Endoscopic Sustainability PrimAry Reporting Essentials (E-SPARE): European Society of Gastrointestinal Endoscopy (ESGE) Position Statement

ESGE

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ABSTRACT

A growing number of studies aim to evaluate gastrointestinal (GI) endoscopy services from the perspective of their environmental impact. However, there are currently no guidelines or frameworks which provide specifically for the reporting of endoscopy sustainability studies, and a variety of metrics and assessment tools have been employed in the literature. To improve the clarity, transparency, and quality of reporting, the European Society of Gastrointestinal Endoscopy (ESGE) has developed a reporting framework for the community of researchers interested in conducting studies on sustainable GI endoscopy.

SCOPE AND PURPOSE

This Position Statement from the European Society of Gastrointestinal Endoscopy (ESGE) reviews the literature pertaining to environmental impacts in gastrointestinal endoscopy and presents a framework to improve the reporting of these environmental sustainability studies with regard to clarity, transparency, and quality.

ABBREVIATIONS

CO_2e	carbon dioxide equivalent
ESGE	European Society of Gastrointestinal Endoscopy
GHG	greenhouse gas
GI	gastrointestinal
GWP	global warming potential
ISO	International Organization for Standardization
LCA	life cycle assessment
LCI	life cycle inventory (analysis phase)
LCIA	life cycle impact assessment

1 Introduction

Healthcare provision is estimated to account for 4%–5% of global greenhouse gas emissions [1]. It is now a focus for endoscopic societies worldwide to mitigate environmental pollution attributable to gastrointestinal (GI) endoscopy services and to identify strategies to align with national decarbonization commitments [2–4]. However, there is currently no standardized approach to the measurement of environmental impacts in this context. Methodological heterogeneity in the studies conducted to date limits the extent to which research findings can be generalized beyond an individual setting. The lack of a consistent approach to measurement and reporting also complicates attempts to compare the environmental impacts of various products or strategies. The complex relationships between clinical process, resource utilization, waste management, and environmental impacts hamper reproducibility even further.

The need for methodological consistency in this evolving field has compelled the European Society of Gastrointestinal Endoscopy (ESGE) to develop a methodological and reporting framework for the community of researchers interested in conducting studies on sustainable GI endoscopy. This document also underlines the commitment of the ESGE Green Endoscopy Working Group to develop an international research network around the issue of environmental awareness.

The aim of E-SPARE (**E**ndoscopic **S**ustainability **P**rim**A**ry **R**eporting **E**ssentials) is to outline the core dimensions for the conduct and reporting of GI endoscopy sustainability studies, and to develop a checklist which helps standardize this approach. This document, developed by and addressed to endoscopists, is designed to create recommendations and serve as a minimum reporting standards guide for authors, readers, editors, and reviewers involved in GI endoscopy sustainability studies. To enhance the understanding of some core terminology and improve its standardized implementation in the clinical literature, a glossary of technical terminology is provided in ▶ **Table 1**.

▶ **Table 1** Glossary of technical terminology for a better understanding of sustainable gastrointestinal endoscopy studies.

Term	Definition/description
5 R principles	Reduce–Reuse–Recycle–Rethink–Research. Circular model to improve sustainable practices, often applied in waste management and resource conservation [5]
carbon dioxide equivalent, CO_2e	Standardized metric to quantify the emissions of various greenhouse gases (GHGs) based up on their global warming potential relative to CO_2 [6]
carbon footprint	Total set of greenhouse gas emissions generated directly and indirectly by an individual, event, organization, or product [7]
carbon neutrality	GHG offsetting objective achieved when human-related CO_2 emissions are counterbalanced by human-induced CO_2 removals within a designated timeframe. In contrast to net zero CO_2 emissions, it may involve the purchase of carbon certificates as a carbon emission offsetting strategy [6]
circular economy	Economic model characterized by activities intentionally designed to restore or regenerate resources. The aim is to eliminate waste through innovative material, product, and system design in order to ultimately decouple growth from the consumption of finite resources [8]
climate change	Long-term weather and temperature changes mostly driven by human-related activities [6]
decarbonization	Endeavor pursued by nations, individuals, or organizations to reach zero fossil carbon presence. Mostly refers to measures aimed at reducing carbon emissions associated with electricity generation, industrial activities, and transportation [6]
ecosystem	An ecosystem comprises living organisms, their abiotic environment, and the interactions occurring within and among them, forming a functional unit [6]
energy efficiency	The measure of useful energy, service, or physical outputs a system, conversion process, transmission, or storage activity provides compared to the energy it takes in [6]
fossil fuel	Fuel derived from fossilized hydrocarbon deposits, primarily composed of carbon. Examples include coal, petroleum, and natural gas [6]
functional unit	The measure of a product or system determined by the performance it delivers in its intended use (i. e., item or process that is being measured) [9]
global warming	Prolonged rise in global temperatures, primarily driven by an increase in atmospheric GHGs [6]
global warming potential (GWP)	Measure developed to quantify the warming effects of various gases relative to CO_2 emissions. A GWP greater than 1 indicates that the particular gas has a greater warming effect on Earth compared to CO_2 during that specific timeframe (usually 100 years) [10]
green endoscopy	GI endoscopy practice aimed at raising awareness of the environmental impact of endoscopy and assessing, and developing measures to reduce it. May also represent an international group of healthcare professionals that advocate for sustainable practices within endoscopic practice [11, 12]
green public procurement/green purchasing	A procurement strategy which prioritizes the purchase of products which have been created and supplied with minimal environmental impact, when compared with competing products that serve the same purpose [13]
greenhouse gases (GHGs)	Atmospheric elements that absorb and release radiation at particular wavelengths within the range of terrestrial radiation emitted by the Earth's surface, the atmosphere, and clouds. This characteristic leads to the greenhouse effect. Key GHGs include water vapor, carbon dioxide, nitrous oxide, methane, and ozone [6]
ISO 14040/14044 standards	International Organization for Standardization (ISO) refers to a worldwide federation of national standards bodies. In this particular case, ISO 14040/14044 refers to international standards that cover life cycle assessment (LCA) studies [9, 13]
landfill waste	Landfill waste refers to solid waste materials such as nonrecyclable items (plastic bags, food waste, paper products, and other household waste) that are disposed of in specially designed areas called landfills. Also, in the present context, non-recyclable endoscopy supplies not contaminated with body fluids [14, 15]
LCA	Life cycle assessment. Methodology that systematically evaluates the environmental factors and potential consequences of product systems through a “cradle-to-grave” or “cradle-to-cradle” analysis, spanning from obtaining raw materials to their ultimate disposal, according to specified objectives and boundaries [9, 13]
▪ LCA goal and scope	*First phase of an LCA*: Includes the specifying principles (functional unit and system boundaries), requirements and guidelines to assess the environmental impacts of products, processes, and organizations [9, 13]
▪ life cycle inventory (LCI) analysis phase	*Second phase of an LCA*: Compilation and quantification of data inputs and outputs for a product or service throughout its life cycle, necessary to meet the goals of the defined study [9, 13]

▶ **Table 1** (Continuation)

Term	Definition/description
▪ life cycle impact assessment (LCIA) phase	*Third phase of an LCA*: Evaluation of the scale and importance of potential environmental impacts associated with a product system over its entire lifecycle. In this phase, LCI results are assigned to impact categories, with specific emissions and resource usages linked to broader environmental and human health impacts. These results provide insights into the environmental concerns linked with both the inputs and outputs of the product system [9, 13]
▪ life cycle interpretation	*Final phase of an LCA*: Summary and discussion of LCI and/or LCIA results in relation to the defined goal and scope, in order to reach conclusions and recommendations [9, 13]
net zero (CO_2) emissions	The state when human-related GHG emissions are counterbalanced by human-induced GHG removals from the atmosphere within a designated timeframe. Frequently referred as a synonym of carbon neutrality. However, net zero CO_2 emissions do not allow carbon offsetting strategies of any other kind, such as the purchase of carbon certificates [6]
planetary health (study of)	Interdisciplinary domain and societal initiative dedicated to examining and tackling the consequences of human activities on Earth's natural systems, impacting both human health and global biodiversity [16, 17]
regulated medical waste	Nonrecyclable items saturated with body fluids or containing infectious agents [14, 15]
Scopes 1, 2, and 3	*Scope 1*: Direct emissions (e. g. fuel combustion for boilers or vehicles, CO_2 insufflation) *Scope 2*: Indirect emissions associated with the purchase of electricity (e. g., for heating, ventilation, or cooling) *Scope 3*: Indirect emissions generated within the supply chain of endoscopic supplies (manufacturing, transportation, and disposal) [18, 19]
sustainability	Dynamic process composed of three domains: environmental, economic, and social. Sustainability foresees the fulfillment of present needs without jeopardizing the capacity of future generations to fulfill their own [6]
sustainable health care	Equally distributed high quality health care based on patient empowerment, prevention, lean services, and low carbon alternatives [20, 21]
sustainable value in healthcare	A framework which aims to maximize health care outcomes for patients and populations, while considering the environmental, social, and economic costs [20]
system boundary	A defined set of criteria for selecting the unit processes that form a product system [9]
temperature overshoot	Temporary surpassing of a predetermined threshold for global warming [6]
triple bottom line	Accounting framework that assesses performance across three dimensions: social, environmental, and financial [22]

2 Methods

2.1 Methods approach

This document focuses on reporting strategies in GI endoscopy sustainability studies and has been developed according to the current ESGE Publications Policy [23]. Considering the current lack of robust evidence and the significance of the topic, a position statement was deemed the most suitable approach. The E-SPARE was developed based on available evidence, complemented by expert consensus where evidence was lacking. The checklist (▶ **Table 2**) was developed to provide authors, readers, editors, and reviewers with a practical tool to aid study design, reporting, and interpretation of GI endoscopy-related sustainability studies. The comprehensive reporting of environmental impact assessment methods, including life cycle assessment (LCA) or engineering domains, fall outside the scope of this document.

In the absence of guidelines or frameworks which provide specifically for the reporting of GI endoscopy sustainability studies, a variety of metrics and assessment tools have been employed in the literature. This methodological heterogeneity hinders a systematic comparison of reporting and data presentation. Acknowledging the challenges posed by the heterogeneity of reporting in GI endoscopy sustainability studies, in April 2024 the project leaders (J.A.C.N., R.B., E.R.D.S., and M.D.R.) carried out a relevance assessment phase, based on a systematic search of all studies on sustainable GI endoscopy, proposing an initial list of core domains and a preliminary checklist.

In June 2024, an email invitation to participate in the Position Statement was sent to a group of experts in sustainable GI endoscopy. The selection of panelists was conducted by the project leaders, according to their expertise in sustainable GI endoscopy, research background, and position statement development. The ESGE Executive Committee subsequently approved a final list encompassing 24 panelists, all of whom are practising gastrointestinal endoscopists.

A virtual online meeting was held in July 2024, during which panelists provided feedback on the Position Statement's structure, preliminary list of domains, checklist, and glossary. A final list of 6 core domains: topic and overview (2 statements),

▶ **Table 2** **E**ndoscopic **S**ustainability **P**rim**A**ry **R**eporting **E**ssentials (E-SPARE) checklist.

		Item	Recommendation	Reported on manuscript page
Title and Abstract: Topic and Overview	Title	1	Title should include the environmental impact and intervention, as appropriate.	
	Abstract	2	The abstract should include a description of the rationale, the intervention, if applicable, and the method used for environmental impact assessment.	
Introduction: Background and Aims	Background/ Motivation	3	Describe the scientific background and the rationale for the reported study.	
	Aims/Objectives	4	State the study hypothesis and objectives.	
		5	Describe the potential impact of the study on GI endoscopy practice.	
Methods: Data Acquisition and Description	Study design	6	State and justify the goal and scope of the environmental impact assessment, defining:	
			a: The functional unit of analysis, i. e. a clearly quantified definition of the item or process that is being measured[1].	
			b: The boundary of analysis, including the clinical care pathway and the temporospatial boundaries (an illustrative schematic is recommended).	
		7	Describe key study parameters, including, where applicable:	
			a: Clinical setting (e. g., home, ambulatory, inpatient).	
			b: Departmental characteristics[2].	
			c: Time period and location of data collection and any recruitment/ exposure.	
			d: A description of the multidisciplinary expertise involved in the study team[3].	
		8	The methodological approach used to assess environmental impacts should be explicitly stated and justified[4].	
		9	An evaluation of the patient perspective should be included if relevant to the study outcome measure(s).	
	Interventions	10	Describe any interventions performed, in sufficient detail to permit replication.	
	Variables and outcomes	11	Define and justify the environmental impacts chosen for assessment[5] using standard terminology and units of measurement (e. g. $kgCO_2e$).	
		12	Clearly state and justify any assumptions or exclusions.	
	Data sources/ management	13	Data sources are reported based on the type of analysis applied[6].	
		14	Where resources are shared across activities, provide details on how these resources have been assigned to each activity and justify the rationale for the allocation method used[7].	
	Bias	15	Clearly describe any attempts to address potential sources of bias[8].	
	Sample size	16	Provide an explanation as to how the sample size was calculated.	
	Quantitative and qualitative variables	17	Describe how quantitative and qualitative variables were handled in the analyses.	
	Statistical methods	18	Describe all statistical methods, including those to control confounders.	
		19	Describe methods used to examine subgroups and interactions.	
		20	Explain how missing data were addressed.	
		21	Data sources used for the impact assessment are described and justified[9].	

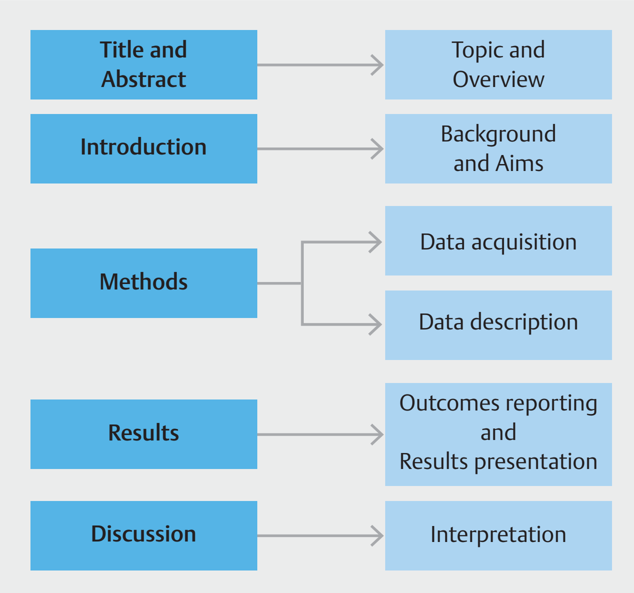
▶ **Table 2** (Continuation)

		Item	Recommendation	Reported on manuscript page
Results: Outcome reporting and Results presentation	Outcome data	22	Endoscopic procedures included in the analysis should be characterized, including (as applicable): type and number, setting (outpatient/inpatient), length of stay, type of sedation, anesthesia, or other medication used.	
		23	Details of the endoscopic devices used in the study should be disclosed, when applicable[10].	
		24	The reporting of GHG emissions should include a breakdown according to the "scope" classification included in the GHG Protocol, when applicable[11].	
		25	Outcome data should be separated into the following domains: preprocedure; periprocedure; post-procedure, when applicable.	
		26	Disclose unadjusted estimates and potential confounder-adjusted estimates with respective precision (e. g., 95 % confidence interval). Clearly state which confounders were adjusted for and the reason to do so, when applicable. The sensitivity of the results to key assumptions or parameters should be explored with an uncertainty assessment.	
Discussion: Interpretation	Main results	27	Describe the main results of the study according to the study objectives.	
	Interpretation	28	Discuss relevant social and financial implications of the findings, in addition to environmental impacts (the "triple bottom line" framework). Particular attention should be paid to any implications for clinical service provision.	
	Generalizability	29	Discuss the generalizability and applicability of the results.	
	Limitations	30	Include a paragraph with the limitations of the study, including potential sources of bias. Discuss potential ways to overcome these limitations. If this has already been included in the interpretation section, may discuss additional limitations.	
	Conclusion	31	If study findings have clear implications for a potential change in process, practice or policy, discuss the necessary next steps for researchers and key stakeholders (e. g., clinicians, suppliers, regulators).	
		32	Draw the main conclusions from the study and recommendations for future study.	

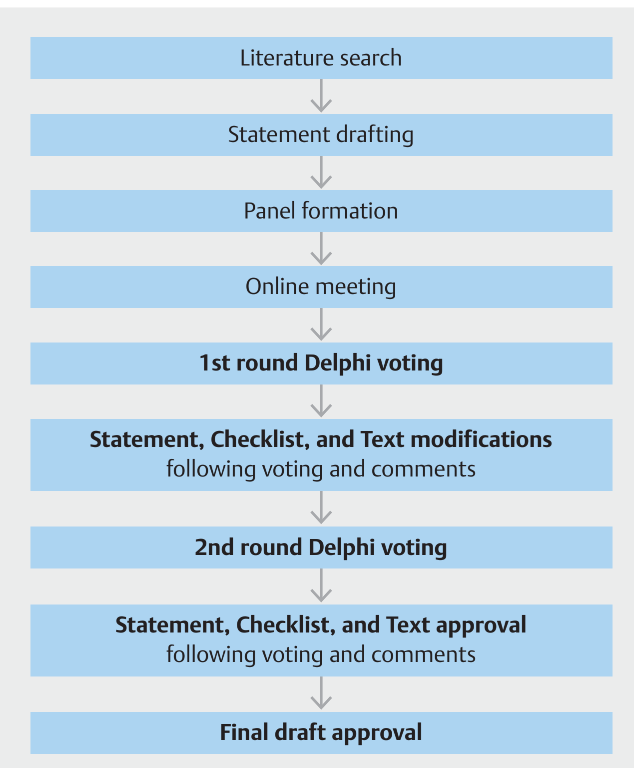
GI, gastrointestinal; GHG, greenhouse gas; CO2e, carbon dioxide equivalent.
Examples:
[1] "The functional unit of the study was chosen as 'the use of endoscopic forceps to obtain a colonic biopsy,' or 'one diagnostic gastroscopy.'"
[2] Setting, floor area, heating, ventilation, air conditioning (HVAC) system, energy source, procedure mix and volume, decontamination protocol, staffing model, patient and staff travel patterns.
[3] For example, if study authors include those with expertise in environmental or materials science.
[4] Carbon footprinting, life cycle assessment (LCA).
[5] Global warming, fine particulate matter formation, water consumption.
[6] Whether activity data is process-based (e. g., production data or operational metrics) or financial (e. g., cost or expenditure records), and whether these are derived from primary or secondary sources.
[7] "Utility use (water, electricity) was allocated to the endoscopy department by its share of floor surface area."
[8] Selection bias (e. g., limiting analysis to procedures with clear environmental benefits), measurement bias (e. g., variability in calculating carbon footprints or waste), or confirmation bias (e. g., focusing solely on positive outcomes of green initiatives).
[9] Emission-related impact studies should specify the emission factors used and their origin, ensuring transparency regarding the reliability of the emissions factors, their relevance to endoscopy, their geographic and temporal applicability, and their scope and boundaries (e. g., cradle-to-grave or operational phases only). Disclose any related assumptions or uncertainties, and if a life cycle inventory database was used (e. g. Ecoinvent, Base Carbone).
[10] Type, brand, major components, single-use vs. reusable, recyclable vs. non-recyclable.
[11] *Scope 1*, emissions directly produced from healthcare facilities, e. g. anesthetic gases or fossil fuels. *Scope 2*, indirect emissions, e. g. electricity or heating/cooling. *Scope 3*, emissions occurring in the health care supply chain, both upstream and downstream, e. g. transportation.

background and aims (3 statements); data acquisition (4 statements) and data description (12 statements); outcome reporting and results presentation (5 statements); and interpretation (6 statements) (▶ **Fig. 1**) was shared with the group, alongside a literature review text supporting the recommendations and a revised version of the checklist.

The consensus among panelists for the checklist statements was reached using a modified anonymous Delphi process. A brief summary of the Delphi process is presented in ▶ **Fig. 2**. In November 2024 panelists voted and provided feedback for each statement in a free-text box. To reach consensus, a maximum of two voting rounds was established beforehand. Statements were graded with a 5-point Likert scale (1, Strongly



▶ **Fig. 1** The six core domains of gastrointestinal endoscopy sustainability studies.



▶ **Fig. 2** Delphi process for developing checklist statements.

disagree; 2, Disagree; 3, Neither agree nor disagree; 4, Agree; 5, Strongly agree) via SurveyMonkey (SurveyMonkey, San Mateo, California, USA; www.surveymonkey.com). Consensus was defined as ≥ 80 % agreement (the sum of Agree and Strongly agree) on each statement. Prior to the second voting round (December 2024), checklist statements and text modifications were reviewed and refined based on panelists' suggestions. Response changes from one round to the next were considered relevant if ≥ 20 %. The results of each voting round are detailed in the **Supplementary Material** (available online-only). Once the voting rounds were complete, the project leaders shared a final draft of the manuscript for approval by all members. During this final assessment of the manuscript, no modifications of the checklist content were allowed.

The peer review process for ESGE policy documents was followed. Members from the ESGE board, along with project leaders and external experts reviewed the manuscript. The final position statement was approved by all authors and submitted to the journal *Endoscopy* for publication.

2.2 Search strategy

A systematic search for relevant articles in English from January 2014 until January 2024 was performed in the following databases: PubMed, Web of Science, and CENTRAL. The included search terms and strategy, combining keywords (e. g. MeSH) and natural language, are described in the **Supplementary Material**. Two authors (J.A.C.N. and R.B.) independently performed the literature search and reviewed the obtained results. This search included articles on sustainable GI endoscopy, focusing on methodology and reporting of environmental impacts.

2.3 Inclusion and exclusion criteria

The inclusion criteria for article selection encompassed original articles that aimed to quantify the environmental impacts of GI endoscopy. Systematic reviews, reviews, abstracts, posters, editorials, brief communications, letters to the editor, and non-English records were excluded. Following the elimination of duplicates, and screening based on titles and abstracts, the remaining articles underwent eligibility review by J.A.C.N. and R.B. When an overlap was identified, it was resolved by the corresponding authors (E.R.D.S. and M.D.R.).

2.4 Data extraction and outcomes

To facilitate systematic data extraction and methodological assessment of included studies, project leaders collectively agreed upon evaluating specific domains within each study. Variables of interest such as the first author of the study, year of publication, study setting and design, aims, and outcomes of the study were identified (▶ **Table 3**). All relevant information was extracted by J.A.C.N. and R.B. independently.

3 The 6 core domains of GI sustainability studies

3.1 Topic and overview (Title and abstract)

STATEMENT 1
Title should include the environmental impact and intervention, as appropriate.
Agreement 96 %

► **Table 3** Published original articles on sustainable gastrointestinal endoscopy.

Author	Year	Setting	Study design	Aims	Outcomes
Gordon IO, et al. [24]	2021	USA	Cross-sectional study	Assessment of the environmental footprint of processing a GI biopsy sample	Primary outcome: carbon dioxide emissions (kgCO_2e)
Namburar S, et al. [25]	2022	USA	Cross-sectional study	Assessment of endoscopic waste generation at a low- and high-volume hospitals and comparative impact assessment of single-use and reusable endoscopes	Primary outcome: average amount of waste produced per endoscopic procedure at each and both hospitals Secondary outcome: single-use endoscope waste estimation
Le NNT, et al. [26]	2022	USA	Cross-sectional study	Comparison of "cradle-to-grave" environmental and human health burdens of single-use and reusable duodenoscopes	Primary outcome: carbon dioxide emissions (kgCO_2e) plus 22 other environmental indicators Secondary outcome: impact on human health
Cunha Neves JA, et al. [15]	2023	Portugal	Single-center prospective interventional study	Implementation of sustainable endoscopy practice and audit on waste carbon footprint and processing expenses in a low/medium volume endoscopy unit. Assessment of waste carbon footprint from diagnostic upper GI endoscopy and colonoscopy.	Primary outcomes: (i) waste carbon footprint (kgCO_2e); (ii) waste-processing expenses – disposal of landfill and regulated medical waste in € per kg; (iii) presentation of retrieved data and educational seminars for endoscopy staff; (iv) reorganization and implementation of recycling streams within endoscopy rooms Secondary outcomes: (i) anonymous survey of the study's impact on daily work routine; (ii) waste carbon footprint of diagnostic GI upper endoscopy (kgCO_2e) prior to and after intervention; (iii) waste carbon footprint of diagnostic colonoscopy (kgCO_2e) prior to and after intervention
Yong KK, et al. [27]	2023	UK	Multicenter retrospective study	Assessment of the environmental and clinical impact of combining several small colorectal polyps within a single specimen pot	Primary outcome: carbon dioxide emissions associated with histology sampling (kgCO_2e)
Lacroute J, et al. [28]	2023	France	Single-center retrospective observational study	Analysis of the annual carbon footprint of GI procedures performed in an ambulatory endoscopic digestive center	Primary outcome: carbon footprint of GI endoscopy (tCO2e) Secondary outcome: contribution (%) of each emission class to the total carbon footprint
López-Muñoz P, et al. [29]	2023	Spain	Single-center prospective interventional study	Determination of endoscopic instruments' composition and LCA. Establishment of a recycling mark ("green mark") on endoscopic instruments and assessment of its potential to reduce environmental impact related to GI endoscopy practice	Primary outcome: endoscopic instrument (biopsy forceps, polypectomy snares and hemostatic clips) composition analysis and LCA (carbon footprint) Secondary outcome: prospective intervention to assess carbon footprint differences based on the establishment of the "green mark"
Zullo A, et al. [30]	2023	Italy	Cross-sectional study	Ability of real time Endofaster-guided biopsies to reduce the environmental impact of upper GI endoscopy compared to conventional biopsy sampling	Primary outcome: comparison of CO_2 emissions (kgCO_2e) between Endofaster-guided biopsies and conventional biopsy sampling
Henniger D, et al. [31]	2023	Germany	Single-center prospective interventional study	Assessment of the yearly carbon emissions of a GI endoscopy unit	Primary outcome: annual Scope 3 emissions (tCO_2e)

▶ **Table 3** (Continuation)

Author	Year	Setting	Study design	Aims	Outcomes
Shiha MG, et al. [32]	2024	UK	Cross-sectional study	Estimation of potential cost-benefits and environmental impact of non-invasive strategies for diagnosing celiac disease during adulthood	Primary outcome: overall cost savings (in pounds, £) Secondary outcomes: (i) GHG emissions from endoscopic procedures and biopsy samples (tCO2e); (ii) productivity savings (in pounds, £)
Desai M, et al. [33]	2024	USA	Single-center prospective observational study	Assessment of solid and liquid waste and energy use practices in a tertiary endoscopy unit. Assessment of staff-guided recyclable waste audit, encompassing examination of used and discarded materials, with identification of areas of potential improvement.	Primary outcome: total and per day waste generation and energy consumption during routine GI endoscopy Secondary outcomes: (i) average total waste per 100 procedures and annually; (ii) identification of potentially recyclable waste based on an audit
Elli L, et al. [34]	2024	Italy	Cross-sectional study	Environmental impact of inappropriate endoscopic procedures	Primary outcome: global carbon footprint (tCO_2e) per endoscopic procedure
Ribeiro T, et al. [35]	2024	Portugal	Single-center prospective observational study	Estimation of endoscopic waste produced at a tertiary gastroenterology center	Primary outcomes: (i) amount of endoscopic waste produced in pre- and postprocedural areas, endoscopy rooms, and reprocessing area; (ii) waste-processing expenses as a result of waste disposal Secondary outcome: water consumption (liters) during reprocessing after a single endoscopy
Cho JH, et al. [36]	2024	South Korea	Single-center prospective observational study	Assessment of the environmental impact and cost reduction of using EGGIM score versus OLGIM staging through biopsy sampling	Primary outcome: environmental impact ($kgCO_2e$) and cost reduction (dollars, $) of performing and processing biopsies according to OLGIM criteria versus optical diagnosis using EGGIM score
Pioche M, et al. [37]	2024	France	Single-center prospective observational study	Quantification of the GHG emissions related to a small-bowel capsule endoscopy (SBCE) examination	Primary outcome: GHG emissions ($kgCO_2e$) of an SBCE procedure
Pioche M, et al. [38]	2024	France	Single-center prospective observational study	LCA comparison of carbon emissions of single-use versus reusable gastroscopes. Examination of environmental impact outcomes associated with reprocessing and waste management of single-use and reusable gastroscopes	Primary outcome: carbon footprint of single-use or reusable gastroscopes for upper endoscopy Secondary outcome: assessment of other environmental impacts

CO_2e carbon dioxide equivalent ($kgCO_2e$, kilograms; tCO_2e, tonnes); EGGIM, endoscopic grading of gastric intestinal metaplasia; GHG, greenhouse gas; GI, gastrointestinal; LCA, life cycle assessment; OLGIM, operative link on gastric intestinal metaplasia; UK, United Kingdom; USA, United States of America.

STATEMENT 2
The abstract should include a description of the rationale, the intervention (if applicable), and the method used for environmental impact assessment.
Agreement 100 %

3.2 Background and aims (Introduction)

STATEMENT 3
Describe the scientific background and the rationale for the reported study.
Agreement 100 %

STATEMENT 4
State the study hypothesis and objectives.
Agreement 100 %

STATEMENT 5
Describe the potential impact of the study on GI endoscopy practice.
Agreement 100 %

3.3 Data acquisition (Methods)

STATEMENT 6
State and justify the goal and scope of the environmental impact assessment, defining:
6a The functional unit of analysis, i. e. a clearly quantified definition of the item or process that is being measured (e. g., the functional unit of the study was chosen as "the use of endoscopic forceps to obtain a colonic biopsy," or as "one diagnostic gastroscopy").
6b The boundary of analysis, including the clinical care pathway and the temporospatial boundaries (an illustrative schematic is recommended).
Agreement 100 %

STATEMENT 7
Describe key study parameters, including, where applicable:
7a Clinical setting (e. g., home, ambulatory, inpatient).
Agreement 100 %
7b Departmental characteristics (i. e., setting, floor area, heating, ventilation, and air conditioning [HVAC] system, energy source, procedure mix and volume, decontamination protocol, staffing model, patient and staff travel patterns).
Agreement 100 %
7c Time period and location of data collection and any recruitment/exposure.
Agreement 96 %
7d A description of the multidisciplinary expertise involved in the study team (e. g. if study authors include those with expertise in environmental or materials science).
Agreement 96 %

STATEMENT 8
The methodological approach used to assess environmental impacts should be explicitly stated and justified (e. g., carbon footprinting, life cycle assessment [LCA]).
Agreement 100 %

STATEMENT 9
An evaluation of the patient perspective should be included if relevant to the study outcome measure(s).
Agreement 96 %

3.4 Data description (Methods)

STATEMENT 10
Describe any interventions performed, in sufficient detail to permit replication.
Agreement 100 %

STATEMENT 11
Define and justify the environmental impacts chosen for assessment (e. g. global warming, fine particulate matter formation, water consumption), using standard terminology and units of measurement (e. g. $kgCO_2e$).
Agreement 100 %

STATEMENT 12
Clearly state and justify any assumptions or exclusions.
Agreement 100 %

STATEMENT 13
Data sources are reported based on the type of analysis applied. For example, whether activity data is process-based (e. g., production data or operational metrics) or financial (e. g., cost or expenditure records), and whether these are derived from primary or secondary sources.
Agreement 92 %

STATEMENT 14
Where resources are shared across activities, provide details on how these resources have been assigned to each activity and justify the rationale for the allocation method used. For example, "utility use (water, electricity) was allocated to the endoscopy department by its share of floor surface area."
Agreement 96 %

STATEMENT 15
Clearly describe any attempts to address potential sources of bias, such as selection bias (e.g., limiting analysis to procedures with clear environmental benefits), measurement bias (e.g., variability in calculating carbon footprints or waste), or confirmation bias (e.g., focusing solely on positive outcomes of green initiatives).
Agreement 100%

STATEMENT 16
Provide an explanation as to how the sample size was calculated.
Agreement 100%

STATEMENT 17
Describe how quantitative and qualitative variables were handled in the analyses.
Agreement 95%

STATEMENT 18
Describe all statistical methods, including those to control confounders.
Agreement 95%

STATEMENT 19
Describe methods used to examine subgroups and interactions.
Agreement 90%

STATEMENT 20
Explain how missing data were addressed.
Agreement 90%

STATEMENT 21
Data sources used for the impact assessment are described and justified. For example, emission-related impact studies should specify the emission factors used and their origin, ensuring transparency regarding the reliability of the emissions factors, their relevance to endoscopy, their geographic and temporal applicability and their scope and boundaries (e.g., cradle-to-grave or operational phases only). Disclose any related assumptions or uncertainties, and if a life cycle inventory database was used (e.g. Ecoinvent, Base Carbone).
Agreement 91%

3.5 Outcome reporting and Results presentation (Results)

STATEMENT 22
Endoscopic procedures included in the analysis should be characterized, including (as applicable): type and number, setting (outpatient/inpatient), length of stay, type of sedation, and anesthesia or other medication used.
Agreement 87%

STATEMENT 23
Details of the endoscopic devices used in the study (e.g. type, brand, major components, single-use vs. reusable, recyclable vs. non-recyclable) should be disclosed, when applicable.
Agreement 100%

STATEMENT 24
The reporting of greenhouse gas (GHG) emissions should include a breakdown according to the “scope” classification included in the GHG Protocol, when applicable: Scope 1 (emissions directly produced from healthcare facilities, e.g., anesthetic gases or fuel combustion); Scope 2 (indirect emissions generated from purchased energy, e.g., electricity, heating, cooling); Scope 3 (emissions occurring in the healthcare supply chain, both upstream and downstream, e.g., transportation).
Agreement 100%

STATEMENT 25
Outcome data should be separated into the following domains: preprocedure; periprocedure; post-procedure; when applicable.
Agreement 86%

STATEMENT 26
Disclose unadjusted estimates and potential confounder-adjusted estimates with respective precision (e.g., 95% confidence interval). Clearly state which confounders were adjusted for and the reason to do so, when applicable. The sensitivity of the results to key assumptions or parameters should be explored with an uncertainty assessment.
Agreement 91%

3.6 Interpretation (Discussion)

STATEMENT 27
Describe the main results of the study according to the study objectives.
Agreement 100 %

STATEMENT 28
Discuss relevant social and financial implications of the findings, in addition to environmental impacts (the "triple bottom line" framework). Particular attention should be paid to any implications for clinical service provision.
Agreement 100 %

STATEMENT 29
Discuss the generalizability and applicability of the results.
Agreement 100 %

STATEMENT 30
Include a paragraph on the limitations of the study, including potential sources of bias. Discuss potential ways to overcome these limitations. If this has already been included in the interpretation section, may discuss additional limitations.
Agreement 100 %

STATEMENT 31
If study findings have clear implications for a potential change in process, practice, or policy, discuss the necessary next steps for researchers and key stakeholders (e. g., clinicians, suppliers, regulators).
Agreement 100 %

STATEMENT 32
Draw the main conclusions from the study and recommendations for future study.
Agreement 100 %

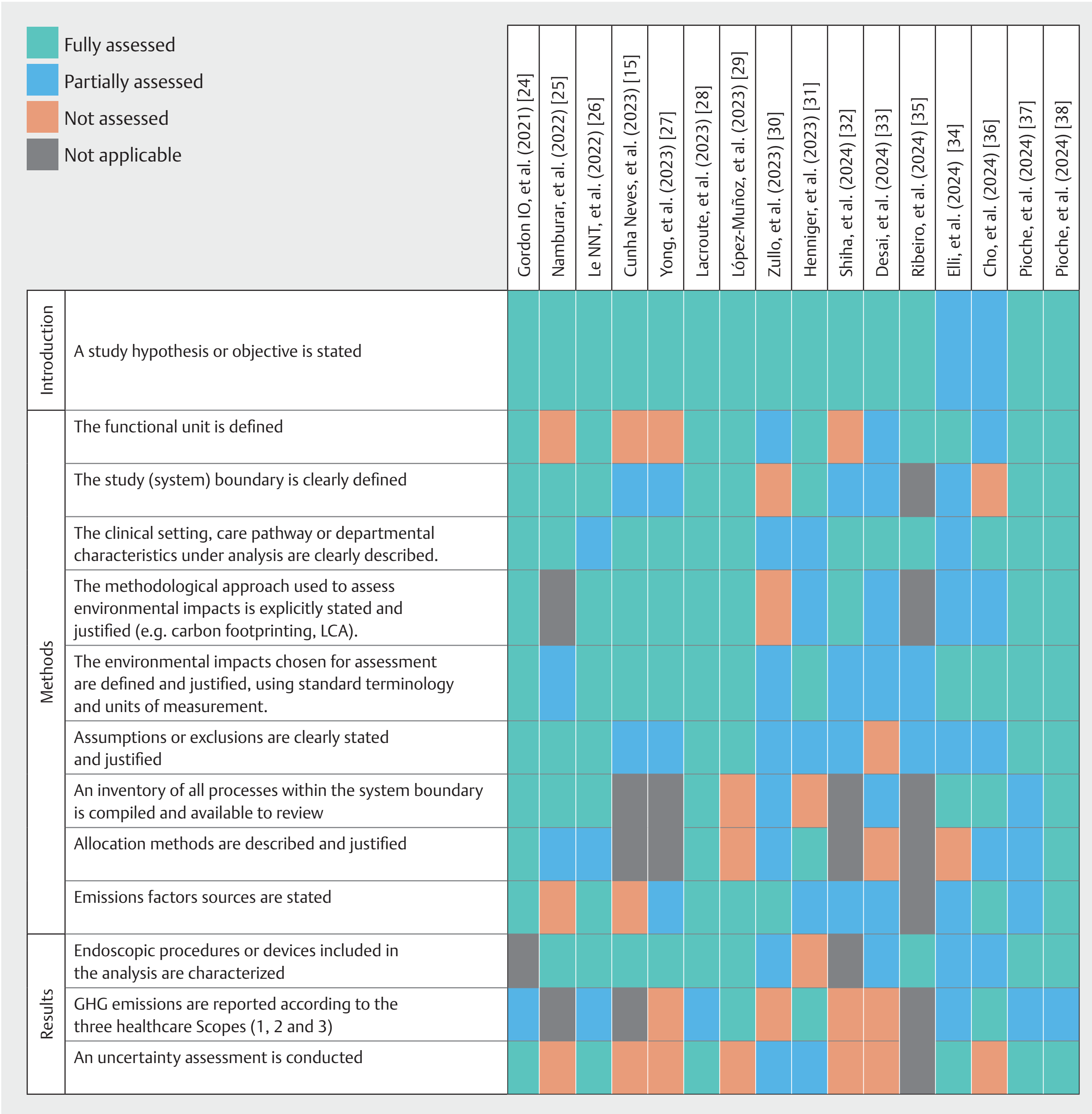
4 Discussion

A review of the literature revealed 16 studies which have sought to quantify environmental impacts relating to GI endoscopy. There is notable heterogeneity across these studies, particularly with regard to the study setting, subject of analysis, and assessment methodology. Four studies are primarily quantifications of waste production in GI endoscopy [15, 25, 33, 35]. Three studies are described as carbon footprint studies, evaluated at the level of an endoscopy department [28, 31, 34]. Five studies report the use of life cycle assessment (LCA) to evaluate emissions generated by: (i) the processing of GI biopsies [24]; (ii) endoscopic accessories [29]; (iii) single-use duodenoscopes [26]; (iv) single-use gastroscopes [38]; and (v) small-bowel video capsule endoscopy [37]. Four studies predominantly use the findings from these previous studies to quantify the GHG emission profile of strategies that reduce the number of procedures performed or biopsies taken [27, 30, 32, 36].

In part, the methodological heterogeneity in the evidence landscape reflects the varied research questions that have been posed. The data, as it currently stands, cannot be aggregated for meta-analysis. However, a review of these studies does reveal inconsistency in the reporting of key environmental impact assessment requirements (► **Fig. 3**). Particular parameters that have been inconsistently reported include the functional unit, the system boundary, and any assumptions or exclusions. An uncertainty assessment is also frequently omitted from the analysis. These aspects of environmental impact assessments need to be clearly and comprehensively communicated if readers are to understand the scope of the analysis and assess the generalizability of the study findings. If the evidence base is to inform strategies for mitigating environmental impacts, it is important that findings can be meaningfully compared across studies and that true variation in environmental impacts can be reliably distinguished from that attributable to methodological choices.

Several guidelines do exist for evaluating environmental impacts, although none have been developed specifically for those conducting and reporting research studies in the setting of GI endoscopy. The GHG Protocol (2011) is the most widely used standard globally for measuring, managing, and reporting GHG emissions [39]. However, it is a general framework that can be applied across industries and not specific to the health care context. The GHG Protocol has been further built upon to provide more sector-specific guidance such as the Greenhouse Gas Accounting Sector Guidance for Pharmaceutical Products and Medical Devices (2012) [40] and the Sustainable Healthcare Coalition's guidance on appraising clinical care pathways [41]. LCA is a systematic method used to evaluate a range of environmental impacts associated with all stages of a product's life cycle, from the extraction of raw materials to its disposal or recycling. The conduct of an LCA is guided by a pair of international standards which specify the principles and framework (ISO 14040) [9] and the requirements and guidelines (ISO 14044) [42].

These guidelines have been variably referenced in the "green endoscopy" studies published to date. There is currently no guideline tailored to the reporting of environmental impact assessments in the field of GI endoscopy. We have drawn on the core reporting principles from existing guidance documents and adapted these to produce a reporting checklist which is accessible to endoscopists. The checklist is not expected to serve as a fully prescriptive nor exhaustive guideline. Instead, the checklist is a set of minimum reporting standards



► **Fig. 3** Reporting of key environmental impact assessment requirements. GHG, greenhouse gas; LCA, lifecycle assessment.

which aims to improve clarity, transparency, and the quality of reporting in the field of "green endoscopy."

Disclaimer

The legal disclaimer for ESGE Guidelines [23] applies to this Position Statement.

Conflict of Interests

Mário Dinis-Ribeiro has received consultancy fees from Roche and Medtronic. Ian M. Gralnek declares Motus GI, Medtronic, Boston Scientific, CheckCap, Clexio Biosciences, Astra-Zeneca, and Vifor Pharma as competing interests. Heiko Pohl declares work for Olympus and Pentax. Enrique Rodríguez de Santiago declares educational and advisory activities for Olympus, educational activities for Apollo Endosurgery, congress fees from Norgine and Casen Recordati, speaker's fees from Izasa and 3-D Matrix, research grant from 3-D Matrix, and advisory work for Adacyte Therapeuthics. The remaining authors declare that they have no conflict of interest.

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E-SPARE Supplementary material

1. E-Spare round 1 results

Q1 First name

Answered: 22 Skipped: 0

Q2 Surname

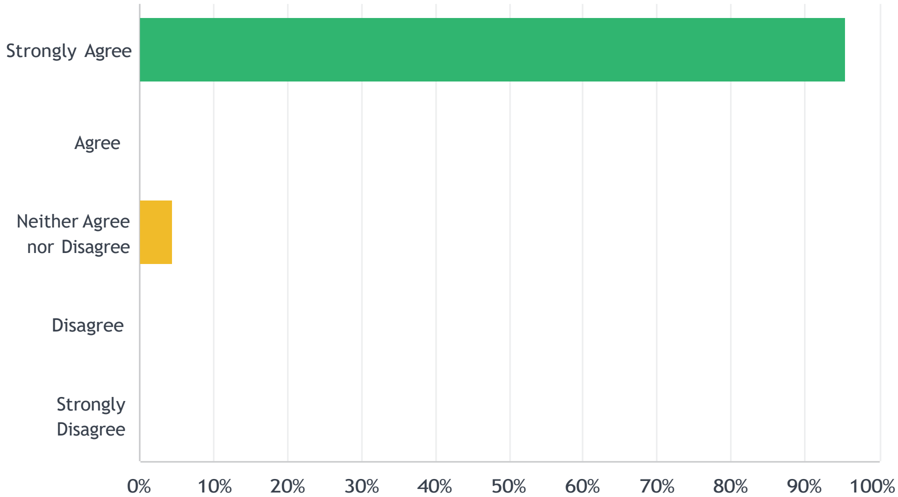
Answered: 22 Skipped: 0

Q3 Email address

Answered: 22 Skipped: 0

Q4 Statement 1: Describe the scientific background and the motivation for the reported study.

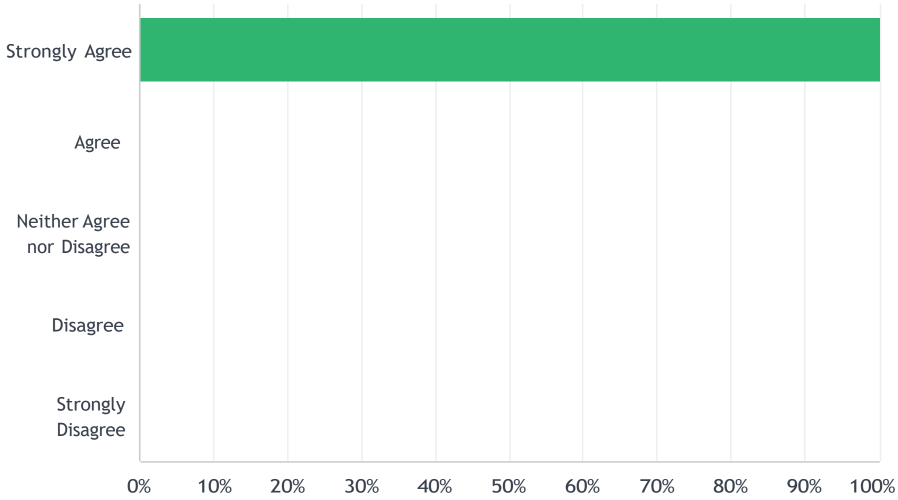
Answered: 22 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	95.45%	21
Agree	0.00%	0
Neither Agree nor Disagree	4.55%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		22

Q5 Statement 2: State the study hypothesis and objectives.

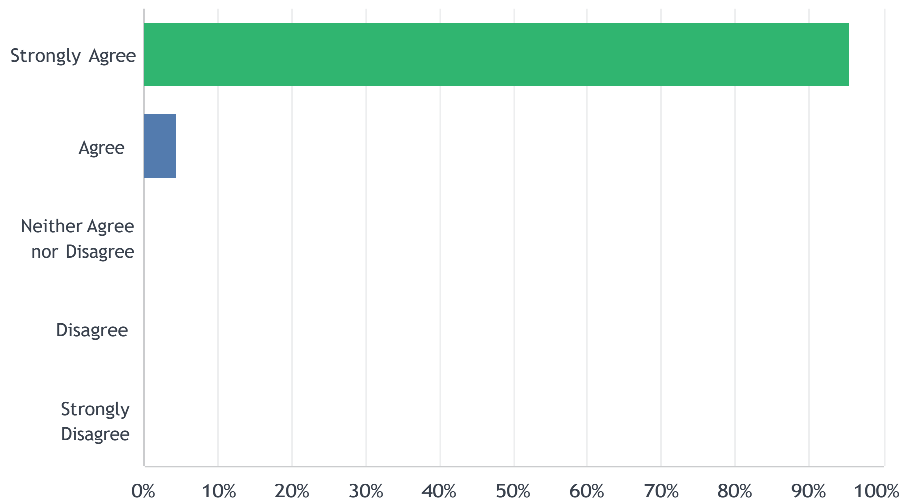
Answered: 22 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	100.00%	22
Agree	0.00%	0
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		22

Q6 Statement 3: Describe the potential impact of the study on GI endoscopy practice.

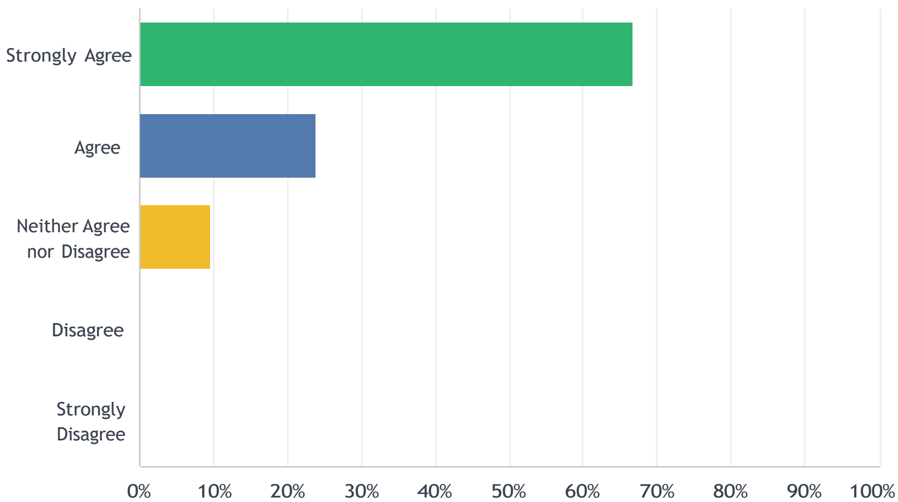
Answered: 22 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	95.45%	21
Agree	4.55%	1
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		22

Q7 State and justify the goal and scope of the environmental impact assessment, defining:Statement 4a: The functional unit of analysis.

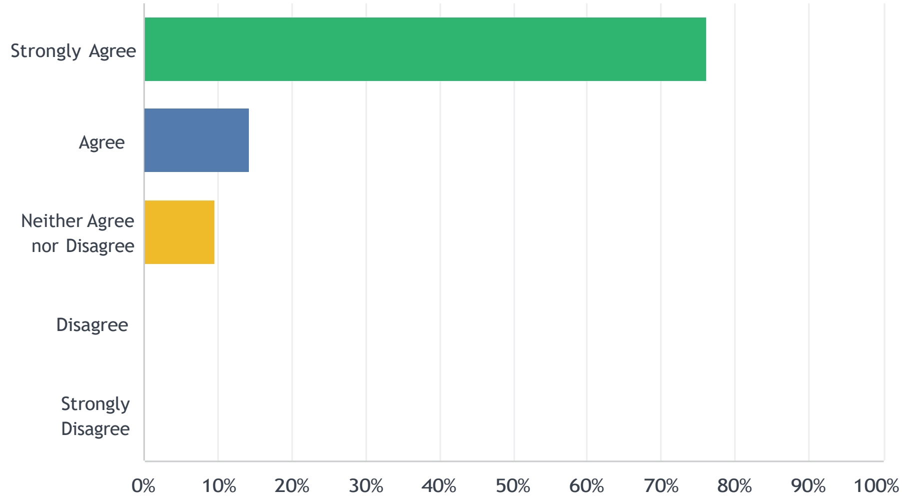
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	66.67%	14
Agree	23.81%	5
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q8 State and justify the goal and scope of the environmental impact assessment, defining:Statement 4b: The boundary of analysis (an illustrative schematic is highly recommended).

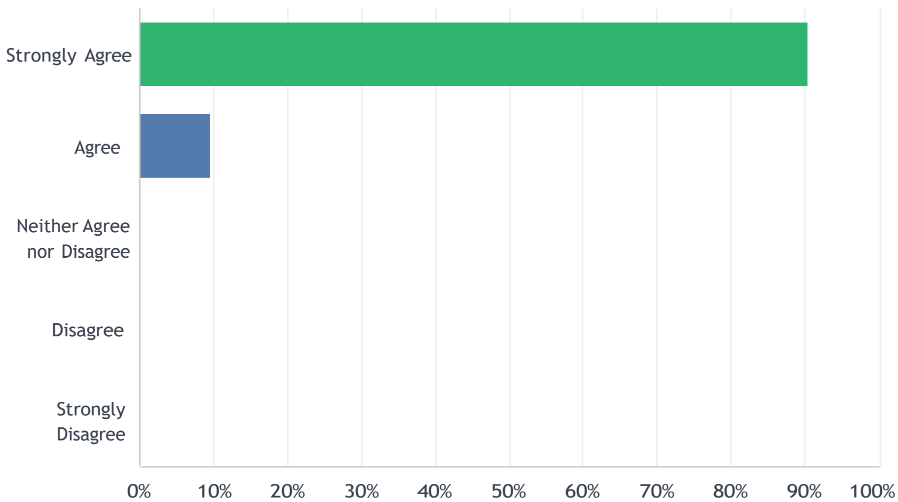
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	76.19%	16
Agree	14.29%	3
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q9 Describe key study parameters, including (if applicable):Statement 5a: Clinical setting (e.g., home, ambulatory, inpatient).

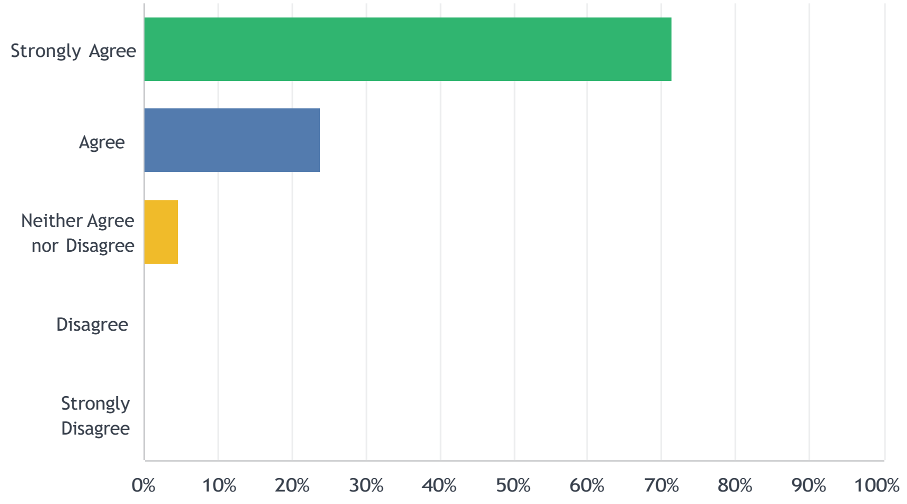
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	90.48%	19
Agree	9.52%	2
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q10 Describe key study parameters, including (if applicable):Statement 5b: The clinical care pathway under analysis (a process map is recommended).

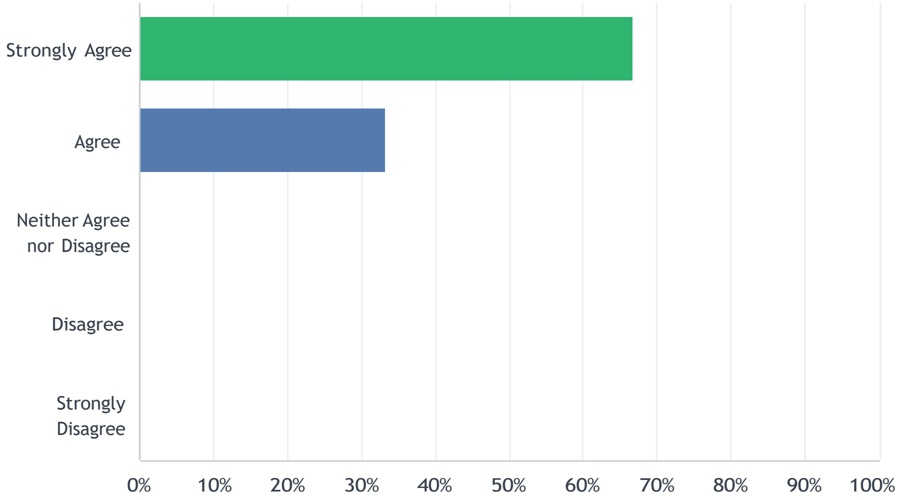
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	23.81%	5
Neither Agree nor Disagree	4.76%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q11 Describe key study parameters, including (if applicable):Statement 5c: Departmental characteristics (i.e., setting, floor area, HVAC* system, energy source, procedure mix and volume, decontamination protocol, staffing model, patient and staff travel patterns).* HVAC – heating, ventilation and air conditioning

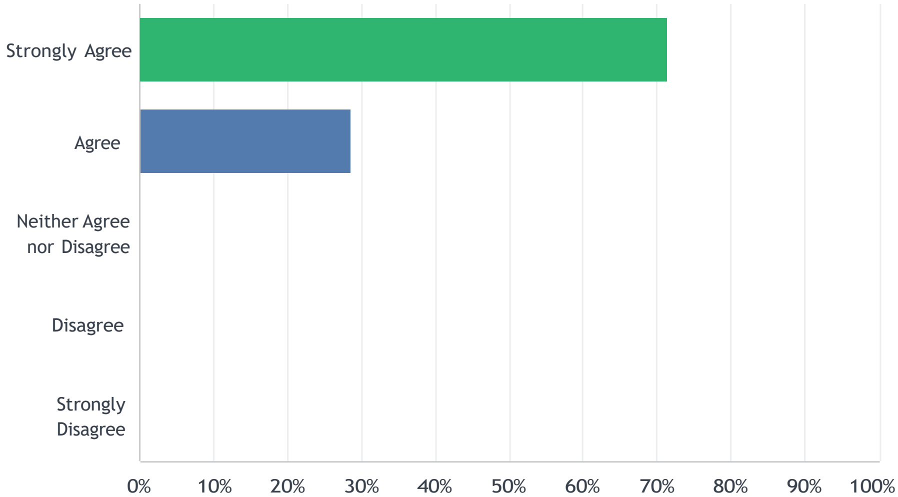
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	66.67%	14
Agree	33.33%	7
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q12 Describe key study parameters, including (if applicable):Statement 5d: Date and location of data collection and any recruitment/exposure.

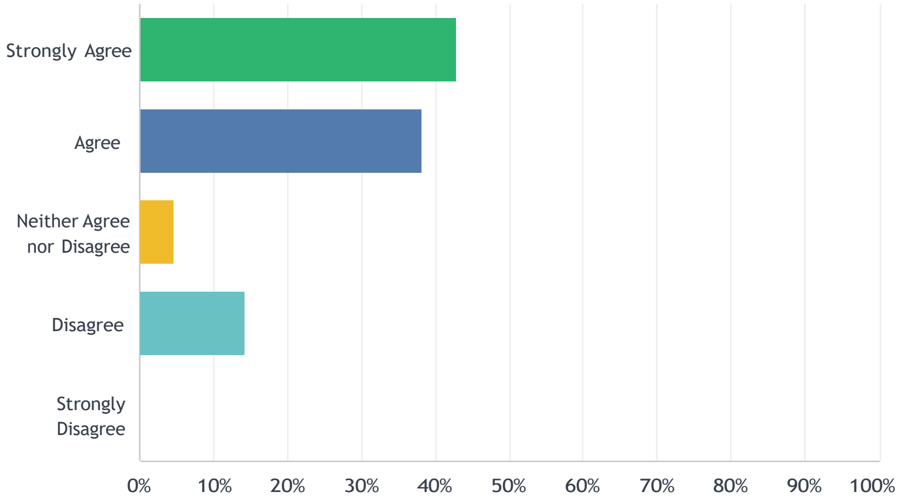
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	28.57%	6
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q13 Describe key study parameters, including (if applicable):Statement 5e: Description of the expertise within the research team

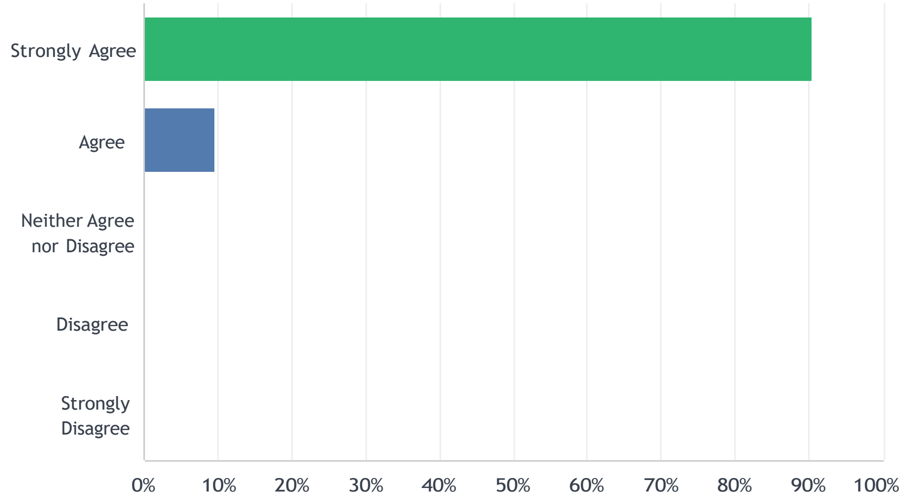
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	42.86%	9
Agree	38.10%	8
Neither Agree nor Disagree	4.76%	1
Disagree	14.29%	3
Strongly Disagree	0.00%	0
TOTAL		21

Q14 Statement 6: The methodological approach used to assess environmental impacts should be explicitly stated and justified (e.g.: carbon footprinting, LCA*).* lifecycle assessment

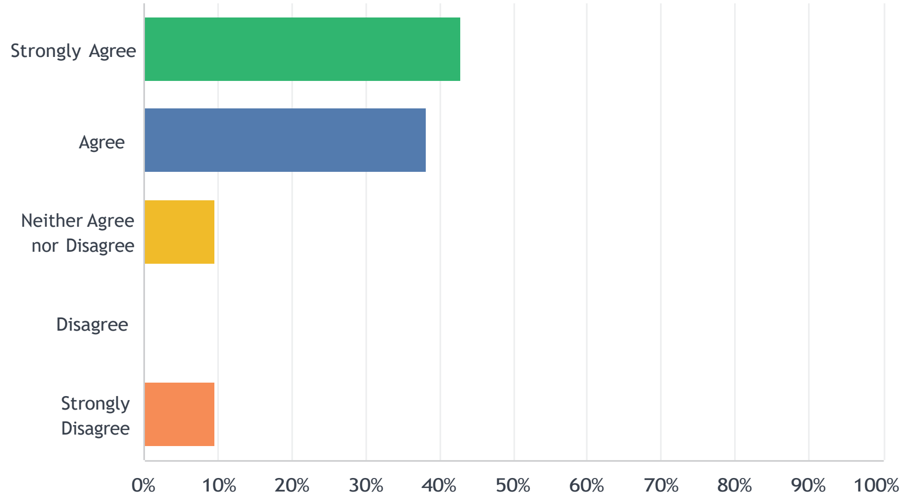
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	90.48%	19
Agree	9.52%	2
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q15 Statement 7: The inclusion of an evaluation of patients' perspectives/involvement as relevant to the research question/intervention is recommended (if applicable).

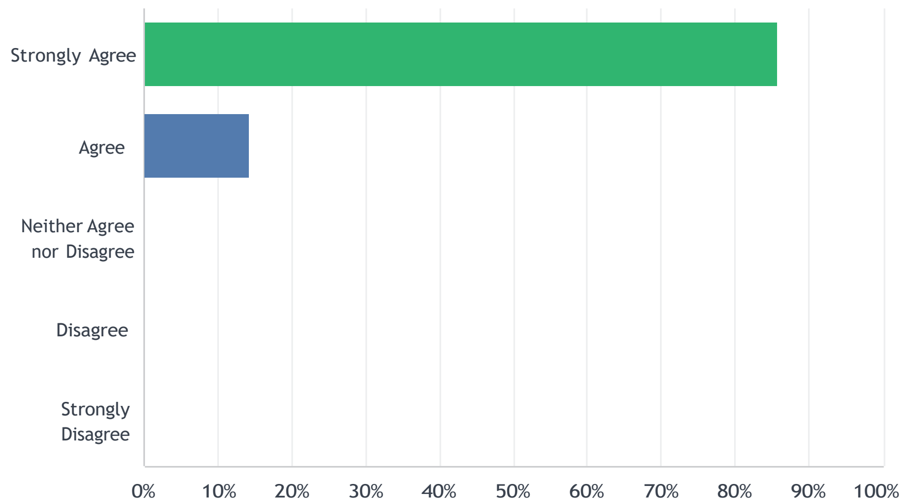
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	42.86%	9
Agree	38.10%	8
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree	9.52%	2
TOTAL		21

Q16 Statement 8: Describe any interventions performed in sufficient detail to permit replication.

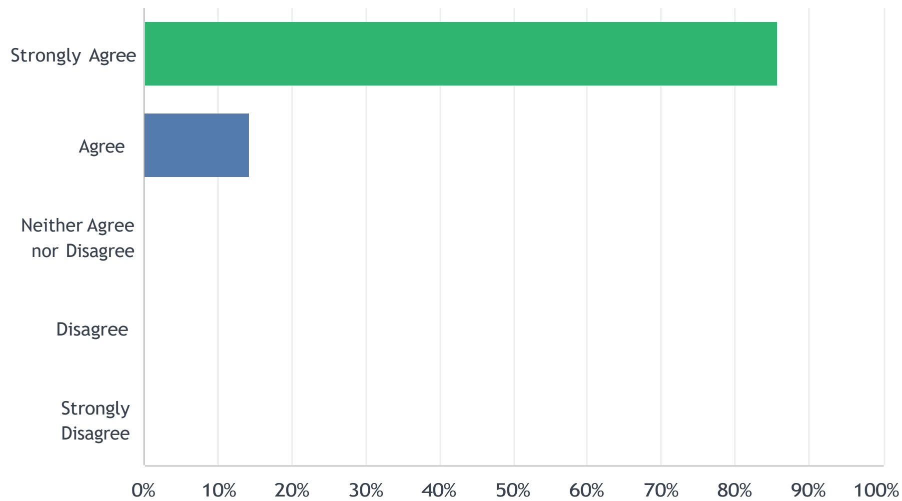
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	85.71%	18
Agree	14.29%	3
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q17 Statement 9: Define and justify the environmental impacts chosen for assessment (e.g. global warming, fine particulate matter formation, water consumption), using standard terminology and units of measurement (e.g. kgCO2e).

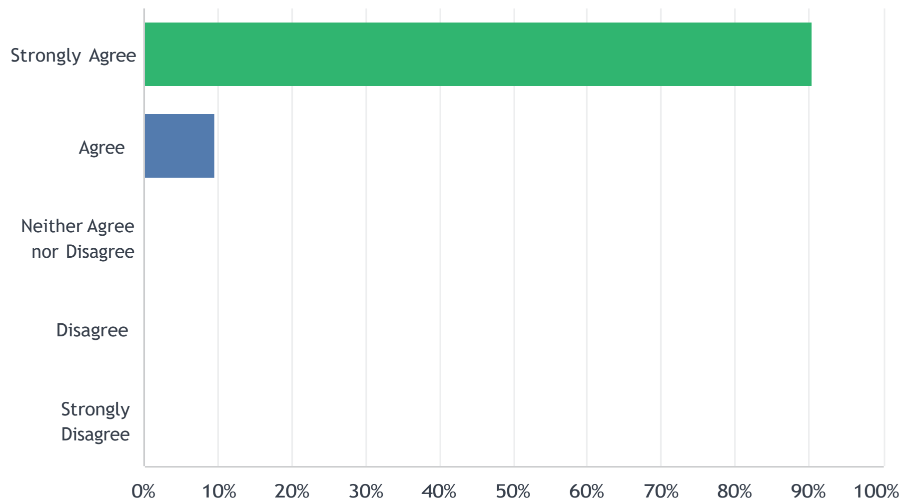
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	85.71%	18
Agree	14.29%	3
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q18 Statement 10: Clearly state and justify any assumptions or exclusions.

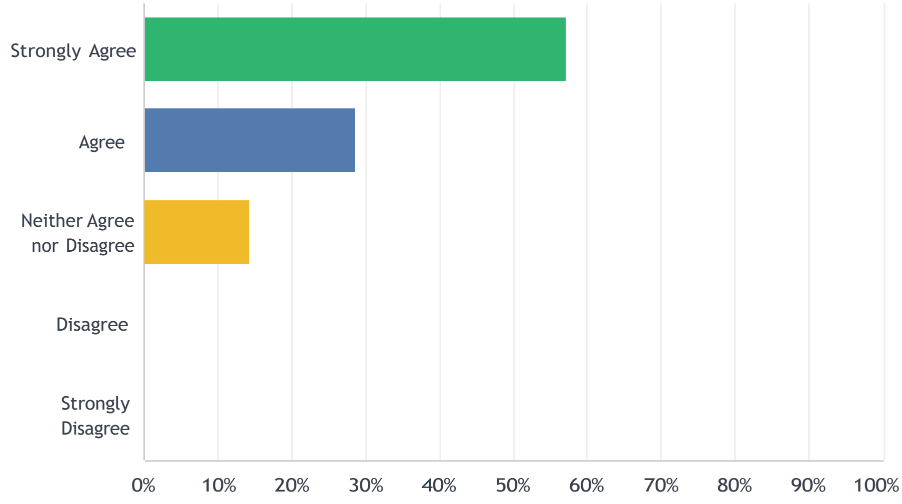
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	90.48%	19
Agree	9.52%	2
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q19 Statement 11: Inventory data should be described with regard to its source (primary, secondary), and whether it is process activity data or financial activity data.

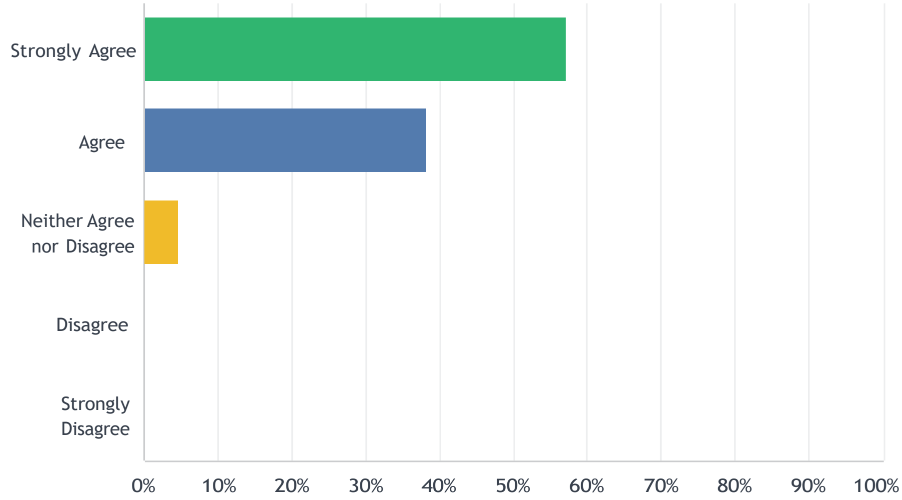
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	57.14%	12
Agree	28.57%	6
Neither Agree nor Disagree	14.29%	3
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q20 Statement 12: State where resources have been allocated across activities and justify the rationale for the allocation method used (e.g. electricity consumption allocated by floor surface area).

Answered: 21 Skipped: 1

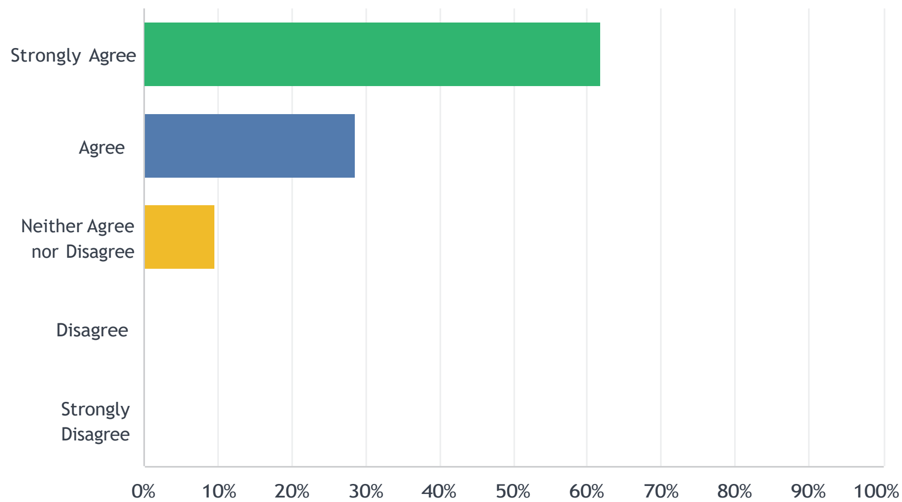


ANSWER CHOICES	RESPONSES	
Strongly Agree	57.14%	12
Agree	38.10%	8
Neither Agree nor Disagree	4.76%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Endoscopy | DOI 10.1055/a-2543-0400 |

Q21 Statement 13: Describe any attempts to address potential sources of bias.

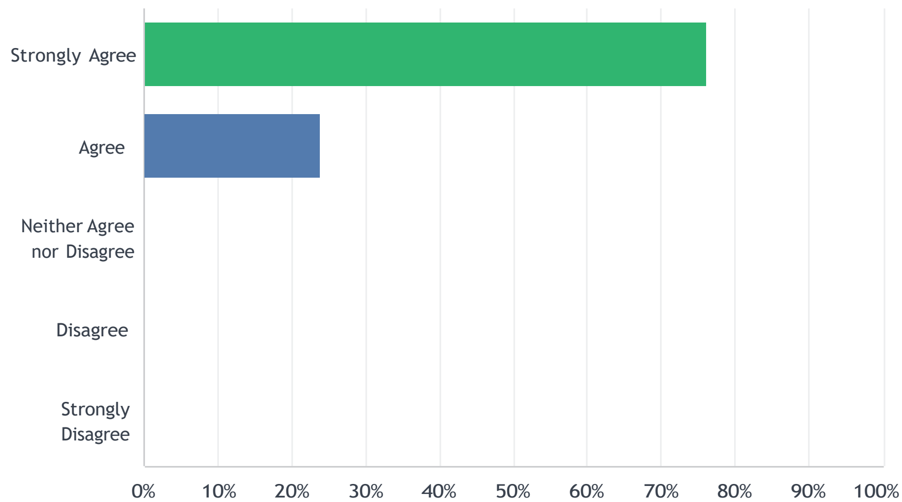
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	61.90%	13
Agree	28.57%	6
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q22 Statement 14: Provide an explanation as to how the sample size was calculated.

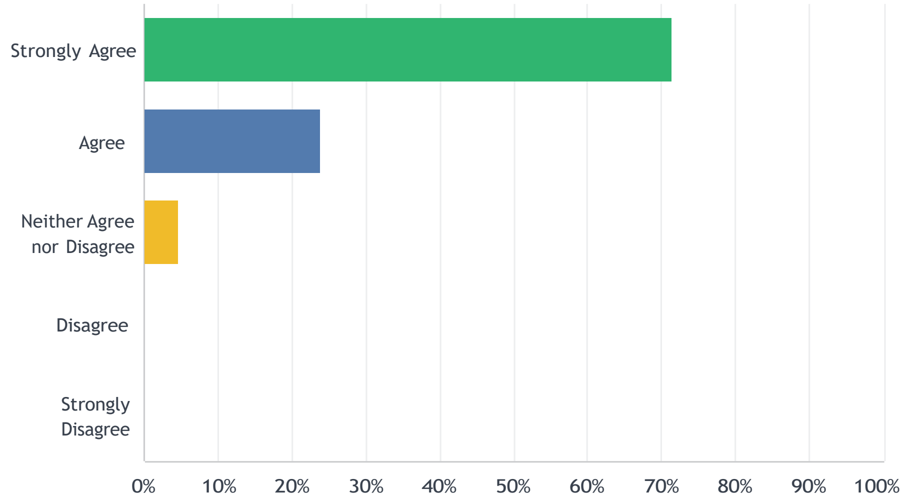
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	76.19%	16
Agree	23.81%	5
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q23 Statement 15: Describe how quantitative and qualitative variables were handled in the analyses.

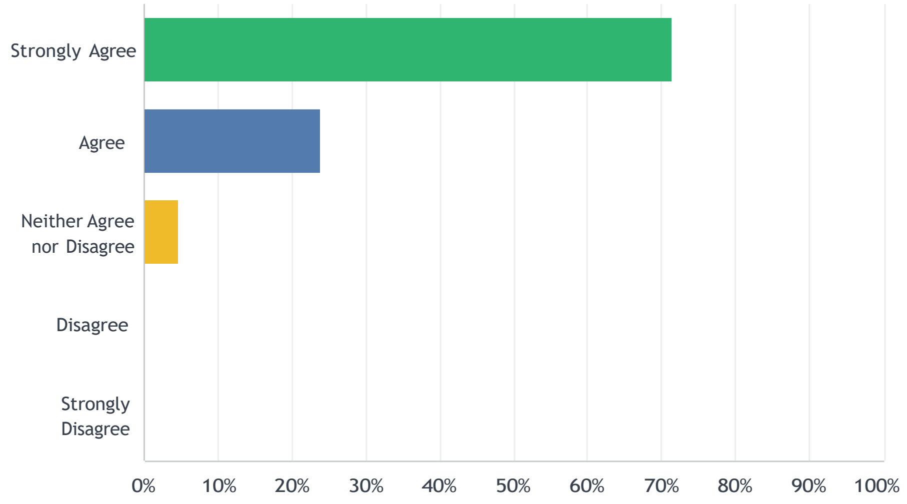
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	23.81%	5
Neither Agree nor Disagree	4.76%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q24 Statement 16: Describe all statistical methods, including those to control confounders.

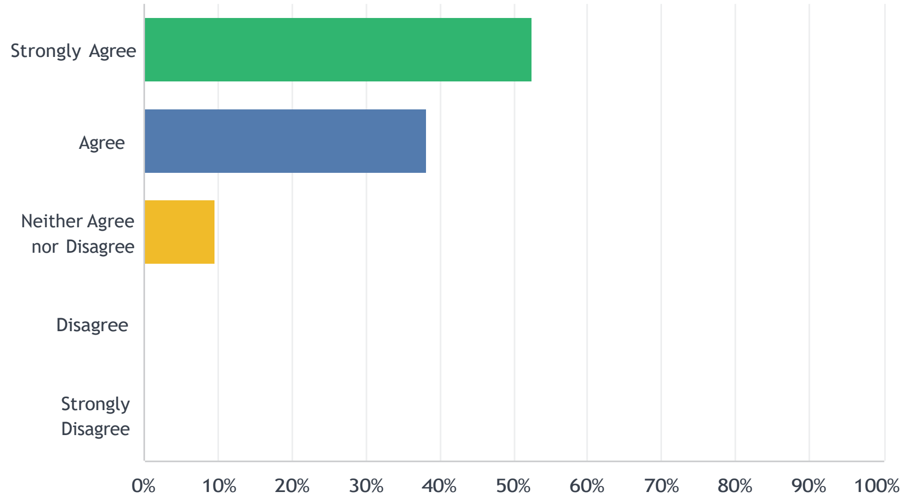
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	23.81%	5
Neither Agree nor Disagree	4.76%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q25 Statement 17: Describe methods used to examine subgroups and interactions.

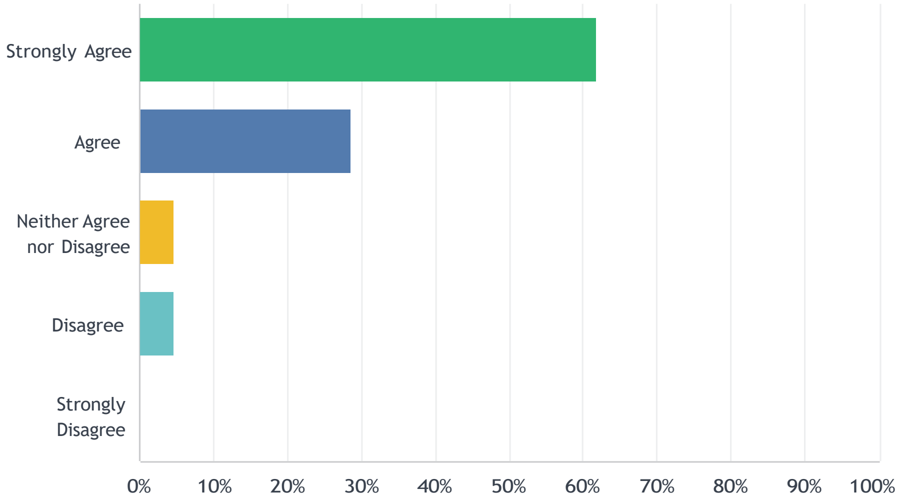
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.38%	11
Agree	38.10%	8
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q26 Statement 18: Explain how missing data were addressed.

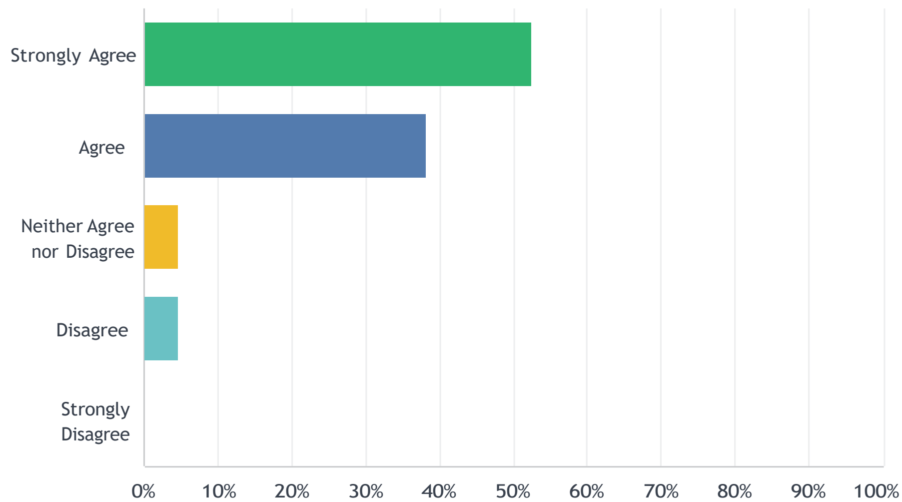
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	61.90%	13
Agree	28.57%	6
Neither Agree nor Disagree	4.76%	1
Disagree	4.76%	1
Strongly Disagree	0.00%	0
TOTAL		21

Q27 Statement 19: The impact assessment should specify the emissions factors sources, or any characterization method used.

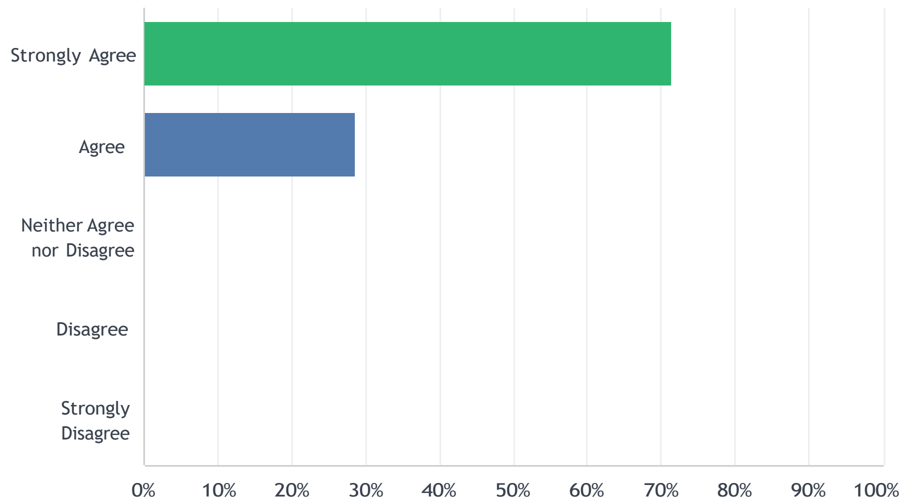
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.38%	11
Agree	38.10%	8
Neither Agree nor Disagree	4.76%	1
Disagree	4.76%	1
Strongly Disagree	0.00%	0
TOTAL		21

Q28 Statement 20: Endoscopic procedures included in the analysis should be characterized, including type and number, type of sedation, anesthesia, or other medication used.

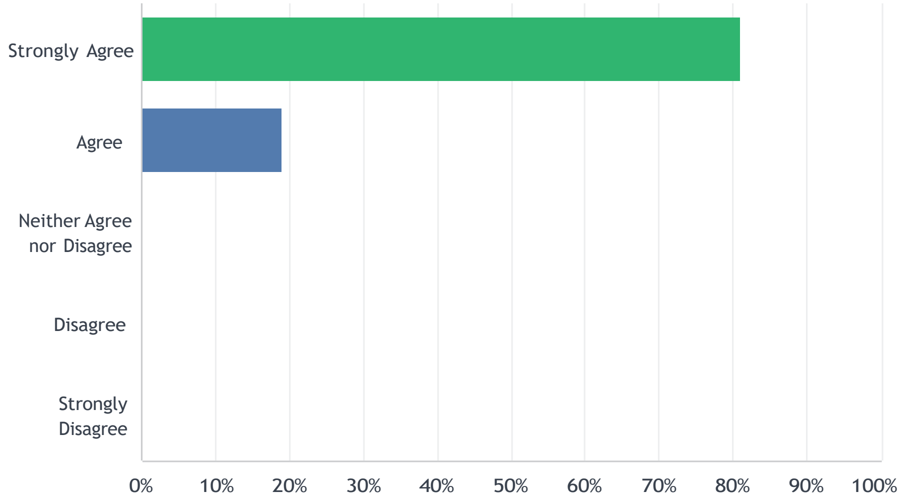
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	28.57%	6
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q29 Statement 21: Details of the endoscopic devices used in the study (e.g. type, brand, major components, single-use vs. reusable, recyclable vs. non-recyclable) should be disclosed (if applicable).

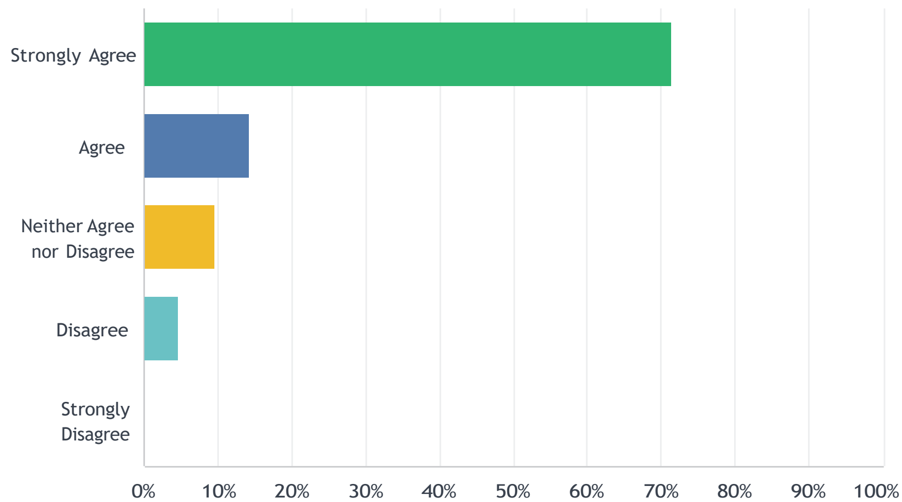
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	80.95%	17
Agree	19.05%	4
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q30 Statement 22: GHG* emissions should be reported according to each scope (1, 2 and 3) (if applicable).*greenhouse gases

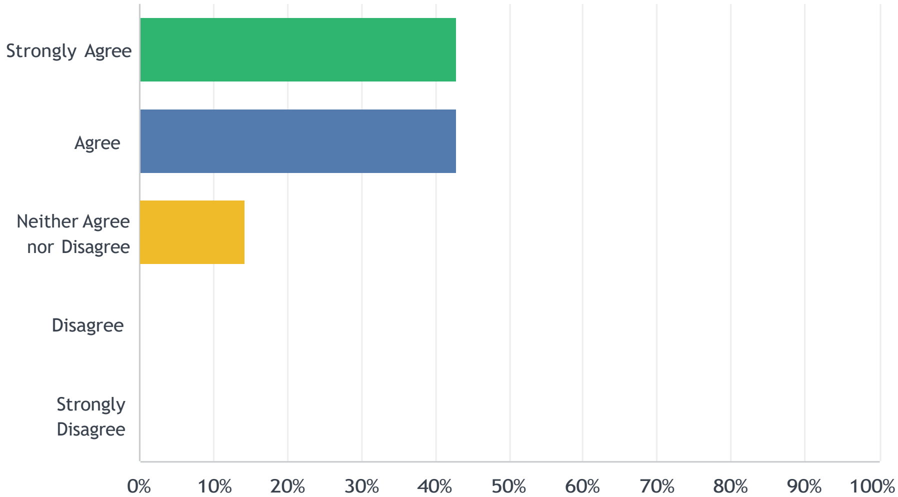
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	14.29%	3
Neither Agree nor Disagree	9.52%	2
Disagree	4.76%	1
Strongly Disagree	0.00%	0
TOTAL		21

Q31 Statement 23: Outcome data should be separated in the following domains: pre-procedure; peri-procedure; post-procedure (if applicable).

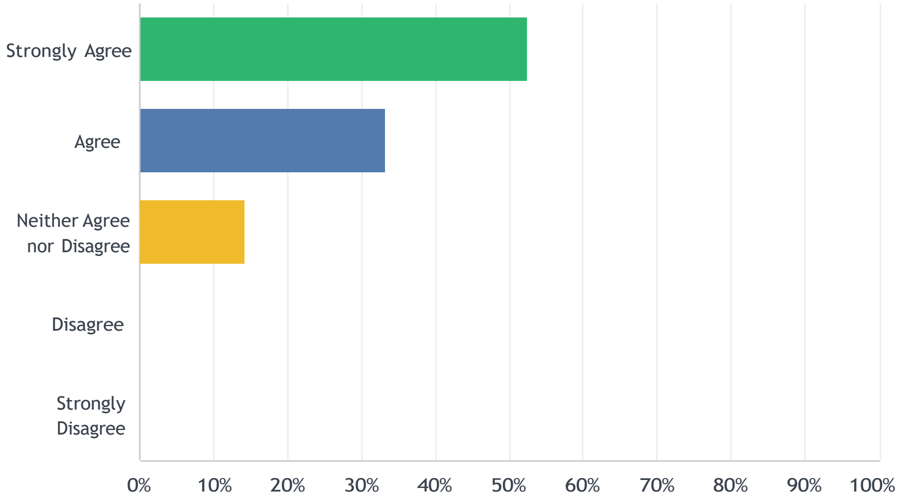
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	42.86%	9
Agree	42.86%	9
Neither Agree nor Disagree	14.29%	3
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q32 Statement 24: Disclose unadjusted estimates. Disclose potential confounder-adjusted estimates and respective precision (e.g., 95% confidence interval). Clearly state which confounders were adjusted for and the reason to do so (if applicable).

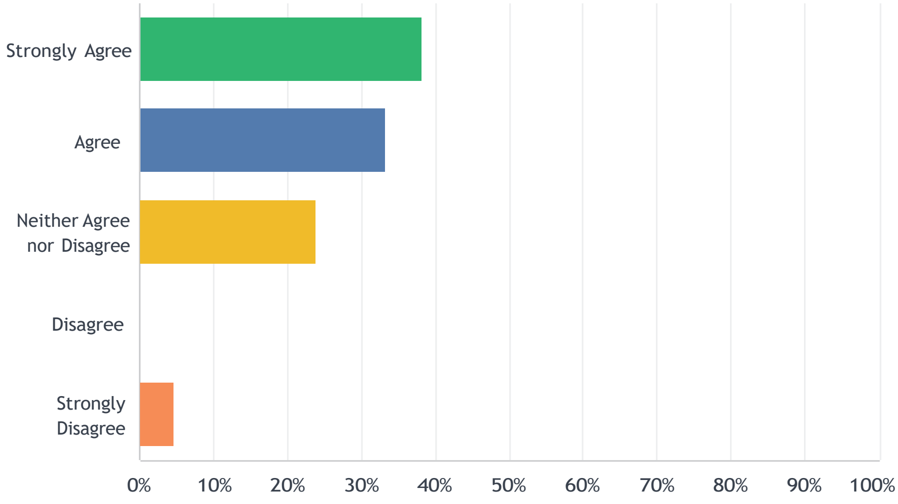
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.38%	11
Agree	33.33%	7
Neither Agree nor Disagree	14.29%	3
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q33 Statement 25: An uncertainty assessment is conducted using analyses which explore the sensitivity of the results to key assumptions, alternative scenarios and parameters.

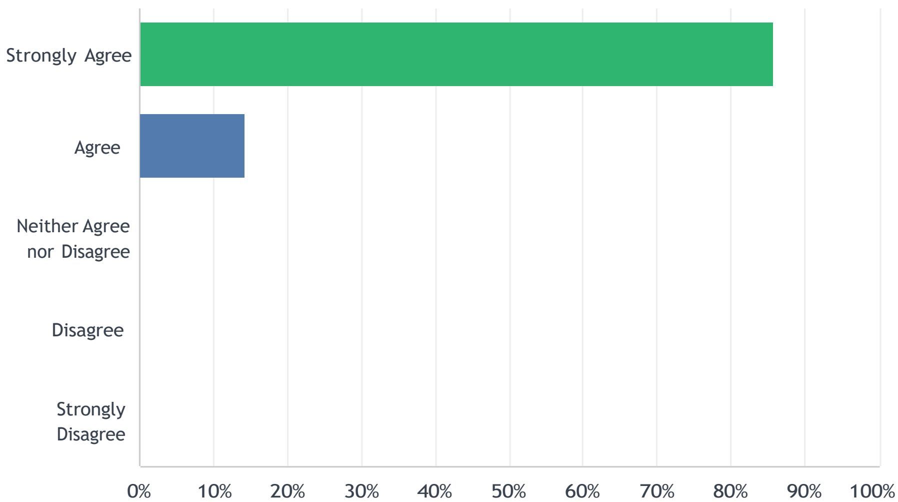
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	38.10%	8
Agree	33.33%	7
Neither Agree nor Disagree	23.81%	5
Disagree	0.00%	0
Strongly Disagree	4.76%	1
TOTAL		21

Q34 Statement 26: Describe the main results of the study according to the study objectives.

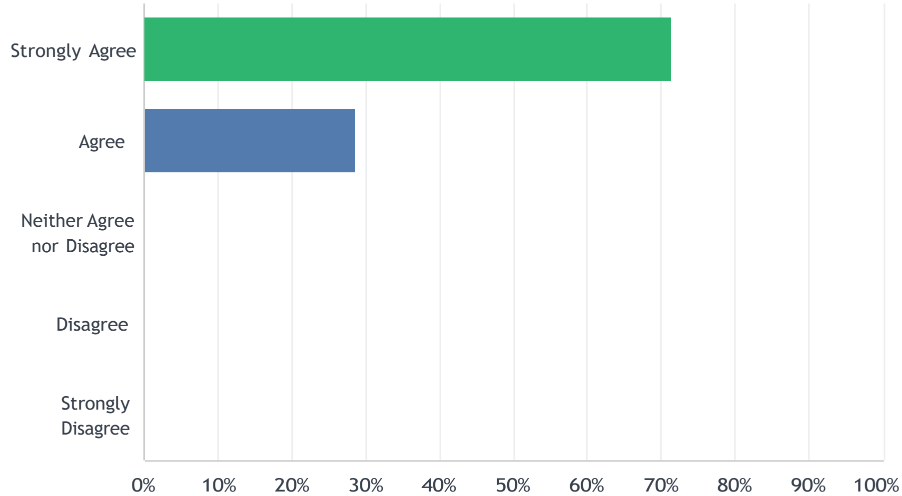
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	85.71%	18
Agree	14.29%	3
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q35 Statement 27: Discuss relevant social and financial implications of the findings, in addition to environmental impacts (the 'triple bottom line' framework). Particular attention should be paid to any implications for clinical service provision.

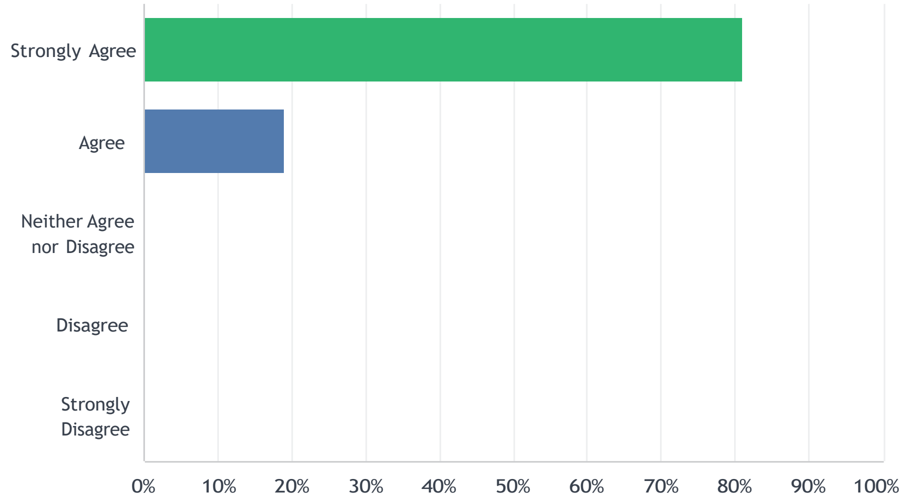
Answered: 21   Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	71.43%	15
Agree	28.57%	6
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q36 Statement 28: Discuss the generalizability and applicability of the results.

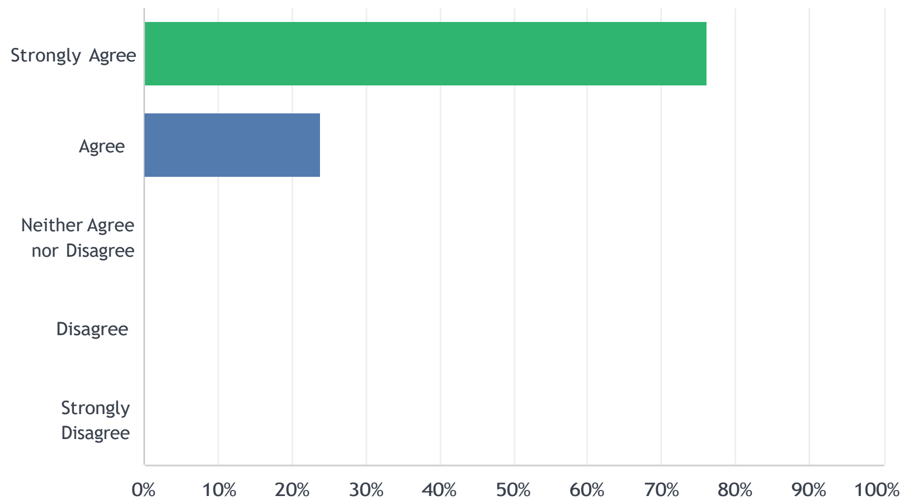
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	80.95%	17
Agree	19.05%	4
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q37 Statement 29: Include a paragraph with the limitations of the study, including potential sources of bias. Discuss potential ways to overcome these limitations. If already included in the interpretation section, may discuss additional limitations.

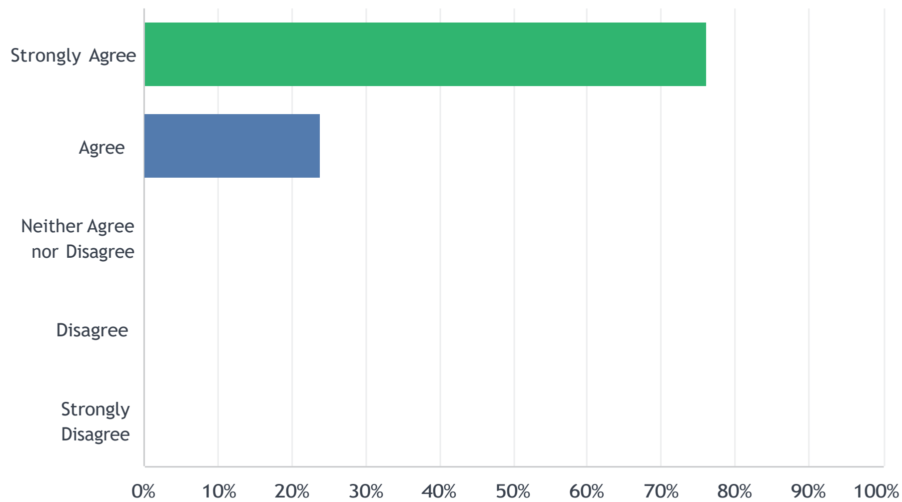
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	76.19%	16
Agree	23.81%	5
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q38 Statement 30: Draw the main conclusions from the study and recommendations for future study.

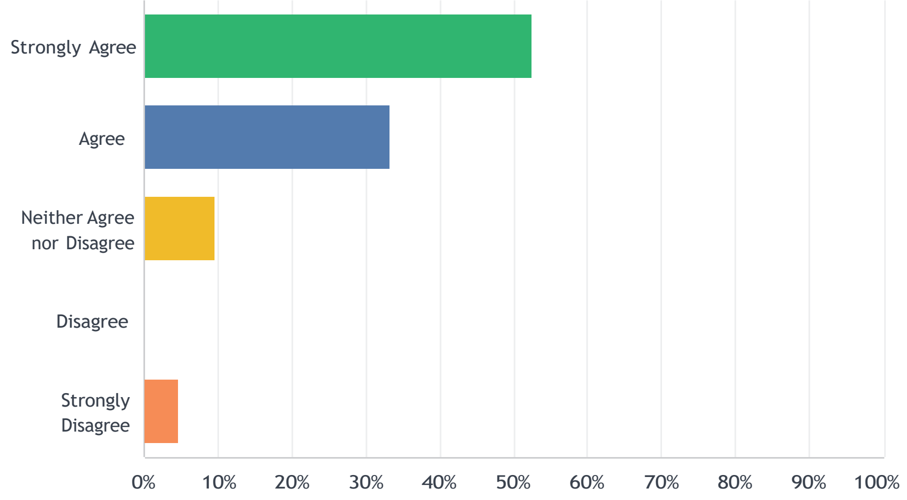
Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	76.19%	16
Agree	23.81%	5
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		21

Q39 Statement 31: Propose routes to improvement, and identify the key actors (e.g. clinicians, suppliers, regulators) necessary to affect a solution in each case.

Answered: 21 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.38%	11
Agree	33.33%	7
Neither Agree nor Disagree	9.52%	2
Disagree	0.00%	0
Strongly Disagree4.76%1		
TOTAL		21

E-Spare Round 2 results

Q1 First name

Answered: 23 Skipped: 0

Q2 Surname

Answered: 23 Skipped: 0

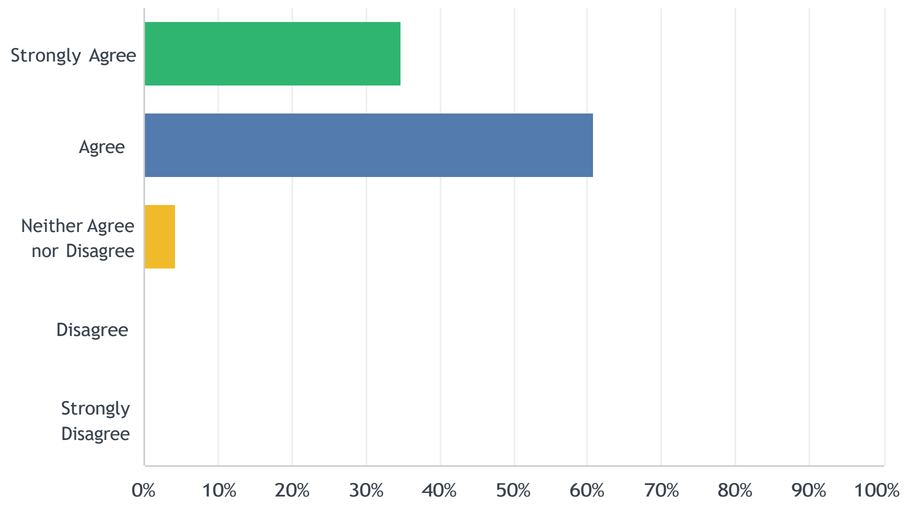
Q3 Email address

Answered: 23 Skipped: 0

Endoscopy | DOI 10.1055/a-2543-0400 |

Q4 (NEW) Statement: Title should include environmental impact and intervention as appropriate.

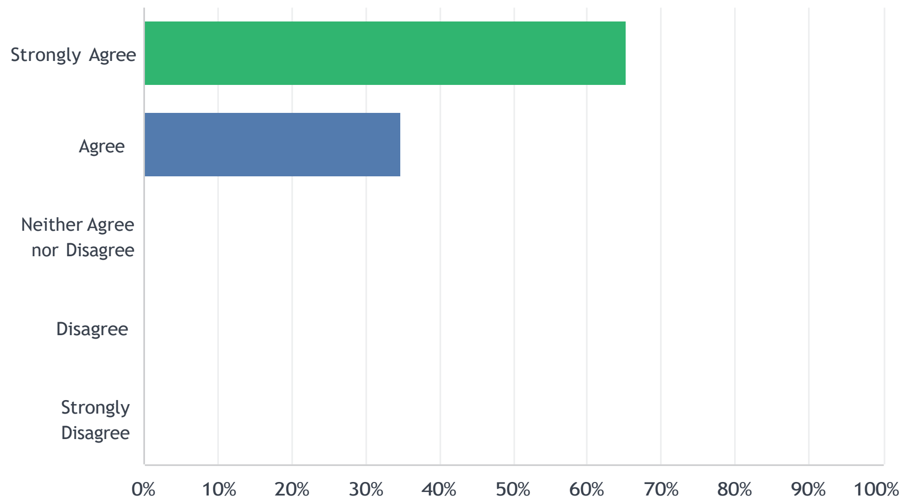
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	34.78%	8
Agree	60.87%	14
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q5 (NEW) Statement: The abstract should include a description of the rationale, the intervention (if applicable), and the method used for environmental impact assessment.

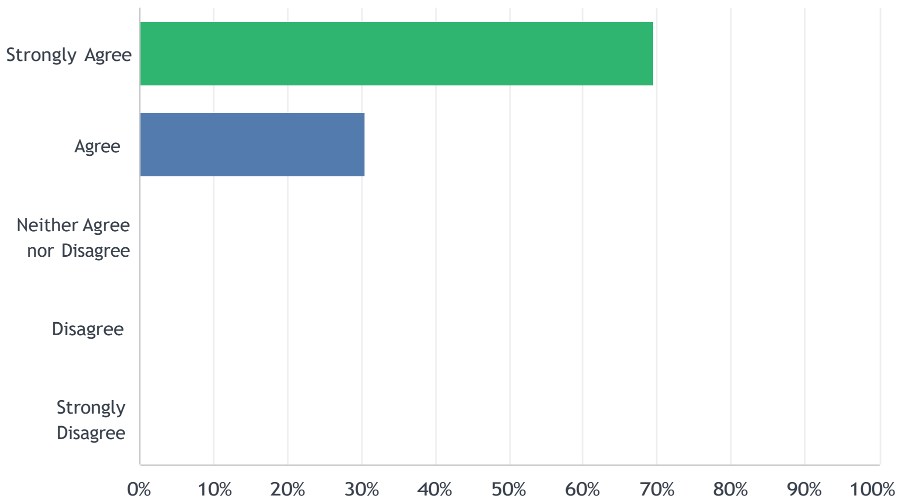
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	65.22%	15
Agree	34.78%	8
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q6 Original statement 1: Describe the scientific background and the motivation for the reported study.New proposal: Describe the scientific background and the rationale for the reported study.Explanation: the word ‘motivation’ was replaced by ‘rationale’.

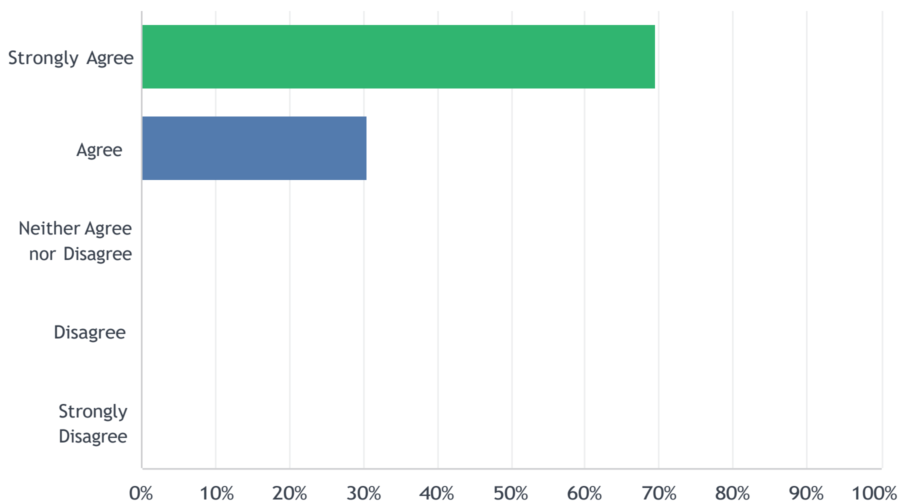
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	69.57%	16
Agree	30.43%	7
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q7 State and justify the goal and scope of the environmental impact assessment, defining:Original Statement 4a: The functional unit of analysis.New proposal: The functional unit of analysis - i.e. a clearly quantified definition of the item or process that is being measured (e.g., The functional unit of the study was chosen as ‘the use of endoscopic forceps to obtain a single colonic biopsy’, or ‘one diagnostic gastroscopy’)Explanation: The statement was rephrased to provide a clearer explanation of the definition of functional analysis, providing practical examples.

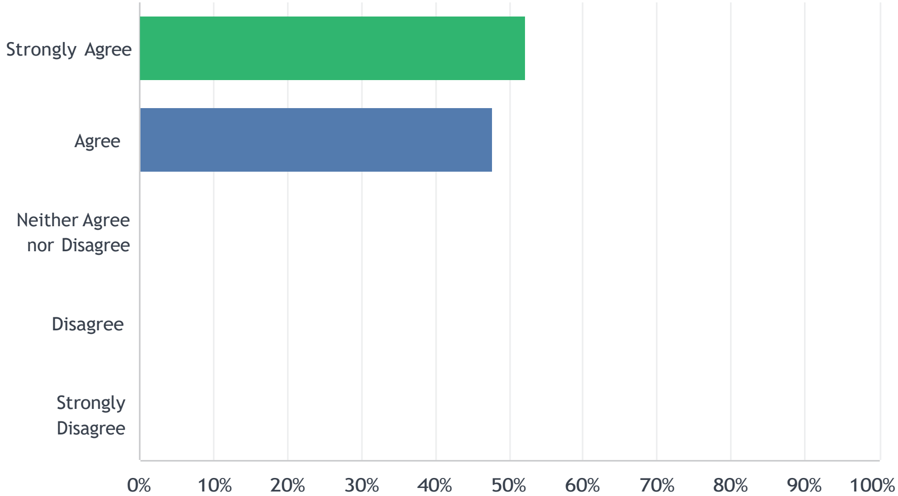
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	69.57%	16
Agree	30.43%	7
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q8 Original statement 4b: The boundary of analysis (an illustrative schematic is highly recommended).New proposal: The boundary of analysis, including the clinical care pathway and the temporospatial boundaries, should be clearly defined (an illustrative schematic is recommended).Explanation: The statement was rephrased in order to include Statement 5b and time and space boundaries; the word ‘highly’ was removed from the statement, in order to soften the statement.

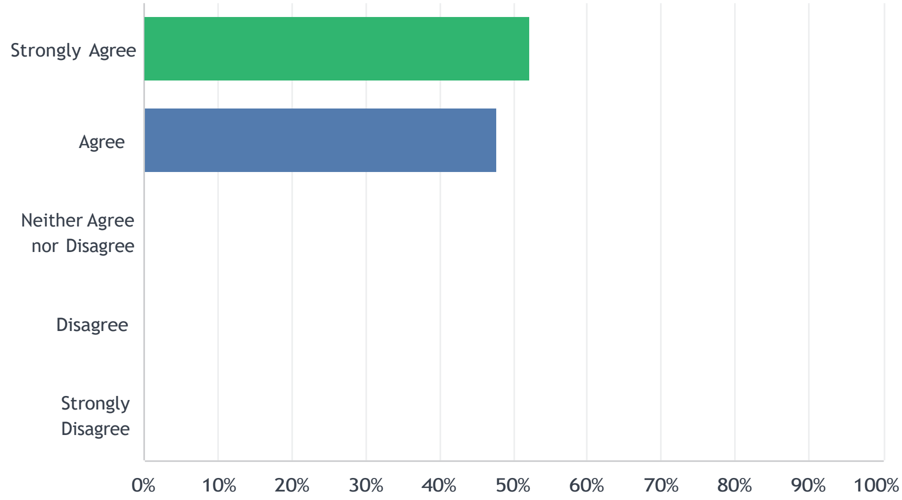
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.17%	12
Agree	47.83%	11
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q9 Original statement 5b: The clinical care pathway under analysis (a process map is recommended).*New proposal: The statement was removed and included within statement 4b.*if applicable

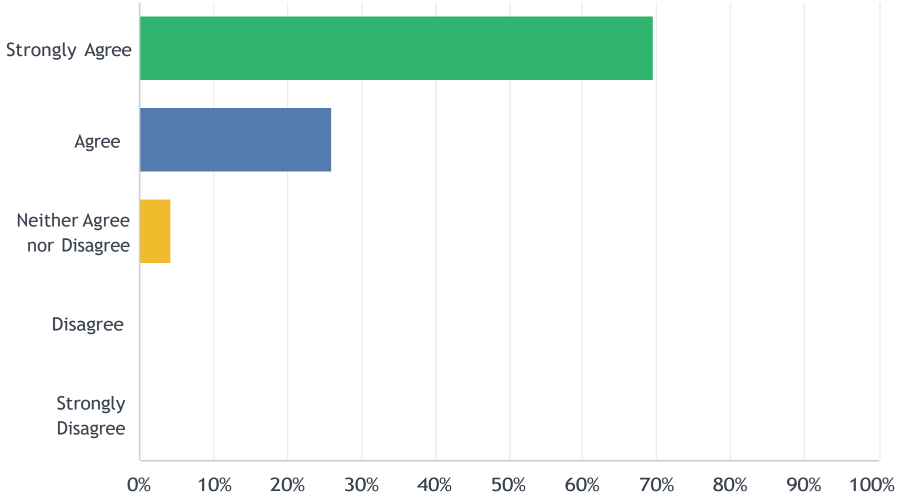
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.17%	12
Agree	47.83%	11
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q10 Original statement 5d: Date and location of data collection and any recruitment/exposure.*New proposal: Time period and location of data collection and any recruitment/exposure.*Explanation: The statement was rephrased in order to improve clarity. The word ‘Date’ was replaced by ‘Time period’.*if applicable

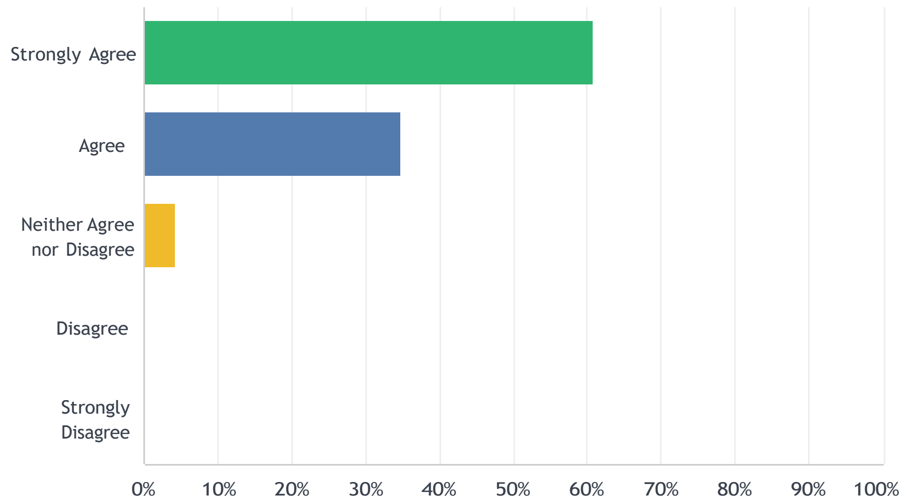
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	69.57%	16
Agree	26.09%	6
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q11 Original statement 5e: Description of the expertise within the research team.*New proposal: A description of the multidisciplinary expertise involved in the study team (e.g. if study authors include those with expertise in environmental or materials science).*Explanation: The statement was rephrased in order clarify that the multidisciplinary expertise of the team should be disclosed.*if applicable

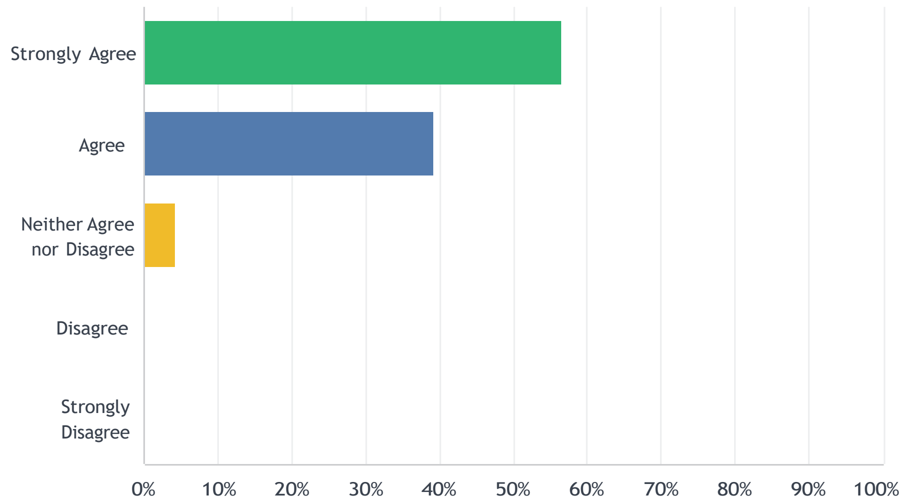
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	60.87%	14
Agree	34.78%	8
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q12 Original statement 7: The inclusion of an evaluation of patients' perspectives/involvement as relevant to the research question/intervention is recommended.*New proposal: An evaluation of the patient perspective should be included only if relevant to the study outcome measure(s).Explanation: The statement was rephrased to reflect the panellists' comments questioning the absolute necessity of the patient perspective.*if applicable

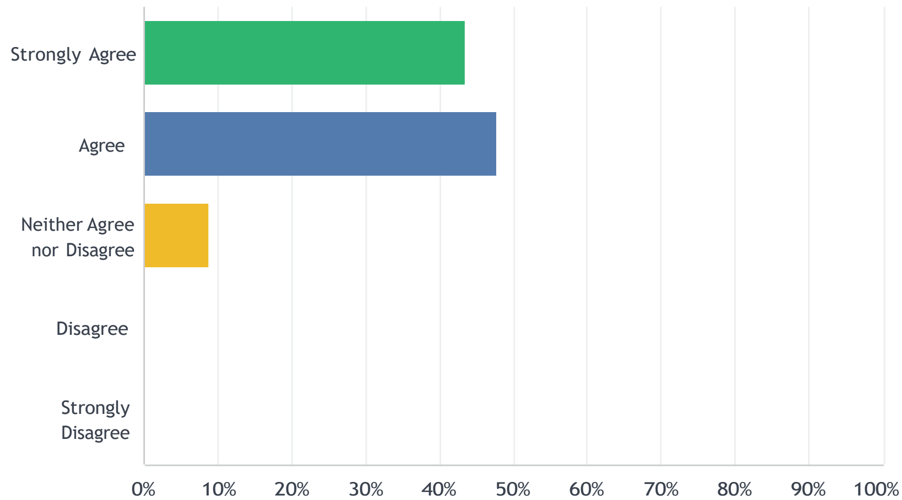
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	56.52%	13
Agree	39.13%	9
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q13 Original statement 11: Inventory data should be described with regard to its source (primary, secondary), and whether it is process activity data or financial activity data.New proposal: Inventory data should be described with regard to its source (primary, secondary), and whether it is process activity data (e.g., production data or operational metrics) or financial activity data (e.g., cost or expenditure records).Explanation: The statement was rephrased to provide a clearer explanation of the definition of process and financial activity data, providing practical examples.

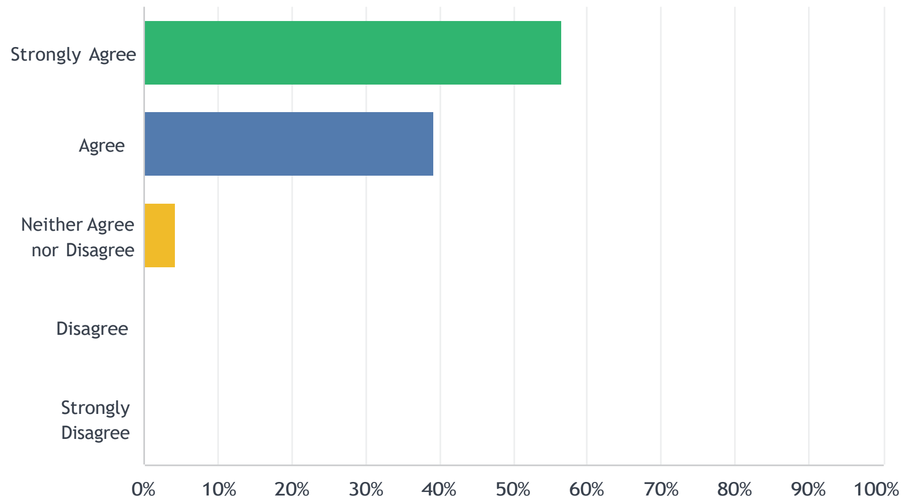
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	43.48%	10
Agree	47.83%	11
Neither Agree nor Disagree	8.70%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q14 Original statement 12: State where resources have been allocated across activities and justify the rationale for the allocation method used (e.g. electricity consumption allocated by floor surface area).New proposal: Where resources are shared across activities, provide details on how these resources have been assigned to each activity and justify the rationale for the allocation method used (e.g. utility use (water, electricity) was allocated to the endoscopy department by share of floor surface area).Explanation: The statement was rephrased to improve its clarity.

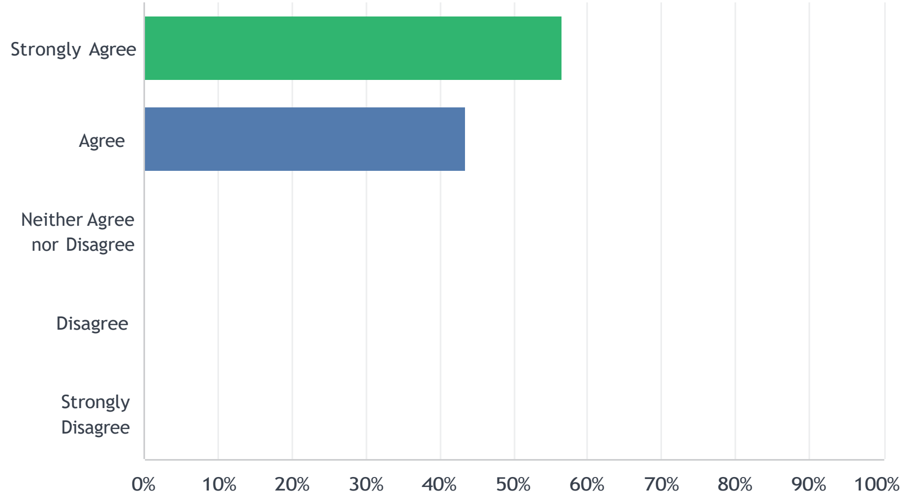
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	56.52%	13
Agree	39.13%	9
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q15 Original statement 13: Describe any attempts to address potential sources of bias.New proposal: Clearly describe any attempts to address potential sources of bias, such as selection bias (e.g., limiting analysis to procedures with clear environmental benefits), measurement bias (e.g., variability in calculating carbon footprints or waste), or confirmation bias (e.g., focusing solely on positive outcomes of green initiatives).Explanation: The statement was rephrased to improve its clarity.

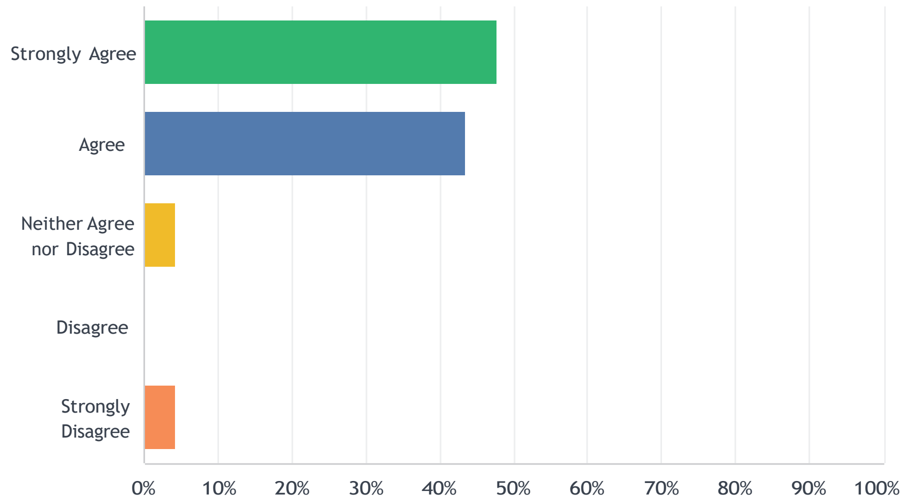
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	56.52%	13
Agree	43.48%	10
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q16 Original statement 19: The impact assessment should specify the emissions factors sources, or any characterization method used.New proposal: Specify the emissions factors applied, and their origin. Ensure transparency about the reliability of the emissions factors, their relevance to endoscopy, their geographic and temporal applicability and their scope and boundaries (e.g., cradle-to-grave or operational phases only). Disclose any related assumptions or uncertainties, and if a life cycle inventory database was used (e.g. Ecoinvent, Base Carbone).Explanation: The statement was rephrased to improve overall clarity and to reflect panellists' comments.

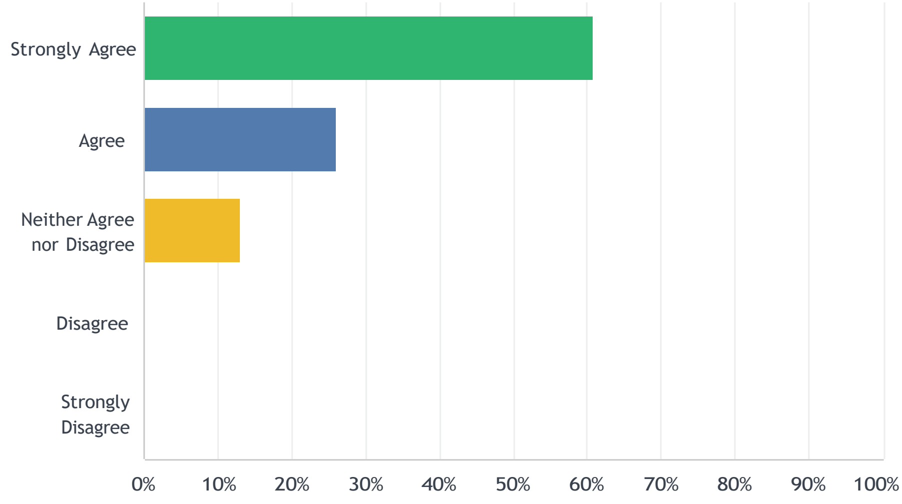
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	47.83%	11
Agree	43.48%	10
Neither Agree nor Disagree	4.35%	1
Disagree	0.00%	0
Strongly Disagree	4.35%	1
TOTAL		23

Q17 Original statement 20: Endoscopic procedures included in the analysis should be characterized, including type and number, type of sedation, anesthesia, or other medication used.New proposal: Endoscopic procedures included in the analysis should be characterized, including type and number, setting (outpatient/inpatient), length of stay, type of sedation, anesthesia, or other medication used.Explanation: The statement was rephrased to improve its clarity.

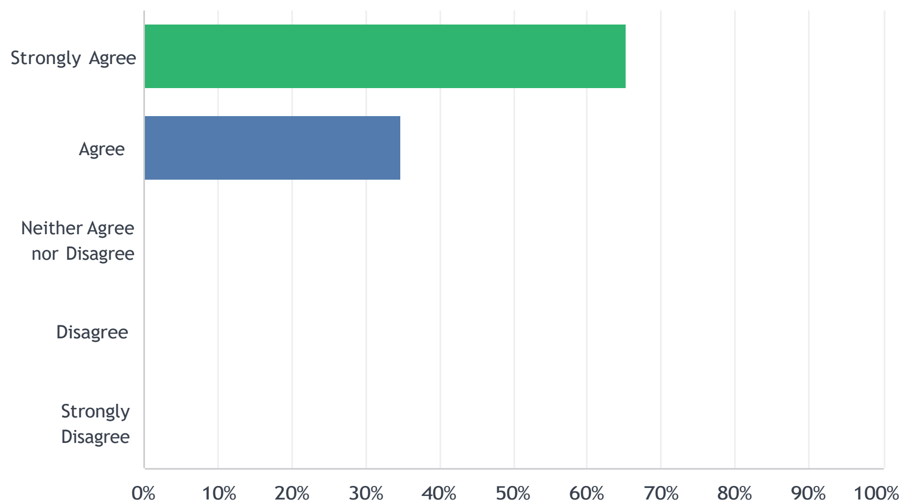
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	60.87%	14
Agree	26.09%	6
Neither Agree nor Disagree	13.04%	3
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q18 Original statement 22: GHG emissions should be reported according to each scope (1, 2 and 3).*New proposal: The reporting of GHG emissions should include a breakdown according to the ‘scope’ classification included in the GHG Protocol*:- Scope 1 (emissions directly produced from healthcare facilities - e.g., anesthetic gases or fuel combustion);- Scope 2 (indirect emissions - e.g., purchased electricity or heating/cooling);- Scope 3 (emissions occurring in the healthcare supply chain, both upstream and downstream – e.g., transportation)Explanation: The statement was rephrased, and definitions of scopes 1, 2, and 3, along with corresponding examples, were added to enhance overall clarity.*if applicable

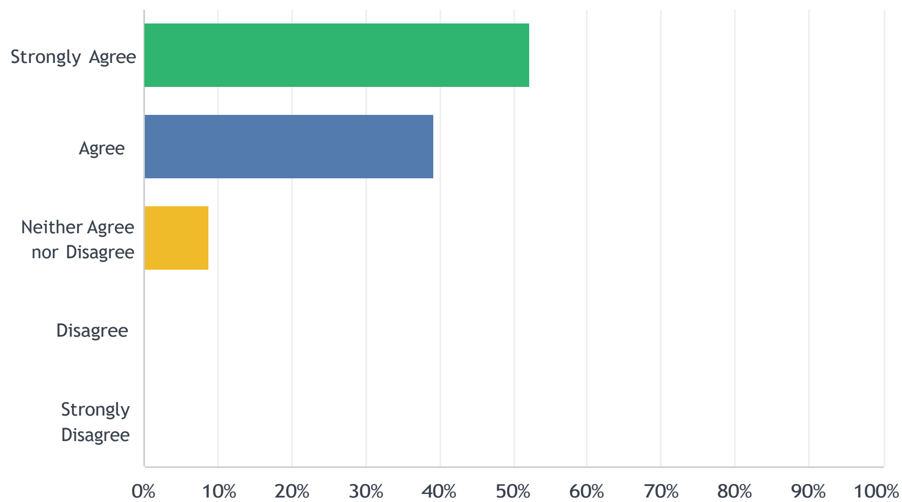
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	65.22%	15
Agree	34.78%	8
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q19 Original statement 24: Disclose unadjusted estimates. Disclose potential confounder-adjusted estimates and respective precision (e.g., 95% confidence interval). Clearly state which confounders were adjusted for and the reason to do so (if applicable).Original statement 25: An uncertainty assessment is conducted using analyses which explore the sensitivity of the results to key assumptions, alternative scenarios and parameters.New proposal: Disclose unadjusted estimates and potential confounder-adjusted estimates with respective precision (e.g., 95% confidence interval). Clearly state which confounders were adjusted for and the reason to do so.* It is suggested that the sensitivity of the results to key assumptions or parameters is explored with an uncertainty assessment.Explanation: Statement 25 is no longer a stand-alone statement. Statement 24 and 25 have been combined to include mention of a sensitivity analysis, given that this is a core part of environmental impact assessment.*if applicable

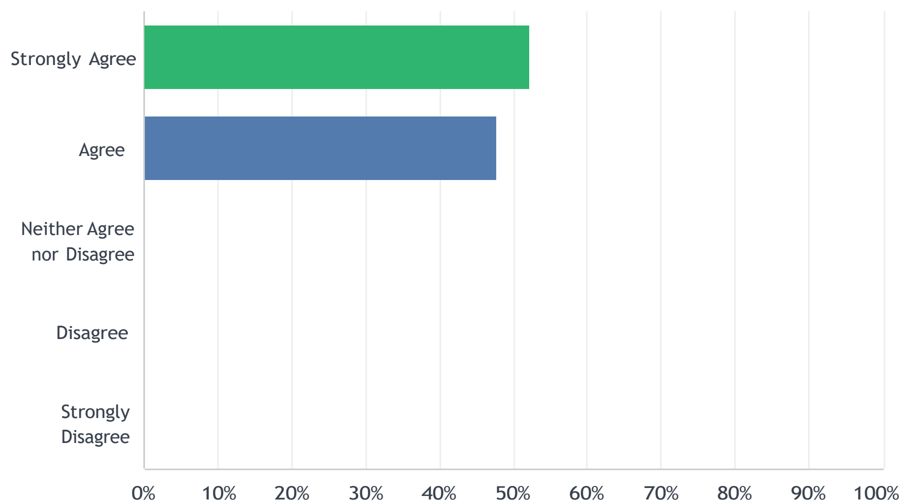
Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.17%	12
Agree	39.13%	9
Neither Agree nor Disagree	8.70%	2
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

Q20 Original statement 31: Propose routes to improvement, and identify the key actors (e.g. clinicians, suppliers, regulators) necessary to affect a solution in each case.New proposal: If study findings have clear implications for a potential change in process, practice or policy, discuss the necessary next steps for researchers and key stakeholders (e.g., clinicians, suppliers, regulators).Explanation: The statement was rephrased to improve overall clarity and neutrality, and to reflect panellists' concern regarding 'solution'-focussed reporting.

Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES	
Strongly Agree	52.17%	12
Agree	47.83%	11
Neither Agree nor Disagree	0.00%	0
Disagree	0.00%	0
Strongly Disagree	0.00%	0
TOTAL		23

3. Literature search

PUBMED SEARCH – 31/01/24

#1(("green" OR "greener") OR ("sustainable" OR "sustainability") OR (environment*) OR ("climate change") OR ("global warming") OR (carbon footprint) OR ("greenhouse" or "GHG") OR (pollution) OR ("single-use" OR "single use") OR ("reusable"))
RESULTS: 2,936,797

#2 (endoscop*[Title/Abstract]) OR (duodenoscop*[Title/Abstract])
RESULTS: 259,714

#1 AND #2
RESULTS: 5,148

#1 AND #2 AND (y_10[Filter])
RESULTS: 3,022

WEB OF SCIENCE SEARCH – 31/01/24

#1 ALL=((("green" OR "greener") OR ("sustainable" OR "sustainability") OR (environment*) OR ("climate change") OR ("global warming") OR (carbon footprint) OR ("greenhouse" or "GHG") OR (pollution) OR ("single-use" OR "single use") OR ("reusable")))
RESULTS: 7,556,443

#2 ((TS=endoscopy OR TS=endoscope OR TS=endoscopes OR TS=endoscopic) OR (TS=duodenoscope OR TS=duodenoscopes OR TS=duodenoscopy))
RESULTS: 279,312

#1 AND #2
RESULTS: 5,820

#1 AND #2 AND (y_10[Filter])
RESULTS: 3,612

CENTRAL – 31/01/24

#1 ((("green" OR "greener") OR ("sustainable" OR "sustainability") OR (environment*) OR ("climate change") OR ("global warming") OR (carbon footprint) OR ("greenhouse" or "GHG") OR (pollution) OR ("single-use" OR "single use") OR ("reusable")))
RESULTS: 113,177

#2 ((endoscopy OR endoscope OR endoscopes OR endoscopic) OR (duodenoscope OR

duodenoscopes OR duodenoscopy))
RESULTS: 35,178

#1 AND #2
RESULTS: 1,169

#1 AND #2 AND (y_10[Filter])
RESULTS: 908

