# **BMJ Open** Barriers and facilitators to implementing reusable personal protective equipment in hospitals, and their impacts on environment, care safety, costs, and supply chain resilience: a scoping review protocol

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Introduction Climate degradation poses a significant global health challenge, with healthcare systems paradoxically contributing to this issue while adhering to the principle of 'do no harm'. Notably, the healthcare sector accounts for a considerable share of greenhouse gas emissions in many industrialised countries, primarily due to the supply chain, including pharmaceuticals. disposable medical devices and personal protective equipment (PPE). The COVID-19 pandemic exacerbated this issue, with millions of tons of CO, emissions attributed to single-use PPE. In response to the pandemic, some hospitals have begun adopting and implementing reusable PPE as a sustainable alternative to reduce emissions, enhance resilience to supply chain disruptions and achieve cost savings. This scoping review aims to synthesise the available evidence on the adoption, implementation barriers and facilitators, as well as the impacts of reusable PPE in hospital settings.

Methods and analysis This protocol is based on York's five-stage framework outlined by Arksey and O'Malley. We will map evidence on the environmental and economic impacts of reusable versus disposable PPE, and the associated infection risks. Using an adapted Consolidated Framework for Implementation Research, our scoping review will identify enablers and barriers to implementation across different clinical settings. The methodology will adhere to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Review guidelines and will include a comprehensive search of peer-reviewed articles in five databases (Medline, Embase, CINAHL, Web of Science and Global Health) and grey literature. Databases will be searched from inception to December 2024. Two reviewers will independently evaluate the eligibility of all identified titles and abstracts for inclusion in the full-text review, as well as for data extraction. Descriptive data will provide insights into the enablers and facilitators of reusable PPE adoption and implementation, along with its impacts on patient and staff safety, costs, the environment and supply chain resilience to disruptions will be reported.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The review employs an adapted Consolidated Framework for Implementation Research, providing a structured approach to understanding the enablers and barriers to implementing reusable personal protective equipment.
- ⇒ The review will include a formal quality assessment or grading of the evidence using the mixed-methods appraisal tool.
- ⇒ The inclusion of diverse study types—both qualitative and quantitative—may result in significant heterogeneity in study designs, data collection methods and outcome measures.

Ethics and dissemination We expect the results to both identify research gaps and generate novel ideas for future studies on transitioning to reusable PPE in healthcare settings. This review will offer healthcare decision-makers valuable insights into the factors influencing the shift from disposable to reusable PPE and its associated impacts. By refining PPE management strategies, the findings will enable managers to clearly understand the challenges and anticipated outcomes, thereby guiding effective decision-making and facilitating a smooth transition that minimises operational disruptions while upholding patient and staff safety. Ethics approval was not required for this review. The findings will be shared through conferences on healthcare management and sustainability, and submitted to peer-reviewed journals in healthcare management and implementation science.

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#### INTRODUCTION

Climate degradation represents a global health challenge with significant implications for both the environment and public health. Paradoxically, healthcare systems contribute to this degradation, contradicting their fundamental principle of 'do no harm'. The health sector contributes significantly to national emissions in many countries, with hospitals being major emitters. In industrialised countries, healthcare systems are indeed responsible for a significant share of greenhouse gas (GHG) emissions. For instance, in the USA, the healthcare sector accounts for approximately 8.5% of the nation's GHG emissions.<sup>1</sup> In Canada, healthcare contributes around 5% of total emissions, surpassing even the aviation industry.<sup>1</sup> The UK's National Health Service is responsible for about 5.4% of the country's GHG emissions.<sup>1</sup> France also has similar figures, with the healthcare sector contributing between 5% and 7% of the national total.<sup>1</sup> A large part of emissions comes from scope 3 (indirect) emissions, which are largely due to the supply chain, including pharmaceuticals, medical devices and personal protective equipment (PPE) such as gloves, masks and gowns.<sup>2</sup> Most PPE items are available in both reusable and single-use forms. Although single-use PPE was originally designed to minimise infection transmission, research indicates that reusable PPE does not necessarily carry an increased risk of infections and still provides safe protection for staff and patients.<sup>3-5</sup> Life cycle assessments have shown that reusable PPE, including gowns, masks and gloves, consumes less energy, generates less waste and produces fewer GHG emissions over its entire lifespan compared with single-use alternatives. <sup>3</sup> <sup>6-8</sup>However, environmental impact may differ depending on the local context-particularly the local energy<sup>3</sup>—and one study demonstrates that reusable PPE is linked to increased water consumption, largely due to the water-intensive cotton production required for reusable gowns.<sup>8</sup> Additionally, several studies highlight significant cost savings, with some estimates suggesting up to 75% reduction in costs per usage of reusable PPE compared with disposable counterparts.<sup>9-11</sup> During the COVID-19 pandemic, it was estimated that PPE was responsible for millions of tons of CO<sub>o</sub> equivalent emissions globally, with single-use masks and gloves contributing significantly to these emissions. For example, a study found that the global healthcare sector generated approximately 1.6 million tons of plastic waste per day during the pandemic, a considerable portion of which was attributed to disposable PPE.<sup>12</sup> Moreover, supply chain disruptions during the pandemic posed significant challenges for healthcare facilities in procuring single-use PPE.<sup>13</sup>

In response to these challenges—not only environmental but also logistical and cost-related—some hospitals worldwide that previously relied on single-use PPE have transitioned to reusable alternatives, driven by the need to reduce GHG emissions, mitigate supply chain disruptions and achieve cost savings, all while maintaining high standards of safety and performance.

Despite these promising developments, some concerns remain. These include the potential for increased infection risk, the high initial investment costs and the logistical demands of washing and storing reusable PPE. Although BMJ Open: first published as 10.1136/bmjopen-2024-096504 on 23 May 2025. Downloaded from http://bmjopen.bmj.com/ on June 12, 2025 at Universite Paris Est Creteil . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

some studies show that the utilisation of reusable PPE does not increase the risk of infections, these issues merit balanced consideration as healthcare facilities weigh the benefits and challenges associated with adopting reusable PPE.<sup>13</sup>

While there is growing recognition of the advantages of reusable PPE,<sup>14</sup> there is currently no clear synthesis of the literature on the implementation of reusable PPE in hospital settings and its comprehensive impact on the environment, patient and staff safety and cost-effectiveness. Therefore, in this scoping review, we aim to synthesise the available evidence on the adoption, implementation barriers and facilitators and impacts of reusable PPE in hospital settings, addressing both its benefits and the challenges it presents.

## **METHODS AND ANALYSIS**

## Protocol design

The review started in September 2024 and is expected to be completed by August 2025. The protocol for this scoping review was registered in the Open Science Framework.<sup>15</sup> To ensure reproducibility, our review will follow the reporting standards outlined in the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines (see online supplemental appendix 2).<sup>16</sup> This protocol is based on York's five-stage framework outlined by Arksey and O'Malley.<sup>17</sup>

## Stage 1: identifying research questions and hypotheses

Through consultation with our team of researchers with diverse expertises (health management, health economics, biostatistics and medicine), the research questions are the following:

- ► What are the barriers and facilitators towards adopting and implementing reusable PPE in hospital settings? Are these adoption and implementation factors different across various clinical units or sectors (eg, low risk vs high-risk surgical units, surgical units vs other units)?
- ► What is the environmental impact of reusable PPE versus disposable PPE in hospital settings?
- What are the differences in patient and staff safety between reusable PPE and disposable PPE in hospital settings? Specifically, how do they compare in terms of infection risk levels and protective performance?
- ► What is the impact of reusable PPE versus disposable PPE on the resilience to supply chain disruption?
- What are the economic costs and benefits of reusable PPE versus disposable PPE in hospital settings?

We hypothesise that implementing reusable PPE in hospital settings will result in reduced GHG emissions and plastic waste, maintain comparable infection risk levels, increase resilience to supply chain disruptions and lead to substantial cost savings, making it a cost-effective solution.

#### Stage 2: identifying relevant studies Review conceptual model

The review will be conducted using an adapted version of the updated Consolidated Framework for Implementation Research by Damschroder *et al.*<sup>18</sup> This framework will facilitate an exploration of various domains related to the implementation of innovations and their outcomes. In this context, 'innovations' refer to interventions such as reusable PPE used in hospital settings.

The review will investigate both enablers and barriers to the implementation of reusable PPE through several domains:

- 1. *Implementation process*: examining the activities and strategies employed to adopt and integrate reusable PPE.
- 2. *Roles of individuals/stakeholders*: assessing factors such as preferences, acceptability, resistance to change and the influence of individual leadership on the implementation process.
- 3. *Inner setting*: analysing characteristics of hospital settings, including types of clinical units, institutional culture and infrastructure.
- 4. *Outer setting*: evaluating the impact of regulatory and policy contexts on the adoption and implementation of reusable PPE. It will be particularly examined whether safety standards and guidelines for reusable PPE exist, and how the presence or absence of these standards might influence the adoption and implementation of these innovations by healthcare facilities.

Additionally, the framework will explore the outcomes of reusable PPE through four domains of impact: financial costs, environmental impact, patient and staff safety and resilience to supply chain disruptions.

## Eligibility criteria

The Population, Concept and Context framework was applied as a guide to construct the eligibility criteria of our scoping review.<sup>19</sup> Eligibility criteria are available in table 1.

## Search strategy

We will conduct a comprehensive search of several electronic databases, including MEDLINE-Ovid, EMBASE-Ovid, Global Health, Web of Science and CINAHL (EBSCO), to gather relevant evidence. Databases will be searched from inception to December 2024. All searches will be conducted in English and will encompass both qualitative and quantitative study designs. Additionally, we will perform a thorough search of grey literature through platforms such as Google Scholar, OpenGrey, Scopus, Faculty Opinions, Publons and governmental websites, including the WHO, Agency for Healthcare Research and Quality, Institute for Healthcare Improvement and Sustainable Healthcare Coalition. Additionally, we will search the grey literature for market research and related documents from reusable PPE manufacturers. We received support from a librarian in developing and validating our research strategies for the databases.

Table 1     Inclusion and exclusion criteria						
	Inclusion criteria	Exclusion criteria				
Study focus	Any type of publication based on primary or secondary research findings focusing on the adoption and implementation of reusable PPE, and/or their impact(s) on the environment, costs and infection risks	Studies neither focusing on reusable PPE implementation nor impact of PPE on infectior risk, environment or costs				
Population	Hospital settings, any types of clinical sectors or units	N/A				
Study context	Hospital settings	Other settings than hospitals (eg, nursing homes, primary care)				
Intervention	Adoption and implementation of reusable PPE (gowns, gloves, masks, respirators, head covers, shoe covers, eye protection and goggles)	Adoption and implementation of reusable medical equipment or devices, excluding reusable PPE				
Outcomes	Environmental impact (greenhouse gas emissions, waste generation, energy and water consumption) Patient and staff safety (PPE protective performance, transmission of pathogens, healthcare-associated infections) Resilience to supply chain disruption Cost reduction					
Study characteristics	Original research articles Reviews of any types Reports Book chapters Conference proceedings Dissertations/theses	Expert opinions or reviews Theoretical frameworks				
Timeframe	No constraints					
Publication language	No constraints	Unable to obtain translation				
N/A, not applicable; PPE, personal protective equipment.						

Table 2 Search terms								
Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6			
Reusable PPE	Implementation barriers, implementation facilitators	Environmental impact, sustainability	Care safety	Economic impact, financial impact	Supply chain resilience/ vulnerability			
Reusable gowns	Organisational challenges, logistic challenges, procurement challenges	GHG emissions	Pathogen transmission, cross-contamination prevention	Cost-benefit analysis, life-cycle costing	Supply chain vulnerability			
Reusable masks	Adoption, transition, switching	Carbon footprint	Laundry process efficacy	Cost saving, financial gain, economic gain	Supply chain resilience			
Reusable gloves	Feasibility	Life cycle assessment	Protective performance, protective value	Financial sustainability, economic viability				
Reusable face covers, shoe covers	Acceptability, resistance, preference	Material waste, waste management	Healthcare-associated infections, nosocomial infections	Economic evaluation, economic assessment				
Reusable face shields								
Reusable respirators								
Reusable eye protection								
GHG, greenhouse gas; PPE, personal protective equipment.								

To refine our search strategy, we initially developed it in MEDLINE, utilising Medical Subject Headings (MeSH) and relevant keywords specific to the implementation and impacts of reusable PPE. We employed the search terms listed in table 2, which presents a non-exhaustive list of these terms. Following a pilot search on PubMed, we reviewed the titles and abstracts of potential sources to identify additional relevant terms and index terms for incorporation into our MEDLINE search strategy (see online supplemental appendix 1).

To ensure the accuracy and comprehensiveness of the search strategy, a health sciences librarian meticulously reviewed it in accordance with the Peer Review of Electronic Search Strategies guidelines<sup>20</sup> before adapting it for other databases. Additionally, we will contact authors of ongoing or upcoming studies to request full-text articles or any supplementary information as needed. We will also search for relevant studies based on the reference lists of the included articles.

## Stage 3: selecting eligible studies

Based on the search strategies developed for each database, all identified studies will be imported into EndNote referencing software to remove duplicates. Two reviewers (NC and CB) will independently assess the relevance of all titles and abstracts using the inclusion and exclusion criteria, facilitated by Covidence. A pilot round involving a randomly selected sample of 10% of the articles will be conducted to evaluate inter-reviewer agreement on the inclusion and exclusion criteria prior to the full screening of all articles.<sup>21 22</sup> Two additional reviewers (FMC and CL) will serve as referees to resolve disagreements between the primary reviewers.

Non-relevant studies will be excluded, and the full texts of selected articles will be assessed to ascertain eligibility for inclusion by the two reviewers. Any disagreements that arise during this process will be resolved through discussion with the third and fourth reviewers.

Screening for eligible studies will be performed with the systematic review management platform RYYAN (https://www.rayyan.ai/).

## Stage 4: extracting data

At this stage, the two reviewers will extract data from the included articles and conduct the evidence synthesis. We will use a data extraction form adapted from the Joanna Briggs Institute's template. The following key information will be collected from the relevant studies: authors, publication year, country, study design, clinical settings, conceptual framework (if applicable), objectives, methods, findings and reported limitations. Additionally, the form will capture key findings related to the scoping review questions and outcomes of interest: (1) enablers and barriers to the implementation of reusable PPE, (2) environmental impact of reusable PPE utilisation, (3)

impact on patient and staff safety, (4) effects on cost and (5) effect on the supply chain resilience/vulnerability.

Simultaneously with data extraction, we will assess the quality of the evidence using the Mixed-Methods Appraisal Tool (MMAT). Given the anticipated heterogeneity in study designs and methods among the articles included in the scoping review, the MMAT is particularly well suited for evaluating their quality.<sup>23</sup>

## Stage 5: structuring the data synthesis

The primary aim of this scoping review is to compile findings and provide an overview of the research rather than evaluate the quality of the studies. We will utilise the PRISMA-ScR checklist to guide the data synthesis process.<sup>16</sup> The synthesis criteria will be based on the number of studies reporting outcomes of interest related to the research questions. A narrative synthesis will be employed to present these findings. For quantitative data concerning impacts on one or more dimensions (environment, patient and staff safety, cost and resilience of the supply chain), descriptive statistics will be reported. Qualitative data will be analysed using a conceptual model that addresses multiple dimensions of implementation: (1) the process of implementation, (2) roles of stakeholders, (3) inner setting and (4) outer setting.

## Patient and public involvement

Patients and the public were not involved in any way in the development of the scoping review protocol.

#### ETHICS AND DISSEMINATION

Since the scoping review methodology involves reviewing and collecting data from publicly available materials, this study does not require ethics approval. We anticipate that the results will highlight research gaps and generate novel ideas for future studies on transitioning to reusable PPE in healthcare settings. The findings will be submitted for publication to relevant peer-reviewed journals and conferences focused on healthcare management and implementation science.

Beyond academic contributions, this scoping review will provide healthcare decision-makers and staff with insights into the implementation factors and potential impacts associated with transitioning from disposable to reusable PPE. The review will objectively assess the differences in patient and staff safety between reusable and disposable PPE, as well as other factors such as cost, environmental impact and logistical requirements. This evidence will inform protocols and practices, enabling healthcare facilities to consider the implementation of reusable PPE based on a comprehensive evaluation of the available data. Ultimately, the results will not only enhance the effectiveness of reusable PPE implementation within individual hospitals but also contribute to the broader development of best practices that can be shared across the healthcare sector.

## Strengths and limitations of this scoping review

The scoping review has several strengths, including its comprehensive approach to synthesising evidence from diverse healthcare settings and its use of a robust conceptual framework to explore multiple aspects of reusable PPE implementation. By examining key impacts—such as environmental footprint, cost-effectiveness, patient and staff safety and supply chain resilience—the review will provide a broad overview of the topic, highlighting both enablers and barriers to adoption. Its rigorous methodology, which includes thorough database searches, multiple stages of data extraction and adherence to PRISMA-ScR guidelines, enhances transparency and reproducibility.

However, the review also has limitations. The reliance on published literature may introduce publication bias, particularly if negative or inconclusive studies are under-represented. Given the inclusion of diverse study types—both qualitative and quantitative—there may be significant heterogeneity in study designs, data collection methods and outcome measures. To address this, we will categorise studies by common themes and conduct a narrative synthesis to identify key patterns. By using a conceptual framework to guide the analysis, we will transparently present the diversity in the evidence, allowing us to draw meaningful conclusions despite the variability in study characteristics.

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#### REFERENCES

- Andrieu B, Marrauld L, Vidal O, *et al.* Health-care systems' resource footprints and their access and quality in 49 regions between 1995 and 2015: an input-output analysis. *Lancet Planet Health* 2023;7:e747–58.
- 2 Seppänen AV, Or Z. Comment améliorer la soutenabilité environnementale des systèmes de santé? Report No.: 278. Institut de Recherche et de Documentation en Économie de la Santé; 2023.278.
- 3 Bromley-Dulfano R, Chan J, Jain N, et al. Switching from disposable to reusable PPE. BMJ 2024;384:e075778.
- 4 Gumera A, Mil M, Hains L, *et al.* Reusable surgical headwear has a reduced carbon footprint and matches disposables regarding surgical site infection: a systematic review and meta-analysis. *J Hosp Infect* 2024;152:164–72.
- 5 McQuerry M, Easter E, Cao A. Disposable versus reusable medical gowns: A performance comparison. *Am J Infect Control* 2021;49:563–70.
- 6 Hiloidhari M, Bandyopadhyay S, Snigdha. Environmental footprints of disposable and reusable personal protective equipment – a product life cycle approach for body coveralls. *J Clean Prod* 2023;394:136166.
- 7 Vozzola E, Overcash M, Griffing E. Environmental considerations in the selection of isolation gowns: A life cycle assessment of reusable and disposable alternatives. *Am J Infect Control* 2018;46:881–6.
- 8 Burguburu A, Tanné C, Bosc K, *et al.* Comparative life cycle assessment of reusable and disposable scrub suits used in hospital operating rooms. *Clean Environ Syst* 2022;4:100068.
- 9 Baykasoğlu A, Dereli T, Yilankirkan N. Application of cost/benefit analysis for surgical gown and drape selection: a case study. Am J Infect Control 2009;37:215–26.

- 10 Baker N, Bromley-Dulfano R, Chan J, et al. COVID-19 Solutions Are Climate Solutions: Lessons From Reusable Gowns. Front Public Health 2020;8:590275.
- 11 Overcash M. A comparison of reusable and disposable perioperative textiles: sustainability state-of-the-art 2012. *Anesth Analg* 2012;114:1055–66.
- 12 Patrício Silva AL, Tubić A, Vujić M, et al. Implications of COVID-19 pandemic on environmental compartments: Is plastic pollution a major issue? J Hazard Mater Adv 2022;5:100041.
- 13 Varangu L, Cowan K, Amin O, *et al*. Reusable personal protective equipment in Canadian healthcare: Safe, secure, and sustainable. *Healthc Manage Forum* 2023;36:207–16.
- 14 Reynier T, Berahou M, Albaladejo P, et al. Moving towards green anaesthesia: Are patient safety and environmentally friendly practices compatible? A focus on single-use devices. Anaesth Crit Care Pain Med 2021;40:100907.
- 15 Clavel N, Castonguay FM, Williams S, et al. A scoping review of reusable personal protective equipment in hospitals: barriers, facilitators, and impacts on environment, care safety, costs, and supply chain resilience. OSF 2024. Available: https://doi.org/10. 17605/OSF.IO/DESVU
- 16 Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 2018;169:467–73.
- 17 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
- 18 Damschroder LJ, Reardon CM, Widerquist MAO, et al. The updated Consolidated Framework for Implementation Research based on user feedback. *Implement Sci* 2022;17:75.
- 19 Pollock D, Peters MDJ, Khalil H, *et al.* Recommendations for the extraction, analysis, and presentation of results in scoping reviews. *JBI Evid Synth* 2023;21:520–32.
- 20 McGowan J, Sampson M, Salzwedel DM, et al. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. J Clin Epidemiol 2016;75:40–6.
- 21 Long L. Routine piloting in systematic reviews--a modified approach? *Syst Rev* 2014;3:77.
- 22 Polanin JR, Pigott TD, Espelage DL, et al. Best practice guidelines for abstract screening large-evidence systematic reviews and metaanalyses. *Res Synth Methods* 2019;10:330–42.
- 23 Hong QN, Gonzalez-Reyes A, Pluye P. Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the Mixed Methods Appraisal Tool (MMAT). *J Eval Clin Pract* 2018;24:459–67.