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The cost-benefits and environmental impact of the no-biopsy approach for the diagnosis of coeliac disease in adults

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Abstract

Objective

Recent evidence suggests that adult patients with IgA tissue transglutaminase levels of ≥10x the upper limit of normal could be accurately diagnosed with coeliac disease without undergoing endoscopy and biopsy. We aimed to evaluate the cost-benefits and the environmental impact of implementing the no-biopsy approach for diagnosing coeliac disease in clinical practice.

Design

We calculated the overall direct and indirect costs of the conventional serology-biopsy approach and the no-biopsy approach for the diagnosis of coeliac disease based on the national average unit costs and the Office of National Statistics data. We further estimated the environmental impact of avoiding endoscopy based on the estimated greenhouse gas emissions from endoscopy.

Results

Approximately 3,000 endoscopies for suspected coeliac disease could be avoided each year in the UK. Implementing the no-biopsy approach for the diagnosis of coeliac disease in adults could save the NHS over £2.5 million in direct and indirect costs per annum and reduce endoscopy carbon footprint by 87 tonnes of CO_2 per year, equivalent to GHG emissions from driving 222,875 miles, carbon emissions from charging over 10 million smartphones, and the carbon sequestrated by 1,438 trees grown for 10 years.

Conclusion

The implementation of this non-invasive green approach could be an essential first step in the “Reduce” strategy advocated by the British Society of Gastroenterology and other international endoscopy societies for sustainable endoscopy practice.

Significance of this study

What is already known on this topic?

- Recent evidence suggests that a 10- fold increase in IgA antitissue transglutaminase (tTG) antibody levels is sufficient to diagnose coeliac disease in adults without upper GI endoscopy and biopsy.
- Upper GI endoscopy is invasive, expensive, and associated with a substantial carbon footprint.
- Endoscopy services are under immense pressure following the COVID-19 pandemic, with hundreds of thousands of people on endoscopy waiting lists.

What this study adds

- We found that implementing the no-biopsy approach to diagnose coeliac disease could save the NHS over £2.5 million in direct and indirect costs per annum.
- The annual endoscopy carbon footprint could be reduced by 87 tonnes of CO_2, equivalent to driving over 200,000 miles or planting over 1,000 trees.

How this study might affect research, practice or policy

- Implementing the no-biopsy approach to diagnose adults with coeliac disease in clinical practice could have a substantial financial and environmental impact by avoiding unnecessary upper GI endoscopy procedures.
- This non-invasive green approach is a readily available first step towards a net-zero greenhouse gas emissions GI endoscopy.

Introduction

Coeliac disease is a chronic autoimmune disorder triggered by ingesting dietary gluten in genetically susceptible individuals [1]. It is estimated that one in a hundred people have coeliac disease, but a significant proportion of patients remain undiagnosed [2]. The current pathway for diagnosing coeliac disease in adults involves detecting serum endomysial and/or tissue transglutaminase (tTG) antibodies, followed by upper gastrointestinal (GI) endoscopy and duodenal biopsy to confirm the diagnosis [3]. However, upper GI endoscopy is an invasive procedure that often results in poor tolerance and considerable patient anxiety. It is also associated with risks of serious complications such as aspiration, bleeding, and perforation [4].

In the UK, over half a million people undergo upper GI endoscopy each year, posing a significant burden on the healthcare system in terms of capacity and financial consideration. The most recent National census of UK endoscopy services demonstrated the high pressures and rising demand on endoscopy services, with hundreds of thousands of people on endoscopy waiting lists, and only 18% of services meeting the routine endoscopy waiting time targets [5]. The environmental impact of GI endoscopy is also substantial as one of the highest hazardous waste-generating departments in healthcare [6]. The high energy consumption, resource-intensive decontamination, and patient and staff travel add to the substantial greenhouse gas (GHG) emissions from GI endoscopy [7–9]. The British Society of Gastroenterology (BSG) and other international endoscopy societies issued position statements calling for immediate actions to mitigate the negative environmental impact of GI endoscopy [10][11]. Avoiding unnecessary procedures comes at the forefront of their recommendations to implement the “Reduce, Reuse, and Recycle” strategy to achieve a

more sustainable GI endoscopy practice aiming for a net-zero GHG emissions practice by 2050 [11].

The BSG COVID-19-specific interim guidance suggested that adult patients (< 55 years) with IgA-tTG levels of ≥10x the upper limit of normal (ULN) could be diagnosed with coeliac disease without undergoing upper GI endoscopy and biopsy in the absence of red-flag symptoms [12]. Recent studies have confirmed that this no-biopsy approach has a high predictive value (>95%) for intestinal villous atrophy in adults [13–15]. However, the economic and environmental consequences of adopting the no-biopsy approach have not been studied.

The aim of this study was to estimate the potential cost-benefits and the environmental impact of implementing the no-biopsy approach for the diagnosis of coeliac disease in adults.

Methods

We used the recently published Scottish data to estimate the annual number of endoscopies performed in the UK for suspected coeliac disease [14]. In this study, 1,429 patients had positive coeliac serology, of whom only 1,037 (72.5%) underwent endoscopy and biopsy [14]. Extrapolating these rates to the UK adult populations suggests that at least 10,000 endoscopies are performed for suspected coeliac disease each year. Studies have shown that approximately 30% to 50% of patients with positive serology will have IgA-tTG levels ≥10x ULN. Hence, using the lowest estimates, 3,000 endoscopies per year could be avoided [13–16].

We calculated the overall cost of two diagnostic pathways for adults with suspected coeliac disease. The standard pathway involves serology followed by confirmatory endoscopy and biopsy, and the no-biopsy pathway involves serological testing only. Both pathways will require referral to secondary care gastroenterology. We used the 2021/2022 National Cost Collection for the NHS to estimate the national average unit costs of initial blood tests, diagnostic upper gastrointestinal endoscopy with biopsy, histopathology, and first attendance to the Gastroenterology clinic (Figure 1) [17]. Assuming that 50% of the endoscopies were performed under conscious sedation, patients would require 1 or 2 days off work. Time off work per patient was calculated based on the 2022 Office of National Statistics median pay for full-time employees [18].

The GHG emissions from endoscopy were calculated based on recently published data by Lacroute et al. who used multi-criteria method to estimate the direct and indirect GHG emissions from energy consumption, waste, consumables, freight, travel, medical and non-medical equipment [8].

Results

Direct costs savings

The overall cost of the standard diagnostic pathway, including first Gastroenterology clinic appointment, was £1017.62 per patient, and the overall cost of the no-biopsy pathway was £232.38 per patient with first gastroenterology clinic appointment included in both pathways. Based on our estimation of 10,000 endoscopies for suspected coeliac disease per annum, almost 3,000 endoscopies could be avoided. The annual cost of the standard biopsy pathway would be £7,123,340 (7,000 patients) compared with £697,140 (3,000 patients) for the no-biopsy pathway. Therefore, adopting a no-biopsy approach would reduce the overall annual costs associated with the diagnosis of coeliac disease from £10,176,200 to £7,820,480, saving the NHS over £2 million per annum.

Productivity savings

We assumed that 50% of patients had endoscopy under conscious sedation. This means that patients who had un-sedated endoscopy would miss one day at work, and those who had sedation would miss the day of the endoscopy and the following day. If 75% of the patients were full-time employees, avoiding endoscopy in 3,000 patients will save 27,000 working hours or 3,375 working days with indirect cost savings of at least £432,000.

Environmental impact

The GHG emissions from endoscopy were calculated based on recently published data by Lacroute et al. who used multi-criteria method to estimate the direct and indirect GHG emissions from energy consumption, waste, consumables, freight, travel, medical and non-

medical equipment [8]. Additionally, the GHG emissions from processing of pathology specimens were calculated based on data from life cycle analysis by Gordon et al. [19].

Hence, if 3,000 endoscopies are avoided with the implementation of the no-biopsy approach on a national level, approximately 87 tonnes of CO_2 will be saved. This is equivalent to the GHG emissions from driving an average passenger vehicle for 222,875 miles, carbon emissions from charging over 10 million smartphones, and the carbon sequestrated by 1,438 trees grown for 10 years (Figure 2) [20].

Discussion

This is the first study to estimate the cost benefits and the positive environmental impact of the no-biopsy approach for the diagnosis of coeliac disease in adults. We estimated that 3,000 patients with IgA-TTG levels ≥10x ULN would avoid endoscopy and biopsy each year in the UK, if the no-biopsy approach is implemented on a national scale. This would result in over £2 million in direct cost savings and at least £432,000 in indirect cost savings as avoiding endoscopy and sedation could prevent the loss of over 27,000 working hours. Furthermore, our study found that implementing the no-biopsy approach could significantly reduce the negative environmental impact and the high GHG emissions associated with endoscopy. The carbon emissions saved were approximately 87 tonnes of CO_2 per year, equivalent to GHG emissions from driving 222,875 miles, carbon emissions from charging over 10 million smartphones, and the carbon sequestrated by 1,438 trees grown for 10 years (Figure 2).

The potential benefits of the no-biopsy approach addresses all three factors of sustainability: economy, environment and society [21]. Beyond its cost benefits and positive environmental impact, this approach offers significant advantages to patients and society. It has been reported that patients with positive serology can wait up to 3 months for endoscopy to confirm the diagnosis of coeliac disease. During this time, they are advised to continue consuming gluten that could be causing them significant symptoms. Implementing the no-biopsy approach could streamline the diagnostic process for a considerable proportion of patients with coeliac disease, whereas the freed-up endoscopy slots can be reallocated to tackle the long waiting lists [5]. Moreover, adherence to the biopsy guidelines occurs only in 40% of cases which increases the risk of missed diagnosis [22]. Therefore, avoiding endoscopy could significantly reduce the waiting time to start treatment and the

risk of missed diagnosis. Additionally, studies have shown that almost a third of patients with positive serology are not referred for confirmatory biopsy despite the clear recommendations from national guidelines at the time [14,15]. This could be, in part, due to the patients' fear of undergoing an invasive procedure with the associated risk of serious complications. Hence, avoiding endoscopy could also lead to an appropriate increase in coeliac disease diagnoses. Conversely, implementing the no-biopsy approach without increasing adherence to the serology-biopsy guidelines in primary care and without developing referral pathways to gastroenterology for the serology-based diagnosis may have unintended consequences such as increased inappropriate diagnoses of coeliac disease or missing co-pathology [23]. A no-biopsy diagnosis of coeliac disease should be a shared decision between patients and gastroenterologists, informed by the best available evidence including the small risk (1% - 5%) of false-positive results [13].

This study has some limitations. Although we used a conservative estimate for those who may not require endoscopy for coeliac diagnosis based on the recent relevant literature, this data is based on IgA-tTG values alone and does not account for those who have an IgA-tTG levels ≥10x ULN but would not qualify for the no-biopsy approach due to meeting the age cut-off or having co-existing red flag symptoms. However, the cost-benefit analysis performed in this study is based on the average unit cost and does not include the cost of staff, complications, endoscopy decontamination and reprocessing. Therefore, the overall cost-benefits are likely to be higher than our estimations. Another limitation is that our calculation of the environmental impact of the no-biopsy approach relied on estimates from a study conducted in France, which may have underestimated the true environmental impact because of France's reliance on nuclear energy for electricity [8]. The lack of a comprehensive life cycle analysis may have also underestimated the endoscopy carbon

footprint in our study. Further work is needed to define the accurate cost and environmental impact of this approach. In conclusion, our study demonstrates that the no-biopsy approach for the diagnosis of coeliac disease in adults is associated with significant cost benefits and reduction in the carbon footprint of endoscopy. Implementing this non-invasive green approach could be an essential first step in the “Reduce” strategy advocated by the BSG and other international endoscopy societies for a more sustainable endoscopy practice.

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Figure legends

Figure 1 – The average unit costs per patient of the standard serology-biopsy pathway (Blue) and the no-biopsy pathway (Green) for the diagnosis of coeliac disease in adults

IgA-tTG, IgA tissue transglutaminase; ULN, upper limit of normal

Figure 2 – The environmental impact of implementing the no-biopsy approach for the diagnosis of coeliac disease in adults

CO_2, Carbon dioxide

Contributorship Statement

MGS and AJH analysed the data. MGS wrote the initial manuscript draft. AJH, NN, SAR, FWDT, LI, HAP and DSS provided critical revisions and edited the manuscript. All authors approved the final version of the manuscript.

Competing interests

HAP has received a speaker honorarium from ThermoFisher.

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Ethics

No ethical approval