical year completed.
Figure 2

Student perspective ranking who would be best to teach sustainable healthcare. 1 = most appropriate, 4 = least appropriate.

Figure 3
Student opinion on what topics would be relevant to teach about sustainable healthcare in medical curricula. X-axis abbreviations: 1 = the NHS' impact on climate change, 2 = the effect of climate change on medical conditions, 3 = already established approaches to reduce the environmental impact of the NHS (e.g. the NHS Long Term Plan), 4 = new approaches to reduce the environmental impact of the NHS, 5 = how COVID-19 has made us re-think strategies to implement healthcare, 6 = renewable energy resources and their utility in healthcare, 7 = financing sustainable healthcare and pitfalls to overcome, 8 = relevant research from other industries, 9 = additional resources available regarding the environmental impact of medical practice, 10 = other.