

# Sustainability in Quality Improvement (SusQI): Challenges and Strategies for Translating Undergraduate Learning Into Clinical Practice

**Oliver Marsden**

University of Bristol

**Philippa Clery**

University Hospitals Bristol NHS Foundation Trust

**Stuart d'Arch Smith**

Centre for Sustainable Healthcare

**Kathleen Leedham-Green** (✉ [k.leedham-green@imperial.ac.uk](mailto:k.leedham-green@imperial.ac.uk))

Imperial College London

---

## Research Article

**Keywords:** Medical education, Quality improvement, Sustainable healthcare

**Posted Date:** February 2nd, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-154613/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

## **Abstract**

# **Background**

The healthcare sector is a major contributor to climate change and there are international calls to mitigate environmental degradation through more sustainable forms of clinical care. The UK healthcare sector has committed to net zero carbon by 2040 and sustainable healthcare is a nationally mandated outcome for all UK graduating doctors who must demonstrate their ability to address social, economic and environmental challenges. Bristol Medical School piloted successful Sustainability in Quality Improvement (SusQI) teaching, but identified challenges translating classroom learning into clinical practice. This paper aims to identify and address those challenges.

## **Methods**

We conducted five focus groups that identified and iteratively explored barriers and facilitators to practice among medical students, comparing a range of experiences to generate a conceptual framework. We then combined our findings with behaviour change theory to generate educational recommendations.

## **Results**

Students that applied their learning to the clinical workplace were internally motivated and self-determined but needed time and opportunity to complete projects. Other students were cautious of disrupting established hierarchies and practices or frustrated by institutional inertia. These barriers impacted on their confidence in suggesting or achieving change. A minority saw sustainable healthcare as beyond their professional role.

## **Conclusions**

We present a series of theoretically informed recommendations. These include wider curricular engagement with concepts of sustainable clinical practice; supportive workplace enablement strategies such as workplace champions and co-creation of improvement goals; and time and headspace for students to engage through structured opportunities for credit-bearing project work.

## **Background**

Climate change and environmental degradation have been recognised as both a threat to human health and a catalyst for new and improved practices [1, 2]. One such practice is the introduction of sustainable healthcare into undergraduate medical curricula.

The NHS Sustainable Development Unit defines sustainable healthcare as “working across the health system and partners to deliver healthcare that delivers on the triple bottom line, i.e. simultaneous financial, social and environmental return on investment. It includes adapting how we deliver services, health promotion, more prevention, corporate social responsibility and developing more sustainable models of care” [3].

NHS England has committed to carbon neutrality by 2040 [4] and the UK’s General Medical Council (GMC) has mandated that all newly qualified doctors “must be able to apply the principles, methods and knowledge of sustainable healthcare to medical practice” and “be able to apply the principles and methods of quality improvement to improve practice” [5].

Quality improvement and sustainable healthcare have become priority areas for Health Education England [6] who commissioned the Centre for Sustainable Healthcare, in collaboration with the Health Foundation and King’s College London, to create a toolkit that combines these two learning outcomes into a practice known as Sustainability in Quality Improvement (“SusQI”). SusQI supports practitioners in improving and maintaining patient care through established quality improvement strategies whilst attending to the triple bottom line, thereby creating social, economic and environmental value [7, 8].

$$\text{Sustainable value} = \frac{\text{Outcomes for patients and populations}}{\text{Environmental + social + financial impacts}} \\ \text{(the 'triple bottom line')}$$

This case study focuses on clinical practices that create social and environmental value, as described in the SusQI toolkit ([www.SusQI.org](http://www.SusQI.org)).

Strategies to reduce the carbon footprint of healthcare [9] include

- health promotion and disease prevention;
- supporting patients in managing their long-term conditions more effectively e.g. through education, health coaching, social prescribing and care planning;
- creating lean clinical pathways that are more effective & efficient;
- choosing options that are less damaging to the environment such as cleaner inhalers and anaesthesia;
- ethical resource allocation, procurement and waste streams.

Strategies to improve the social value of services include attention to equity, social determinants of health, social justice, safety, wellbeing, advocacy, empowerment, participation and access to healthcare [10].

There are considerable co-benefits across domains of improvement: lower carbon care is often easier, cheaper over time, and better for patients which has the potential for a strongly positive net impact on patient care and service provision [11].

The toolkit is being piloted at a number of UK medical schools including Bristol, and this research is part of that pilot. Clery et al evaluated that pilot which was successful in building motivation and skills, however they identified variable translation of learning into practice [12]. This research aims to build explanatory theory from participant experiences so that further implementations of SusQI are both evidentially and theoretically informed and the impacts of learning maximised.

## Methods

### Aim

What enabled some students to engage in SusQI? Where this was not the case, what needed to change for the behaviour to change?

### Design

Charmaz defines grounded theory as 'a method of conducting qualitative research that focuses on creating conceptual frameworks or theories through building inductive analysis from the data' [13] (p. 187). Grounded theory has different schools of thought that either tend towards a purely inductive 'theory generating', or those that include deductive 'theory testing'; some that emphasise methodological flexibility in response to emergent data, and others that emphasise a relatively rigid axial coding stage. Our approach was purely inductive, and our analysis was initially flexible however the data naturally coalesced into an axial coding paradigm of causal conditions, context, intervening conditions, action/interaction strategies, and consequences [14]. We used a process of constant comparison to explore and describe different outcomes from the same learning experience, which were tested back against the data to check that they accounted for all cases.

As Charmaz suggests (p.155) it is unrealistic to approach an area of research without pre-existing theoretical constructs which may need to be 'wrestled with' and only included if they enhance the research. We have included some pre-existing categorisations in our analysis as they highlight not only what is there, but what is not. We therefore discuss our findings in relation to established categorisations of motivation [15], educational outcomes [16, 17] and, in the abductive inference stage, behaviour [18].

### Research team

The research team included two clinical academics involved in SusQI teaching (PC, SdAS), a medical student from the same institution as participants (OM) who undertook this study as a self-selected component, and a full-time educational researcher from a neutral institution (KLG).

### Participants and setting

All third year undergraduate medical students who had undertaken SusQI training at the University of Bristol were eligible to participate (n = 342). They had had no previous quality improvement or sustainable healthcare training. Teaching took place in January-February 2020, focus groups were conducted in May-June 2020. The completion of some projects was interrupted by the COVID-19

pandemic. Bristol has a strong culture of engagement in sustainability and sustainable healthcare [19–21].

## **Intervention**

PC and SdAS ran a SusQI workshop using a hub and spoke model (central teaching telecast to teaching hospitals with locally facilitated workshops). The teaching was supported by the Centre for Sustainable Healthcare and used their freely available educational toolkit [22]. A detailed description and evaluation of these workshops is available [12]. Students were paired with a named Clinical Teaching Fellow who undertook to support students' projects, with a follow-up workshop planned.

## **Data generation**

Students were invited to participate in this research via email and social media. We obtained informed consent according to our research ethics (University of Bristol ethics #98065) and allocated participants to online focus groups of 3–5 people. We re-circulated workshop resources to participants one week prior to the focus groups. The topic guide was co-designed by all four authors to explore motivations, experiences and educational outcomes and tested on two medical students who helped refine wording and content. Focus groups were conducted by OM using a semi-structured approach so that all topics were covered, but emergent areas of interest could be explored as they arose. Each focus group lasted approximately 1 hour and was transcribed verbatim by OM assisted by automated software (Otter.ai) adding speaker identifiers and verbal cues (emphatics, laughter) to enrich the data. Finally, transcriptions were proofread by KLG against the original recordings so that both authors were fully immersed in the data.

## **Data analysis**

Our initial analysis involved OM coding core ideas line by line, facilitated by NVivo 12 software. Core ideas were merged, refined and arranged by OM and KLG into themes through a process of iterative consensual discussion. Themes were arranged into a categorical framework that explored differences in experience between students and the underlying factors that modulated those experiences. These were refined through a process of constant comparison into four types of experience. During subsequent focus groups we explored emergent categories and the relationships between them in greater depth. Data collection continued until no new categories arose and we had rich data across the range of participants' motivations, experiences and outcomes. This involved 5 focus groups and 17 participants. Codes relating to motivation and educational outcomes were sorted into sub-categories informed by existing theories. Other subcategories emerged from the data. Some categories, including those relating to the COVID-19 pandemic and the hub and spoke teaching model are explored in our sister paper [12] and not discussed here. Our final conceptual framework (Fig. 1) was refined and checked back against the underlying data by PC and SdAS.

## **Results & Interpretation**

# How students conceptualised SusQI

Students tended to conceptualise sustainable healthcare in terms of resource usage: for example, reducing plastics or energy waste; however, the session appeared successful in introducing more clinical conceptions. Participants talked about reducing over-investigation and over-treatment, reducing antibiotic misuse, choosing less damaging anaesthetic and inhaler options, reducing wasted labour through more effective and efficient clinical practices, and reducing the need for services through patient activation and disease prevention.

## What educational value was created?

There was strong student engagement with and appreciation of the teaching session. Students described learning skills that they wanted to use as well as positively reframing their thinking about quality improvement, healthcare and their future professional role. Very few students, however, attempted SusQI projects, and most reported multiple barriers to applying their learning or generating sustainable value for services. Amongst the 17 focus group participants, there were two attempted and no completed projects at the time of writing.

## Who did it work for & why?

We were able to identify four distinct educational outcomes for students, illustrated in the impacts column of Fig. 1:

- the activated practitioner who fully assimilated their classroom-based learning to develop a ‘SusQI gaze’;
- the willing but cautious practitioner who needed permission and support;
- the frustrated practitioner who felt overwhelmed by barriers to action;
- the disinterested (or pre-contemplative) practitioner who saw sustainability as beyond their future professional role.

We present these four outcomes in the above order, and explore them in relation to preceding factors, motivations and other modulating factors. Quotes are identified according to focus group letter (A-E) and participant number. Square brackets and ellipses indicate where the verbatim quote has been clarified or condensed.

## Outcome 1: The activated SusQI practitioner

The SusQI teaching session was most successful in activating students who already prioritised sustainability. These participants recognised a spectrum of sustainability and identified themselves as more sustainably minded than most. They already valued and were familiar with concepts of sustainability, however the session reframed their thinking about healthcare as a contributor to the global health emergency and ecological degradation.

External motivators such as career benefits, mitigating future threats, avoiding guilt, and associated prestige were common activating factors across all student groups, however these sustainably-minded students were additionally motivated by internal values such as curiosity, altruism and self-determination. We found no comments explained by goal-orientation, perhaps because the completion of SusQI projects did not contribute to summative assessments. Activated practitioners expressed a set of core beliefs: sustainability action as necessary, the healthcare system as running unsustainably, SusQI as a helpful tool, change as possible, the workplace as welcoming of improvement, and action as a professional duty.

Workshop content demonstrating the scale of unsustainable practices in healthcare troubled these students who felt alarmed that their involvement with the health service was out of step with their sustainable lifestyles and values.

*I think it just really took me aback, like 'wow, [the health service plays] such a big role in [environmental destruction.]' I always think that I'm quite a sustainable person generally, but I think I realise my involvement with the NHS [counteracts that], and that... I need to do something to balance [my footprint] out. D2*

They were also shaken by the impacts of environmental degradation on patients and healthcare: *"It made me realise that it's going to directly impact my future career. And that was quite scary"* A1.

Near-peer examples of successful projects enabled these students to reframe sustainability as within their control and influence, helping to mitigate those concerns. SusQI then became powerful tool for change through relatable examples of the SusQI framework which *"put [QI] in a context that made us \*want\* to do it"* E1.

*I think it kind of made me more curious because it made me feel like I could make a change... if you've got the right research and you go about it the right way with the right process, you can make small changes that can make a difference. So, I think that was quite empowering and it kind of changed my impression of QI. C2*

Interactive discussions during the workshop were valued, empowering students to identify and reflect on unsustainable workplace practices with peers. They expressed frustration that solutions were not yet in place but felt reassured by a like-minded peer community and the potential for change *"that actually felt like we could make a difference if we actually put some effort into this."* C3

Participants were inspired by role models who framed SusQI as *"part of the bubble of patient care"* A2, whilst depicting the NHS as *"an ever-evolving system"* A3, which would ultimately embrace sustainability.

*[This teaching showed me] that people are willing to change like, I never really realised that the NHS is supportive of these changes, like they want to help decrease their environmental emissions and things because there are so many benefits... actually, it's been quite optimistic. A1*

Activated students worked to overcome barriers, for example, leveraging workshop resources to mitigate hierarchy and broach conversations about change.

*Almost like a slip of paper to wave at your colleagues saying "Look, this is why we have to [make sustainable change] It's not just my own personal, you know, want" or anything. Sorry! B4*

They conceptualised sustainability as an integral part of their future clinical practice rather than a separate siloed concept:

*It's made me more aware in my understanding that everything's interlinked... "patient care, my own health, you know, "education, treatment," it's all interlinked with sustainability rather than sustainability being this separate thing. C1*

The session transformed the way these students saw previously accepted practices, developing a new critical sustainability lens or 'SusQI gaze' which prompted them to start up conversations with clinicians.

*... rather than just following things for no reason, kind of looking for improvements and going in with that kind of "QI head on your shoulders" C2*

*When I do go back to the hospital, it will be [a case of] trying to start up conversations with people more. So, if you notice, like, "oh, like, that's a lot of waste." A1*

The session had a strongly positive impact on their professional identity creating "a sense of meaning within your job, even greater than just [the job] itself" D1. The session was also successful in creating a sense of leadership and agency "that actually, we have the capability to make a massive difference... quite inspiring... you wanted to go out and help" A1. Another noted "it was something that I anecdotally told other people about because it impacted on me so much" E1.

We identified a triad of positive reframing in this group, illustrated in Fig. 2. Activated students newly identified themselves as agents for positive change, their profession as potentially ethical and sustainable, and quality improvement as a worthwhile practice.

## **Outcome 2: The willing but cautious SusQI practitioner**

Willing but cautious participants described expectations to conform when shadowing on placement, which included adopting seniors' unsustainable practices. Tacit professional boundaries prevented these students suggesting new or improved practices.

*I don't know how the wards run... Managerial staff will know more than I do... And so yeah... Going onto the ward and trying to bring about changes is terrifying. A2*

They explained that students "don't feel comfortable enough to be able to broach that conversation to a consultant or anyone else" C4. They felt it would be inappropriate to educate their busy seniors. These students identified themselves at "the bottom of the food chain" A2 in a hierarchical organisation, lacking

the social capital or knowledge to push for sustainability. Constantly rotating between specialties and hospitals left them without insights into local expertise, systems or processes.

*To suddenly come up and say, "Can we look at [sustainability as well]", it might seem slightly [brash, over-confident]... I don't feel in the place [of authority] where I can do that right now. C3*

In contrast, they perceived their mentors as possessing the influence to drive SusQI projects but unapproachable and lacking awareness or time, undermining the achievability of SusQI.

*I think educating more senior doctors [is needed]. Once more senior positions start doing something you think "I could do that" and make it more likely for people to listen and do something about it. C1*

Their perceptions of how the clinical hierarchy impacted on their ability to enact SusQI are illustrated in Fig. 3.

Students suggested appointing established team members as sustainability champions to collate and advocate for SusQI ideas, and to act as role models.

*If they'd previously put their name out there as someone who would be interested in something like this... then yeah, I would be more inclined to go forward [and approach them]. C3*

*I feel quite daunted by the idea of having to go and speak to doctors myself and bring about a change myself. Doesn't necessarily have to be doctors, it could be nurses, it could be HCA's, could be anyone [in the healthcare team] really, couldn't it? A2*

## **Outcome 3: The frustrated SusQI practitioner**

Students in this outcome group valued and were motivated by the SusQI teaching session, however barriers due to their junior status were compounded by perceptions of structural barriers in the clinical workplace. These combined to undermine their belief in the achievability of SusQI, leading to disengagement and frustration.

*I've sent numerous emails... It's like [I get] blocked, people don't... have anything for me to do... I feel quite disheartened that [QI] was this big, like, exciting thing you can get involved in and it's actually, in reality, it's not... The actual getting [a project] is really difficult. E1*

They also described a disconnect between senior and junior engagement and criticised the absence of sustainability guidance from the NHS or University "if everyone's been told the same thing, you're working together to do it" B2.

Clinical administration was described as over-regulated, complex and mysterious; clinical teams as busy and resistant to change. The busy, hectic and often stressful healthcare workplace was described as lacking the psychological space to engage clinical staff in SusQI planning.

*Trying to find the time and headspace to stand and, just thinking 'how [we] could change practice for sustainable benefit?' That's quite difficult. E1.*

Where sustainability guidelines were in place, contradictory actions within a local NHS trust epitomised the greenwashing perceived by students, who expressed disillusionment that they were not being followed. They felt that large-scale sustainability appeared unrealistic *"until cultural change happens at the lower levels"* B1.

Conformity to clinical guidelines was described as part of patient safety but also a safety blanket for clinical staff, with change perceived as disruptive. Systems were too complex to adapt and fear of blame stifled innovation. Frustrated participants expressed a dilemma: whether to persevere with action, or to stick with current practices and accept the associated moral injury: *"the ethical implications of not doing things sustainably are quite high for future generations... It's a big ethical problem"* D2.

*Like, putting yourself in the firing line [if you question it]. But it would be so much easier just to keep on going, and using all this PPE, and throwing it in the bin, and going home and [getting praised] "you've done such a great job [on the COVID front-line]." But in reality, you're acting incredibly unsustainably. E4*

## **Outcome 4: The pre-contemplative SusQI practitioner**

Students in this outcome group were not ready to engage with the learning. They described sustainable healthcare concepts as unfamiliar: *"[It was] the first time.... that we've talked [in medicine] about environmental issues... [we] would obviously really love to integrate it, but... [we] need more information and about how to do that"* E3. These students suggested that sustainable healthcare needed to be an integral theme, rather than confined to quality improvement teaching.

*But I feel like one lecture will not just change how I act and how I - sort of - work. I feel like it needs to be a continuous thing of building upon what we've learnt already... you're not going to learn one thing from one lecture and change the entire way you act, you need to keep on sort of building up on that, I think." A2*

Unsustainable healthcare and ecological breakdown were perceived as an insurmountable far away problem that someone else would sort out: *"... I think a lot of people feel like it's not actually helping themselves. So, it's easier... to leave it to other people to deal with it"* B2. They prioritised the health of patients today over the health of wider populations tomorrow, despite acknowledging the exponential consequences for future generations.

*What you do now doesn't have any immediate ramifications for you but has... everlasting ramifications for 'this many' people. But since it doesn't affect you, you don't pay attention to it. B3*

Quality improvement projects had a prior reputation as *"boring... something that you had to do"* D2, and preventative health was described as too abstract and less exciting than patient-facing acute medicine.

*If you're [undertaking QI] there's not that immediate kind of satisfaction of "I can do this"... it's the cliché thing to say, I've gone into medicine because I want to help people... There's more immediate satisfaction*

*[in helping patients] than there would be with QI projects, I think. C1*

*I'm not gonna lie: I think when I hear quality improvement, it just ... kind of just, like makes me start snoring a little bit. B1*

Pushing for change was seen as exhausting and beyond their professional scope.

*Yeah, it gets a bit exhausting if you're thinking about how to improve every aspect of your job at all times. B1.*

Motivation to persevere was related to expected success rate, with students dissuaded by rumours that "QI failing is brutal" C1. For these students, altruistic motivations did not appear to justify the perceived effort and risks of engagement.

## Discussion

We have presented an analysis of five focus groups involving 17 third year medical students exploring their motivations, experiences and outcomes of engaging in SusQI education as well as their perceptions of the barriers and enablers to translating workshop learning to the clinical context. Through a process of constant comparison across participants, we have been able to identify four distinct educational outcomes: activated, cautious, frustrated and pre-contemplative SusQI practitioners. Activated students tended to be already sustainably minded, internally and altruistically motivated, and experienced a triad of positive reframing: linking their personal values to their future professional practice through quality improvement practices. Cautious students were willing but felt too junior to suggest change, however they expressed willingness to engage with support and permission. Frustrated students saw both the sustainability of the NHS and environmental degradation as intractable problems, with concomitant moral injury, and were discouraged by perceived infrastructural barriers. Pre-contemplative students saw sustainable healthcare practices as beyond their professional scope or interest, preferring nearer more tangible rewards.

The educational approaches within the SusQI workshops appeared successful and students engaged with the learning. They wanted to use their new skills and experienced positive reframing. The main difficulty related to translation of workshop-based learning to behaviours in the clinical context. We therefore discuss our findings in relation to Michie's behaviour change wheel [23] and the associated theoretical domains framework [24]. These describe behaviour as a product of capability, opportunity and motivation with associated domains of evidence-based strategies for behaviour change.

Activated students clearly felt motivated and capable of leading change, suggesting that opportunity was their principle need. Cautious and frustrated students expressed needs relating to perceived capability. Pre-contemplative students' needs related to motivation. These needs were cumulative, so once motivated, students needed to feel that they had the right skills and were capable of making a positive difference, and finally all students needed the opportunity to act.

Figure 4 presents these students on a spectrum of activation, from amotivation and non-regulation; through extrinsic motivation with an externalised locus of control; through to intrinsic motivation and self-determined practice.

If we apply the theoretical domains framework and intervention functions from the behaviour change wheel, this suggests that pre-contemplative students could be supported through incentivisation and/or education: either alignment of project outcomes to their current goals, or reframing their social and professional identity to incorporate longer term goals. Frustrated students could build belief in their capabilities and optimism through seeing near-peers model achievable but impactful projects, and having structural inertia addressed by introducing sustainability into wider multi-professional quality improvement training. Cautious students could be supported through enablement strategies and social support, for example project ideas that were co-created with clinical teams, so that students felt they were working within acceptable norms and not breaking unspoken rules, and SusQI champions to provide ongoing social permission and encouragement. This is supported by previous research that suggests that student projects are more often fruitful when linked to hospital agendas and where there is organisational momentum [25]. A key factor for activated students to undertake a project was not a lack of motivation or lack of confidence in SusQI methods (as long they had access to additional resources for self-directed study), it was finding and creating opportunities in the clinical workplace. Activated students could therefore be supported through infrastructural changes, for example through access to quality improvement networks, resources and allocated time for projects. The national organisations behind the SusQI toolkit, including Health Education England and the Centre for Sustainable Healthcare, are working to rapidly propagate concepts of sustainability within postgraduate and wider health professional quality improvement teaching. This should make it progressively easier for students to get involved if clinical teams are already engaged and familiar with the framework.

## **Strengths and limitations**

This research has built theory from an exploration of a local phenomenon, and as such it should be seen as programme-level theory, rather than mid-range theory or grand theory [26]. Our findings therefore need to be interpreted within our context, and translation to other healthcare schools should be based on local knowledge. We used convenience sampling for focus groups and participants may not be representative of the student population. SdAS and PC were involved in both the intervention and its evaluation, and all researchers are interested in sustainability and planetary health and are therefore likely have positionality on this research. This has been mitigated as far as possible through reflexive discussions and auditing against the underlying data to confirm all views have been represented.

## **Conclusions**

The workshop and resources were successful in building motivation and skills, and in reframing thinking on sustainability in quality improvement. As junior members of the healthcare team, however, many medical students required additional support to apply their learning and realise sustainable value for

services. Our findings, interpreted through existing theories of motivation, educational value and behaviour, suggest several theoretically informed recommendations for education practice. These include wider curricular engagement with concepts of sustainable clinical practice; supportive workplace enablement strategies such as incorporation of sustainability into existing postgraduate QI training, workplace champions and co-creation of improvement goals; and ensuring time and headspace for students to engage through opportunities for credit-bearing project work.

Further research is needed to explore the impacts of these recommendations.

## List Of Abbreviations

SusQI  
Sustainability in Quality Improvement  
QI  
Quality Improvement  
GMC  
General Medical Council  
NHS  
National Health Service

## Declarations

### **Ethics approval and consent to participate**

This research was conducted in accordance with the Declaration of Helsinki and had ethical approval from the University of Bristol Research Ethics Committee #98065. All participants gave written informed consent.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets generated and/or analysed during the current study are not publicly available as this was not included within our consent, but are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

This research was not externally funded.

## Authors' contributions

All authors contributed to the conception and design of the study. PC and SdAS contributed to the intervention. OM and KLG contributed the acquisition, analysis and interpretation of data and drafted the work. All authors revised it critically for important intellectual content and agree to be accountable for all aspects of the work.

## Acknowledgements

We would like to acknowledge the support and encouragement we have received from the Centre for Sustainable Healthcare, Oxford; the Medical Education Research Unit, Imperial College London; and Year 3 Student Choice Team at Bristol Medical School.

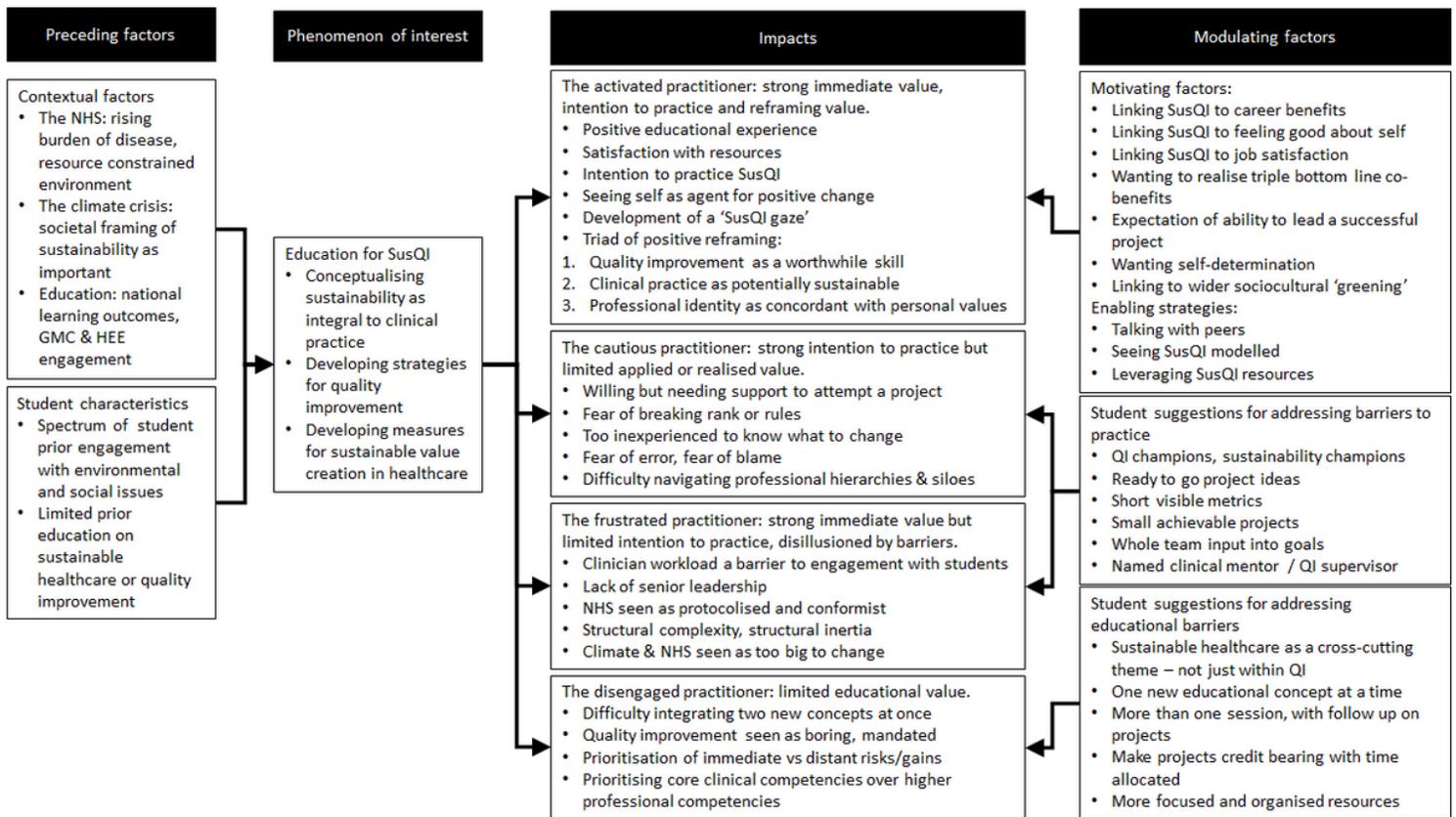
## References

1. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet*. 2009;373(9676):1693–733.
2. Wang H, Horton R. Tackling climate change: the greatest opportunity for global health. *The Lancet*. 2015;386(10006):1798–9.
3. Sustainable Development Unit. What is sustainable health? 2018 [Available from: <https://www.sduhealth.org.uk/policy-strategy/what-is-sustainable-health.aspx>].
4. NHS England and NHS Improvement. Delivering a 'Net Zero' National Health Service. 2020.
5. GMC. Outcomes for Graduates 2018. Available from: [https://www.gmc-uk.org/-/media/documents/dc11326-outcomes-for-graduates-2018\\_pdf-75040796.pdf](https://www.gmc-uk.org/-/media/documents/dc11326-outcomes-for-graduates-2018_pdf-75040796.pdf).
6. Health Education England. The Future Doctor Programme: A co-created vision for the future clinical team. 2020.
7. Mortimer F, Isherwood J, Pearce M, Kenward C, Vaux E. Sustainability in quality improvement: measuring impact. *Future Hospital Journal*. 2018;5(2):94–7.
8. Mortimer F, Isherwood J, Wilkinson A, Vaux E. Sustainability in quality improvement: redefining value. *Future Hospital Journal*. 2018;5(2):88–93.
9. Mortimer F. The sustainable physician. *Clinical Medicine*. 2010;10(2):110–1.
10. Dixon T, Colantonio A, Ganser R, Carpenter J, Ng'ombe A, editors. Measuring socially sustainable urban regeneration in Europe 2009.
11. Smith AC, Holland M, Korkeala O, Warmington J, Forster D, ApSimon H, et al. Health and environmental co-benefits and conflicts of actions to meet UK carbon targets. *Climate Policy*. 2016;16(3):253–83.
12. Clery P, D'Arch Smith S, Marsden O, Leedham-Green K. Sustainability in quality improvement (SusQI): a case-study in undergraduate medical education. Pre-publication communication [Internet]. 2021.

Available from: <https://imperialcollegelondon.box.com/s/ljnzpsxjgwjnozsf2hiuztwlej6qf9k>.

13. Charmaz K. *Constructing grounded theory*: sage; 2014.
14. Strauss A, Corbin JM. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*: SAGE Publications; 1998.
15. Cook DA, Artino Jr AR. Motivation to learn: an overview of contemporary theories. *Medical education*. 2016;50(10):997–1014.
16. Kirkpatrick DL. *Evaluating training programs*: Tata McGraw-Hill Education; 1975.
17. Yardley S, Dornan T. Kirkpatrick's levels and education evidence'. *Medical education*. 2012;46(1):97–106.
18. Michie S, Johnston M. Theories and techniques of behaviour change: Developing a cumulative science of behaviour change. *Health Psychology Review*. 2012;6(1):1–6.
19. Schroeder K, Thompson T, Frith K, Pencheon D. *Sustainable Healthcare*: Wiley; 2012.
20. Kemple T. Toolkit for GPs to take action on climate change. *BMJ*. 2019;364:l1342.
21. Clayton W, Longhurst J, Willmore C. Review of the contribution of Green Capital: Student capital to Bristol's year as European Green Capital. 2016.
22. Healthcare CfS. Sustainability in Quality Improvement 2020 [Available from: <https://www.susqi.org/>].
23. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci*. 2011;6:42.
24. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation science*. 2012;7(1):37.
25. Wong BM, Etchells EE, Kuper A, Levinson W, Shojania KG. Teaching quality improvement and patient safety to trainees: a systematic review. *Acad Med*. 2010;85(9):1425–39.
26. Davidoff F, Dixon-Woods M, Leviton L, Michie S. Demystifying theory and its use in improvement. *BMJ Qual Saf*. 2015;24(3):228–38.

## Figures



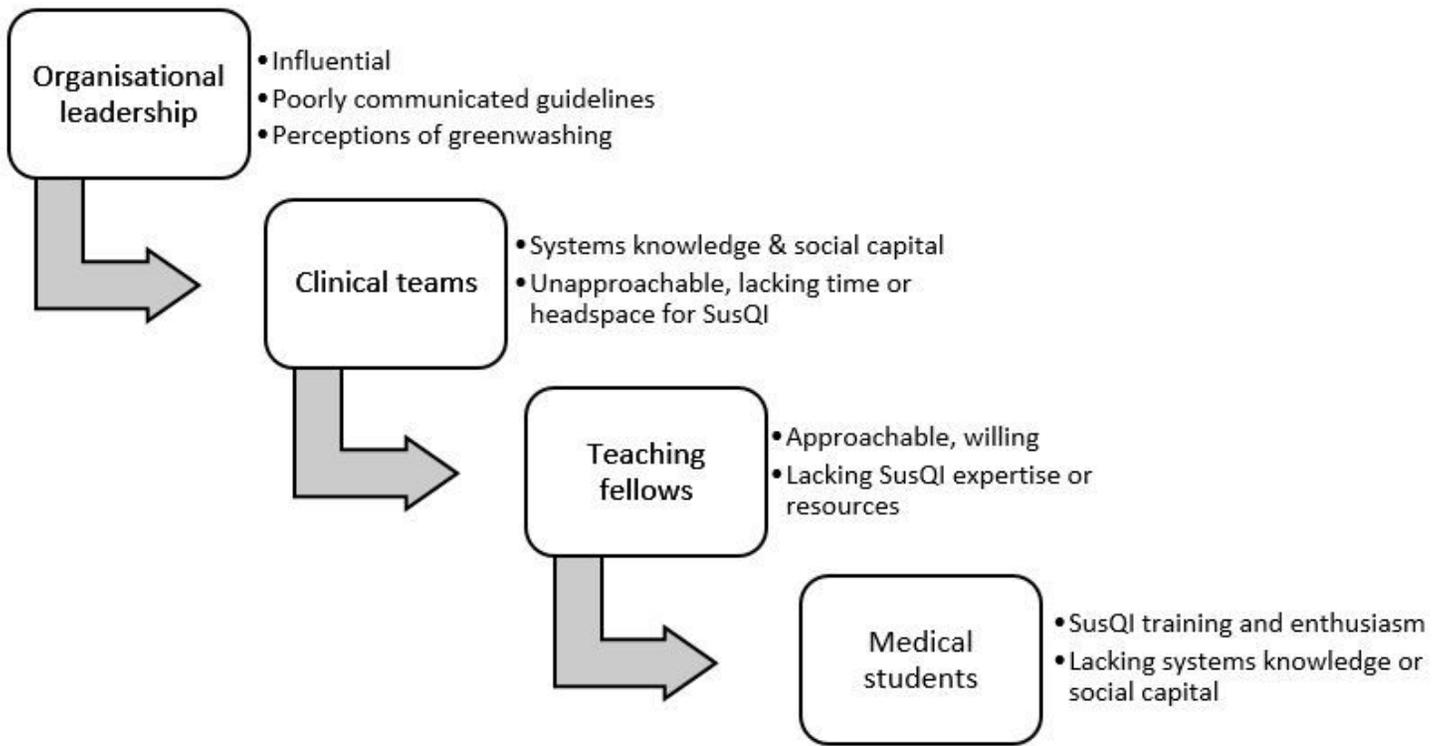
**Figure 1**

Translating SusQI education into practice: a conceptual framework footnote: This conceptual framework was based on a qualitative analysis of focus groups involving third year medical students at Bristol Medical School who had undertaken Sustainability in Quality Improvement (SusQI) training.



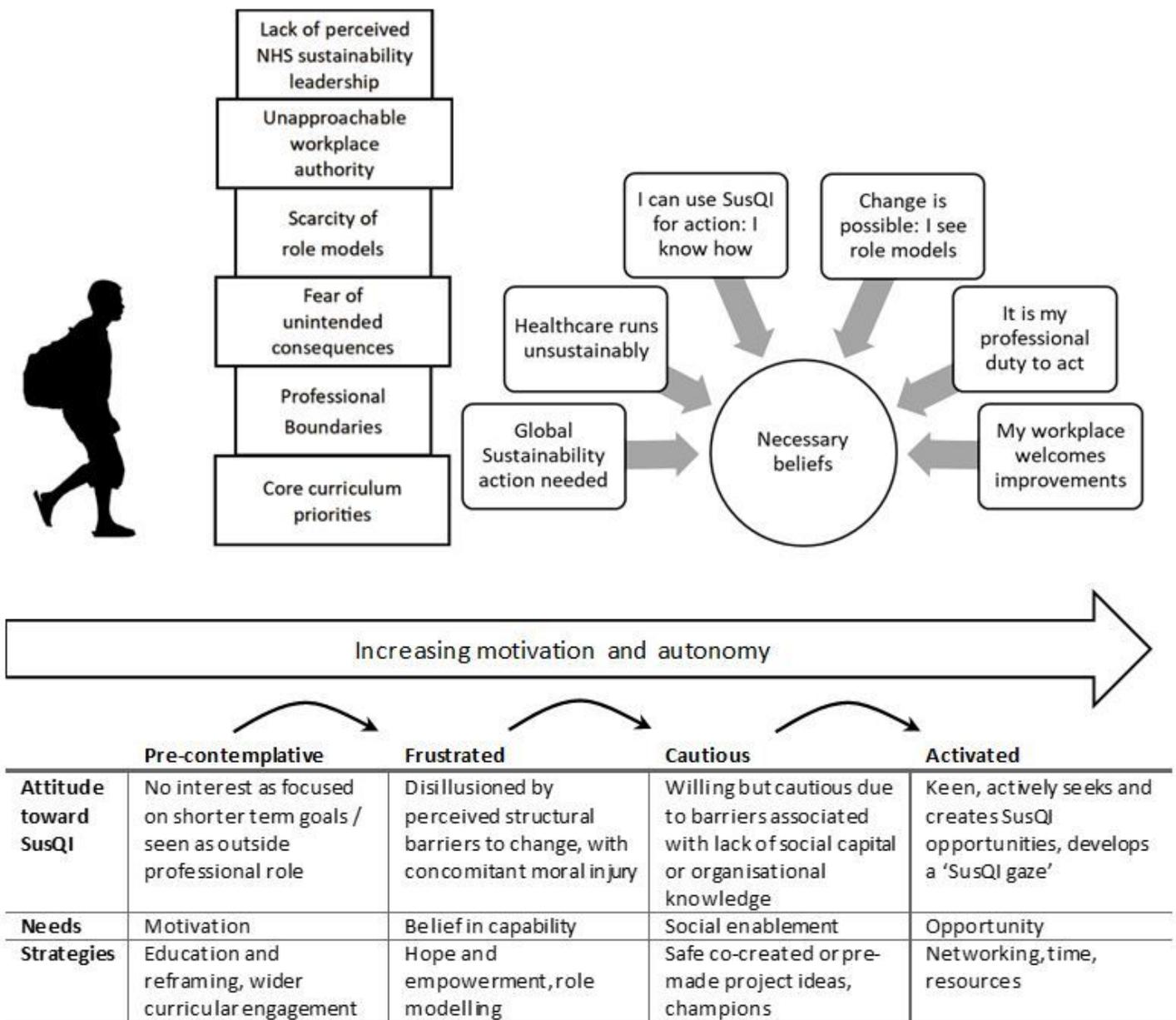
**Figure 2**

The triad of positive reframing for activated SusQI practitioners



**Figure 3**

Student perceptions of the clinical hierarchy in relation to SusQI



**Figure 4**

Theoretical framework for supporting students in addressing barriers and achieving the necessary conditions for action footnote: This analysis was based on focus groups involving third year medical students at Bristol Medical School who had undertaken Sustainability in Quality Improvement (SusQI) training. It was informed by theories of motivation, educational outcome and behaviour.