Access to and quality of elective care: a prospective cohort study using hernia surgery as a tracer condition in 83 countries

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Summary

Background Timely and safe elective health care facilitates return to normal activities for patients and prevents emergency admissions. Surgery is a cornerstone of elective care and relies on complex pathways. This study aimed to take a whole-system approach to evaluating access to and quality of elective health care globally, using inguinal hernia as a tracer condition.

Methods This was a prospective, international, cohort study conducted between Jan 30 and May 21, 2023, in which any hospital performing inguinal hernia repairs was eligible to take part. Consecutive patients of any age undergoing primary inguinal hernia repair were included. A measurement set mapped to the attributes of WHO's Health System Building Blocks was defined to evaluate access (emergency surgery rates, bowel resection rates, and waiting times) and quality (mesh use, day-case rates, and postoperative complications). These were compared across World Bank income groups (high-income, upper-middle-income, lower-middle-income, and low-income countries), adjusted for hospital and country. Factors associated with postoperative complications were explored with a three-level multilevel logistic regression model.

Findings 18 058 patients from 640 hospitals in 83 countries were included, of whom 1287 (7·1%) underwent emergency surgery. Emergency surgery rates increased from high-income to low-income countries (6·8%, 9·7%, 11·4%, 14·2%), accompanied by an increase in bowel resection rates (1·2%, 1·4%, 2·3%, 4·2%). Overall waiting times for elective surgery were similar around the world (median 8·0 months from symptoms to surgery), largely because of delays between symptom onset and diagnosis rather than waiting for treatment. In 14 768 elective operations in adults, mesh use decreased from high-income to low-income countries (97·6%, 94·3%, 80·6%, 61·0%). In patients eligible for day-case surgery (n=12 658), day-case rates were low and variable (50·0%, 38·0%, 42·1%, 44·5%). Complications occurred in 2415 (13·4%) of 18 018 patients and were more common after emergency surgery (adjusted odds ratio 2·06, 95% CI 1·72–2·46) and bowel resection (1·85, 1·31–2·63), and less common after day-case surgery (0·39, 0·34–0·44).

Interpretation This study demonstrates that elective health care is essential to preventing over-reliance on emergency systems. We identified actionable targets for system strengthening: clear referral pathways and increasing mesh repair in lower-income settings, and boosting day-case surgery in all income settings. These measures might strengthen non-surgical pathways too, reducing the burden on society and health services.

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See Online for appendix 1

Introduction

Elective health care remains the cornerstone to well functioning health systems,[1] with common examples including diagnostics, surgery, and cardiovascular disease optimisation.[2] Across a very wide range of health-care systems, elective care allows a fast recovery to normal activities, reduces the need for complex emergency care, and reduces health-care costs.[1] During and after the COVID-19 pandemic, elective care was deprioritised and continues to struggle to recover, particularly in terms of access and volume.[3,4] Continual deprioritisation is leading to a downward spiral of increasing emergency admissions and further stress on the remaining elective capacity, with crisis management of emergency conditions fast becoming the norm.[5,6]

Elective health care is a broad umbrella that includes a wide range of diseases, diagnostics, and treatments, meaning that any research needs to be focused.[1] A tracer condition is a common condition where diagnosis and management are established, and a lack of treatment can cause harm.[7] A tracer condition that is common to countries around the world and able to describe a whole-system pathway, would be able to assess post-COVID-19 elective care and identify targets for improvement.

Research in context

Evidence before this study

Elective care is cost-effective, ensures patients return to normal activities quickly, and prevents emergency admissions. Partly through COVID-19 shutdowns in elective care and the subsequent slow recovery, health care is facing an international crisis, with emergency care becoming the norm. It is creating a downward spiral that is further reducing elective capacity. We planned to use inguinal hernia care as a tracer condition (ie, a condition for which there are accepted definitions and proven, cost-effective treatments) to assess elective health care. We searched PubMed for global studies linking assessment of health care and patient-level data. We used the search terms "elective healthcare", "elective surgery", and "inguinal hernia repair", as well as related terms. We did not find any study with data collected from patients with inguinal hernias and health system evaluation. We also did not find any study assessing waiting times for elective surgery at a global scale before the pandemic. However, we identified inguinal hernia as part of the World Bank's Essential Surgery Package and the 2023 HerniaSurge Collaborative guidelines, which set acceptable and achievable standards around the world. We identified the Surgical Preparedness Index, which helps hospitals establish resilient elective systems but showed wide global variation in preparedness. We reviewed the *Lancet* Commission on Surgery (2015) and the *Lancet* Commission on Diagnostics (2021), both of which advocate for stronger elective systems, and called for actionable research.

Added value of this study

This study used hernia repair as a tracer condition for elective health care. It showed that inguinal hernias are mostly a disease of working age patients around the world, and when limited to the inguinal region, are treatable with simple, elective, day-case surgery. If neglected, the need for more complex emergency surgery increases substantially, as do major life-threatening complications of bowel resection, leading to delayed recovery and far higher total health-care costs. The delays shown were in diagnosis, not in waiting for treatment. Additionally, access to mesh in lower-income settings could be improved, and day-case surgery for simple hernias promoted. This allowed us to identify actionable targets: improving community worker knowledge and referral pathways is necessary in low-income settings, combined with a global quality improvement programme to boost mesh availability. The lack of mesh in lower-income settings exposes inequities in affordable medical devices and can be solved with industry collaboration and a global training programme. Day-case rates for eligible patients were still far from the targets desired in most income settings, so setting up dedicated pathways will reduce overall costs, boost capacity, and improve system resilience.

Implications of all the available evidence

Without correcting downwards spirals of reliance on emergency care, crisis management becomes the norm across a wide range of conditions, as is currently being seen globally. Strengthening elective pathways will also relieve the burden on emergency pathways by avoiding emergency presentation for conditions that can be fixed at an early stage with simple treatments. It can promote earlier presentation for emergency surgery, such as surgery for appendicitis, preventing the need for complex emergency care too. Policy makers can use this study as a proxy for other elective conditions, which are likely to suffer from the same weaknesses but are too numerous to study individually. Opportunistic detection and optimisation of non-surgical disorders (eg, raised blood pressure, raised blood sugar) would integrate surgery into the wider system of primary and preventive health care rather than leave it as a standalone entity. This system strengthening approach will also be realised in the management of multimorbidity. All these factors, underpinned by timely elective care, will reduce the health burden on society and health-care services.

Inguinal hernias are a common, global surgical condition and suitable for such a task.[8] The World Bank Essential Surgery Package identifies inguinal hernia as a condition that leads to substantial global burden, treatment represents a substantial surgical need, and its repair is cost-effective.[9] Inguinal hernia repairs are offered by health systems worldwide, and there are accepted guidelines for treatment.[10,11] Not offering timely repair can impact patients' ability to do daily activities, limits their capacity to do heavy work leading to societal cost, and can increase the rate of emergency surgery.[12–14]

The study aimed to take a whole-system approach to evaluate access to and quality of elective health care around the world, using inguinal hernia as a tracer condition. We set out to collect data at both patient level and health system level, bridging the gap between the two. We designed the analysis to identify actionable targets directly relevant to inguinal hernia repair, but with features that might also strengthen wider elective care pathways. We accepted from the very start of planning that a single outcome measure would not be appropriate for whole-system assessment, so we set out to design the study in a way that reported evenly across wider health systems.

For the **protocol** see https://www.globalsurgeryunit.org/clinical-trials-holding-page/hippo/

Methods

Study design and participants

We conducted an international, multicentre, prospective cohort study of patients undergoing inguinal hernia surgery (HIPPO). We collected only routine, anonymised data, without making any change to existing clinical care pathways within each hospital. The study was prospectively registered in ClinicalTrials.gov (NCT05748886) and the full protocol is available online. The local principal

investigators were responsible for seeking approvals according to regulations in place. In some participating hospitals, informed patient consent was taken, whereas in other hospitals it was waived by the local research ethics committees.

Any hospital performing inguinal hernia repair was eligible to take part. Eligible hospitals were identified by national leads and invited to take part. Participating hospitals identified and included consecutive patients of any age undergoing primary inguinal hernia repair as the main procedure during a 4-week inclusion window, between Jan 30 and May 21, 2023, with a follow-up window of 30 days after the date of surgery. Both elective and emergency indications were included. All surgical approaches were included apart from open surgeries performed via midline incision as these represent more complex operations, often associated with other procedures.

Measurement set

The Study Management Group identified that no single outcome would have face validity in accurately evaluating performance of whole surgical systems, based on literature review and discussions. To have a more comprehensive evaluation of elective surgery system performance, we needed to consider multiple different measures. Therefore, we defined a measurement set through a multi-stage consensus process within the Study Management Group (appendix 1 p 36). The measures we used were designed to align with the attributes of WHO's Health System Building Blocks: (1) access, including measures of access and coverage, and (2) quality, including measures of quality and safety.[15]

The measurement set was organised into six key performance measures and seven additional descriptive measures (appendix 1 p 38). We used staged inclusion and exclusion criteria to determine the sample in which each measure would be assessed. To address access we measured: (1) emergency rate: the proportion of patients undergoing emergency surgery (measurable in all included patients); (2) bowel resection rate: the proportion of patients in whom bowel resection occurred (all patients); and (3) waiting time: time between the date of surgery and start of symptoms for symptomatic patients and the date of diagnosis for asymptomatic patients (elective surgery only). To address quality we measured: (1) mesh use rate: the proportion of patients in whom a mesh was used out of all patients in whom a mesh would be indicated according to international guidelines[11] (adults undergoing elective surgery only); (2) day-case rate: the proportion of patients who were discharged on the same day out of all patients for whom day-case surgery would be recommended (adults younger than 90 years, American Society of Anesthesiologists Physical Status Classification System [ASA] grade I–II, undergoing elective surgery); and (3) postoperative complications: defined by Clavien-Dindo classification and including all grades I–V (all patients). To better assess safety, we created a model for complications taking into account the features of the patient pathway. Detailed rationale for the key performance measures is described in appendix 1 (p 39).

Seven additional descriptive measures were also defined. To further describe access, we used hospital-level measures (standardised patient pathways, waiting list management, availability of day-case surgical unit, and financing methods). To describe quality, we used intraoperative measures including primary operator (a self-identified variable of senior surgeon, trainee surgeon, and non-surgeon medical practitioner), anaesthesia used (local, regional block, spinal, and general), and surgical approach (open, minimally invasive, and minimally invasive converted to open).

Data management

Data were collected and stored online through a secure server running the Research Electronic Data Capture (REDCap) web application.[16] The service was managed by the Global Surgery REDCap system hosted at the University of Birmingham, UK, and its security was governed by the policies of the University of Birmingham. Collaborators were given REDCap project server login details, allowing secure data entry and storage. For more information on data collection see appendix 1 (p 37).

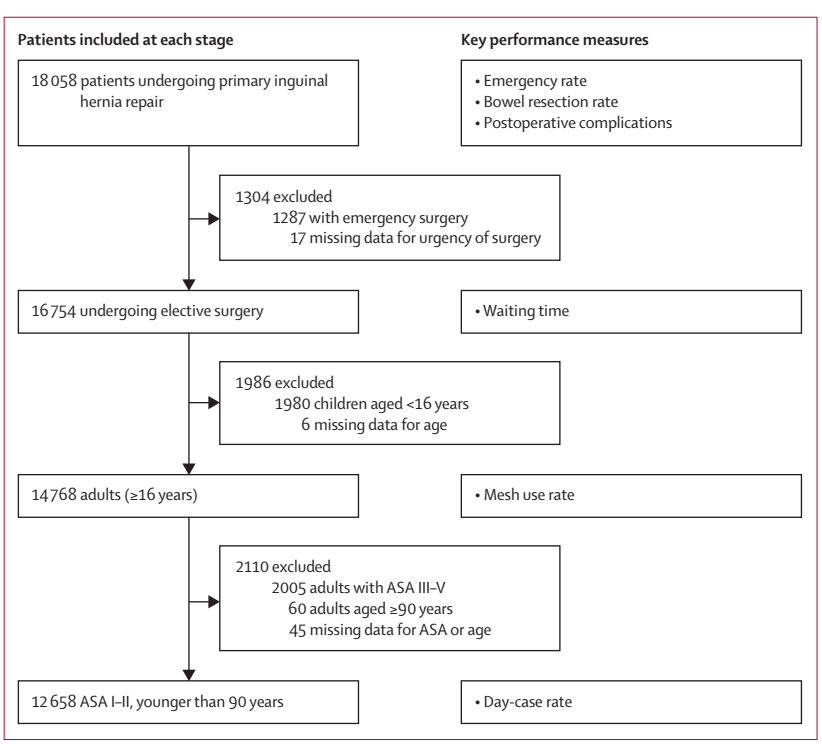


Figure 1: **Flow of patients mapped to key performance measures**
This figure shows the included and excluded patients when staged inclusion and exclusion criteria were applied, to evaluate the key performance measures in the correct sample. The rationale for this is explained in appendix 1 (p 39). ASA=American Society of Anesthesiologists Physical Status Classification System grade.

	HICs (n=9808)	UMICs (n=3366)	LMICs (n=3948)	LICs (n=936)	Total (n=18 058)
Age, years					
Median	63·0	53·0	42·0	44·0	57·0
IQR	51·0–73·0	32·0–66·0	11·5–58·5	20·0–60·0	39·0–69·0
Age groups					
Infants (<1 year)	124 (1·3%)	243 (7·2%)	389 (9·9%)	78 (8·4%)	834 (4·6%)
Children (1 year to <16 years)	245 (2·5%)	325 (9·7%)	640 (16·2%)	128 (13·7%)	1338 (7·4%)
Adults (≥16 years)	9432 (96·2%)	2796 (83·1%)	2918 (73·9%)	725 (77·9%)	15 871 (88·0%)
Missing	7	2	1	5	15
Sex					
Female	1008 (10·3%)	386 (11·5%)	361 (9·1%)	84 (9·0%)	1839 (10·2%)
Male	8792 (89·7%)	2980 (88·5%)	3586 (90·9%)	847 (91·0%)	16 205 (89·8%)
Missing	8	0	1	5	14
ASA grade					
I–II	7865 (80·3%)	3070 (91·2%)	3793 (96·1%)	895 (96·1%)	15 623 (86·6%)
III–V	1868 (19·1%)	290 (8·6%)	144 (3·6%)	29 (3·1%)	2331 (12·9%)
Not recorded	67 (0·7%)	6 (0·2%)	10 (0·3%)	7 (0·8%)	90 (0·5%)
Missing	8	0	1	5	14
Comorbidities					
None	7267 (74·1%)	2670 (79·4%)	3417 (86·6%)	802 (86·1%)	14 156 (78·5%)
One	1840 (18·8%)	535 (15·9%)	436 (11·1%)	119 (12·8%)	2930 (16·2%)
Two	515 (5·3%)	121 (3·6%)	84 (2·1%)	10 (1·1%)	730 (4·1%)
Three or more	172 (1·8%)	36 (1·1%)	7 (0·2%)	0 (0·0%)	215 (1·2%)
Missing	12	3	4	5	24
Symptoms					
Asymptomatic	1312 (13·4%)	520 (15·4%)	974 (24·7%)	117 (12·6%)	2923 (16·2%)
Symptomatic	8486 (86·6%)	2846 (84·6%)	2972 (75·3%)	815 (87·4%)	15 119 (83·8%)
Missing	10	0	2	4	16
Hernia size					
Limited to inguinal region	8209 (83·8%)	2498 (74·2%)	2351 (59·6%)	636 (68·3%)	13 694 (75·9%)
Limited to scrotum	1490 (15·2%)	826 (24·5%)	1535 (38·9%)	283 (30·4%)	4134 (22·9%)
Extending to mid-thigh or beyond	102 (1·0%)	42 (1·2%)	61 (1·5%)	12 (1·3%)	217 (1·2%)
Missing	7	0	1	5	13
Contamination					
Clean	9640 (98·4%)	3081 (91·6%)	3731 (94·6%)	898 (96·4%)	17 350 (96·2%)
Clean-contaminated	138 (1·4%)	271 (8·1%)	185 (4·7%)	30 (3·2%)	624 (3·5%)
Contaminated	15 (0·2%)	10 (0·3%)	25 (0·6%)	0 (0·0%)	50 (0·3%)
Dirty	5 (0·1%)	3 (0·1%)	5 (0·1%)	4 (0·4%)	17 (0·1%)
Missing	10	1	2	4	17
Hernia defect size					
<1·5 cm	2132 (21·8%)	703 (20·9%)	988 (25·0%)	238 (25·5%)	4061 (22·5%)
1·5 cm to 3 cm	3872 (39·5%)	1223 (36·3%)	1444 (36·6%)	378 (40·6%)	6917 (38·3%)
>3 cm	1975 (20·2%)	998 (29·6%)	1154 (29·2%)	235 (25·2%)	4362 (24·2%)
Not known	1816 (18·5%)	442 (13·1%)	360 (9·1%)	81 (8·7%)	2699 (15·0%)
Missing	13	0	2	4	19

Data are n (%) unless stated otherwise. Denominators for each group are presented in the top row; missing data are excluded from the denominators when calculating the percentages. Patient characteristics and intraoperative details from all patients included in the analysis are shown. HIC=high-income country. UMIC=upper-middle-income country. LMIC=lower-middle-income country. LIC=low-income country. ASA=American Society of Anesthesiologists Physical Status Classification System.

Table: **Preoperative and intraoperative characteristics across income groups**

Data validation

We have previously validated our data collection methodology in terms of case ascertainment and data accuracy.[17,18] Each hospital lead was responsible for data accuracy and data completeness collected and uploaded from their teams. The data were checked centrally and when there were missing data or invalid data, the hospital lead was contacted to complete and correct the data

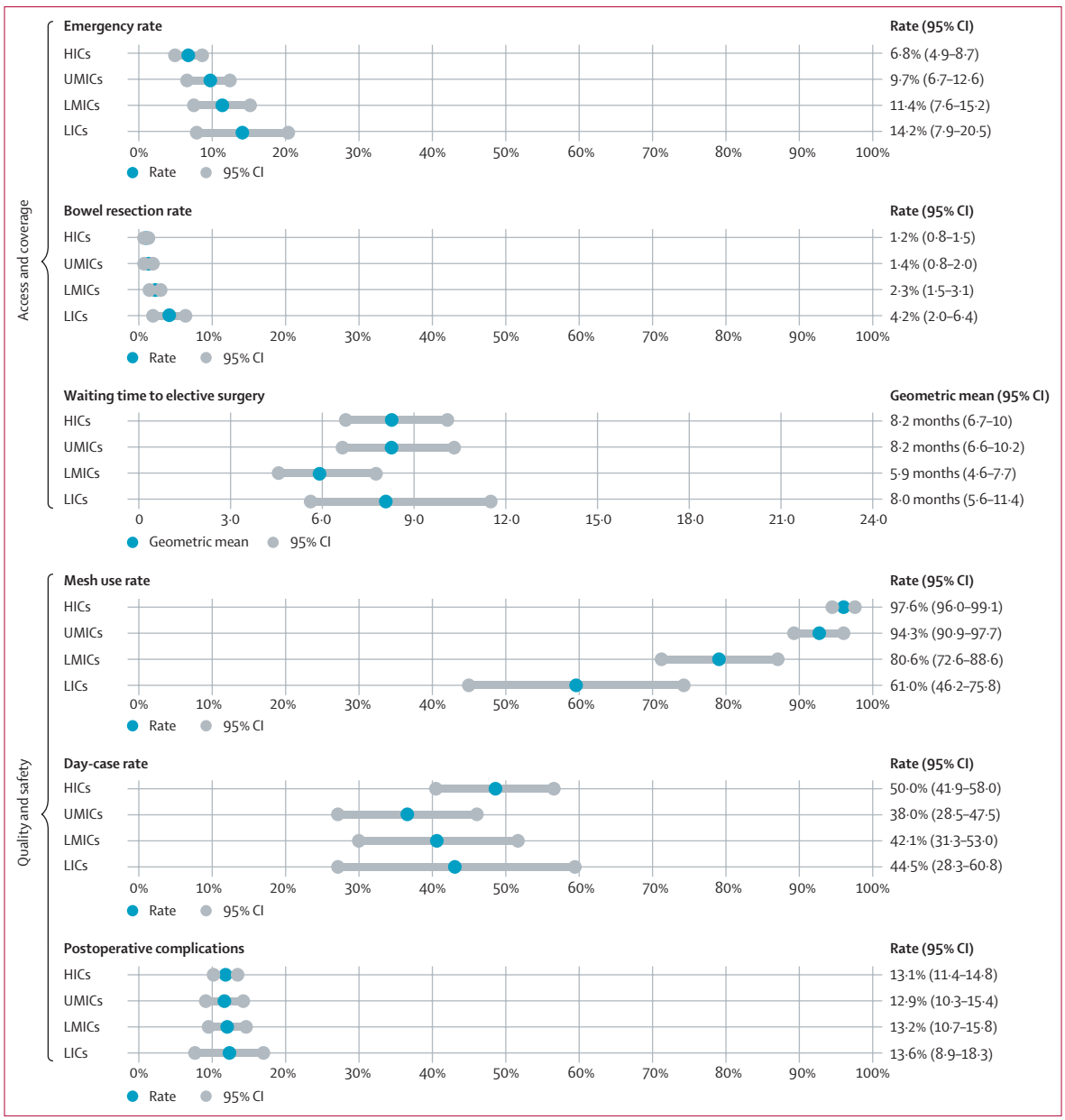


Figure 2: **Key performance measures to evaluate access and quality**
This figure shows the variation of access, coverage, quality, and safety across the income groups. Categorical variables are presented with adjusted rates for hospital and country, and waiting times are presented as geometric means, also adjusted for hospital and country. Missing data are excluded from this figure and are reported in appendix 1 (p 46). HIC=high-income country. UMIC=upper-middle-income country. LMIC=lower-middle-income country. LIC=low-income country.

entered before the data lock. Following this, participating hospitals with data completeness below 95% were excluded.

Sample size

To ensure global generalisability of the results and to justify the resources put into the study, we estimated a minimum number of 300 hospitals contributing patient-level data from 70 countries, based on previous cohort studies (ie, GlobalSurg, COVIDSurg).[17,18] Assuming an average of 30 patients per hospital, we predicted a minimum sample size of 10 000 patients. A sample of 10 000 equates to margins of error between 0·2% and 0·85% depending on the binary outcome and a width of 0·39 for the continuous outcome (see appendix 1 p 40 for full details).

Statistical analysis

The data were mapped to country income groups, which were defined according to the World Bank into four

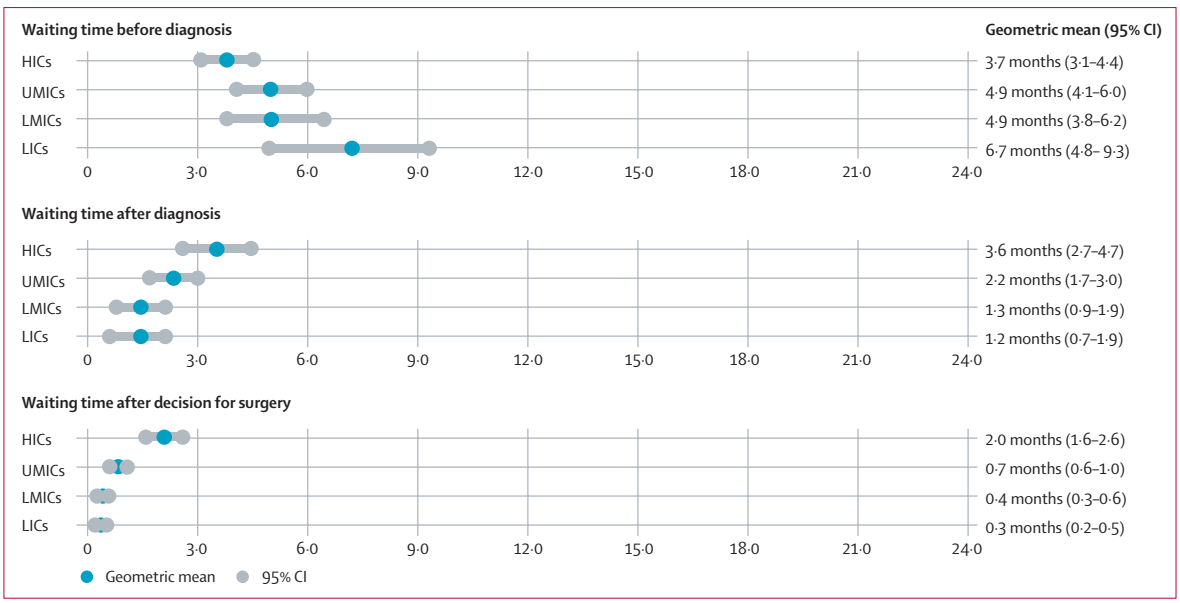


Figure 3: **Waiting times components to elective surgery across income groups**
This figure shows the distribution of waiting times across the patient pathway; diagnosis and decision for surgery represent key points in access to elective surgery. Data are presented as geometric mean and 95% CI. Missing data are excluded from this figure and are reported in appendix 1 (p 46). HIC=high-income country. UMIC=upper-middle-income country. LMIC=lower-middle-income country. LIC=low-income country.

categories: low-income countries (LICs), lower-middle-income countries (LMICs), upper-middle-income countries (UMICs), and high-income countries (HICs), as the importance of country income level in relation to health-care access and quality has been widely recognised.[6]

Continuous hospital, patient, and intraoperative characteristics were presented as mean and SD if normally distributed and median and IQR if not normally distributed. Categorical variables were described using frequencies and percentages. Rates of key performance measures by income group were presented with adjusted rates from three-level multilevel logistic regression models (hospital nested within country) and 95% CIs. Log-transformed waiting times between income groups were summarised using geometric means and 95% CIs from three-level multilevel linear regression models with similar structure as above. A three-level multilevel logistic regression model was used to explore the association of factors describing the patient pathway with complications. Clinically plausible factors agreed by the Study Management Group were included as covariates: income groups, age group, ASA groups, urgency of surgery, anaesthesia type, contamination, bowel resection, use of mesh, and day-case surgery. Hospitals nested within country were included as random effects. For the above analyses, appropriate model fit diagnostics were checked to confirm that validity and model assumptions hold for the data. All statistical analyses were performed using R (version 4.0.2). A p value of less than 0·05 was considered statistically significant.

Role of the funding source
The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results
Data from 18 465 patients were collected across 642 hospitals from 83 countries that participated in this study. From those, 407 patients were excluded and data from 18 058 patients, across 640 hospitals, were analysed. Exclusion reasons, proportions within each income group, and distribution across countries are shown in appendix 1 (pp 48–49). Patient selection, including the patient group in which each key performance measure was assessed, is presented in figure 1.

Overall, most patients were male (16 205 [89·8%] of 18 044), with a median age of 57·0 years (IQR 39·0–69·0; table). There were more patients with symptoms related to their inguinal hernia (15 119 [83·8%] of 18 042) than patients without symptoms. Most hernias were limited in size to the inguinal region (13 694 [75·9%] of 18 045), with the remainder limited to the scrotum. Most operations were classified as clean (17 350 [96·2%] of 18 041). Other preoperative and intraoperative characteristics are described in appendix 1 (pp 41–43).

Most included patients underwent surgery in tertiary-level hospitals (11 645 [65·1%] of 17 887; appendix 1 p 44). From the included hospitals, most were publicly funded (500 [80·1%] of 624; appendix 1 p 45). In addition, most were able to provide emergency surgery over 24 h (565 [90·5%] of 624).

The overall emergency surgery rate was 7·1% (1287 of 18 041 patients), which increased from HICs to LICs, as shown by figure 2. This was accompanied by an increase in bowel resection rate, from adjusted rates of 1·2% (105 of 9798 patients) in HICs to 4·2% (36 of 932s) in LICs.

The geometric mean of overall waiting time for elective surgery was 8·0 months (95% CI 7·8–8·1). Overall waiting times for elective patients were slightly longer in HICs (geometric mean 8·2 months) and shortest in LMICs (geometric mean 5·9 months). When looking in more detail at the components of the overall waiting time, important differences appeared, particularly after contact with the health system was established. After diagnosis, the waiting time to surgery was 3·6 months in HICs but only 1·2 months in LICs (figure 3)

Overall mesh use rate was 94·8% (13 995 of 14 768 patients), which decreased from HICs (adjusted rate 97·6%; 8842 of 8916) to LICs (adjusted rate 61·0%; 457 of 635).

Day-case rates were low and variable across income groups. The highest adoption of day-case surgery occurred in HICs and in LICs, with adjusted rates of 50·0% (4464 of 7182) and 44·5% (368 of 605), respectively.

Of the 18 058 included patients, 14 580 (80·7%) had a follow-up appointment within 30 days of the surgery. A total of 18 018 patients had follow-up data available, as data were also available for some patients from emergency department or unplanned clinic records. The overall postoperative complications rate at 30 days was 13·4% (2415 of 18 018 cases). Of these 2415 cases, 1808 (74·9%) were Clavien-Dindo grade I–II, and only 16 (0·7%) were Clavien-Dindo grade V (death; appendix 1 p 46). An ASA grade of III–V, clean-contaminated, contaminated, or dirty surgery, emergency surgery, and bowel resection were all associated with increased risk of postoperative complications (figure 4).

Standardised patient pathways, waiting list management, and availability of day-case surgical units were variable across the different income groups (figure 5). All were consistently highest in HICs (appendix 1 p 47).

Insurance provided by the government was the payment type used by most patients in all income groups (14 297 [79·9%] of 17 887). From the other payment methods, out-of-pocket payments were highest in LMICs (1081 [27·4%] of 3948) and LICs (189 [20·8%] of 908).

Senior surgeons were present in 12 752 (70·7%) of 18 042 cases overall, which was similar in the different income groups (figure 5). Anaesthesia type showed wide variation. General anaesthesia was more used in HICs and UMICs (5867 [59·9%] of 9798 and 1920 [57·0%] of 3366, respectively) as opposed to spinal anaesthesia, which was more commonly used in LMICs and LICs (1890 [47·9%] of 3944 and 548 [58·8%] of 932, respectively). More details on other anaesthetic practices are described in figure 5 and appendix 1 p 47.

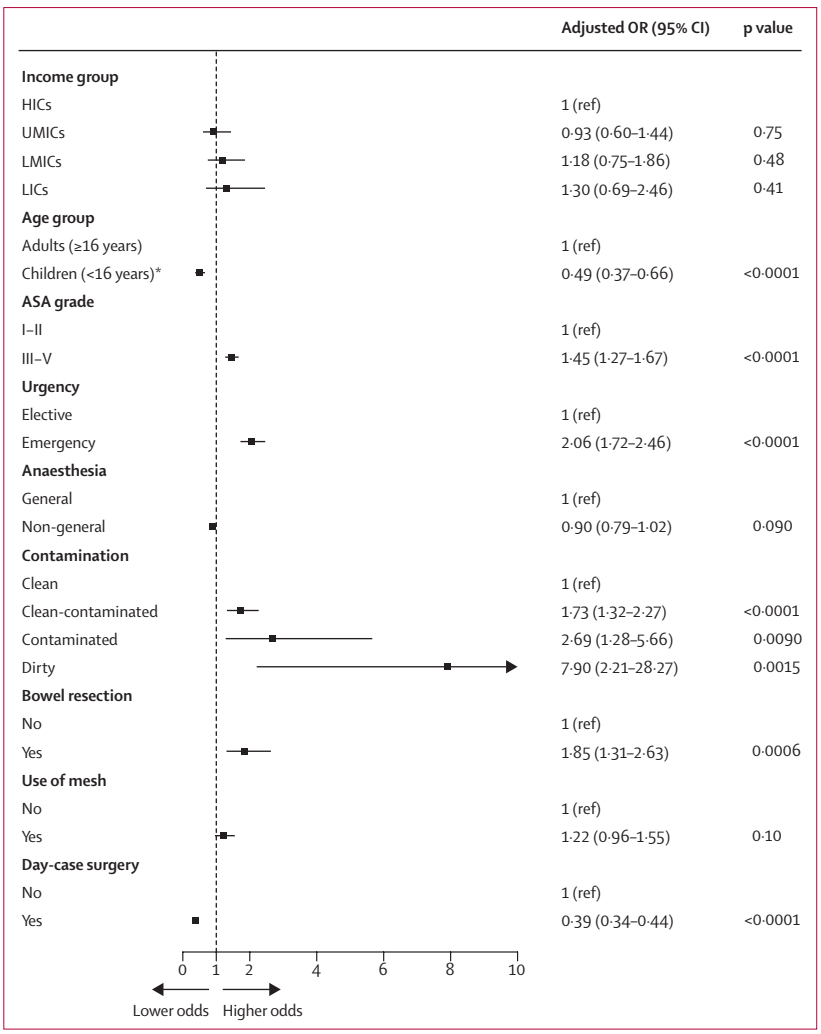
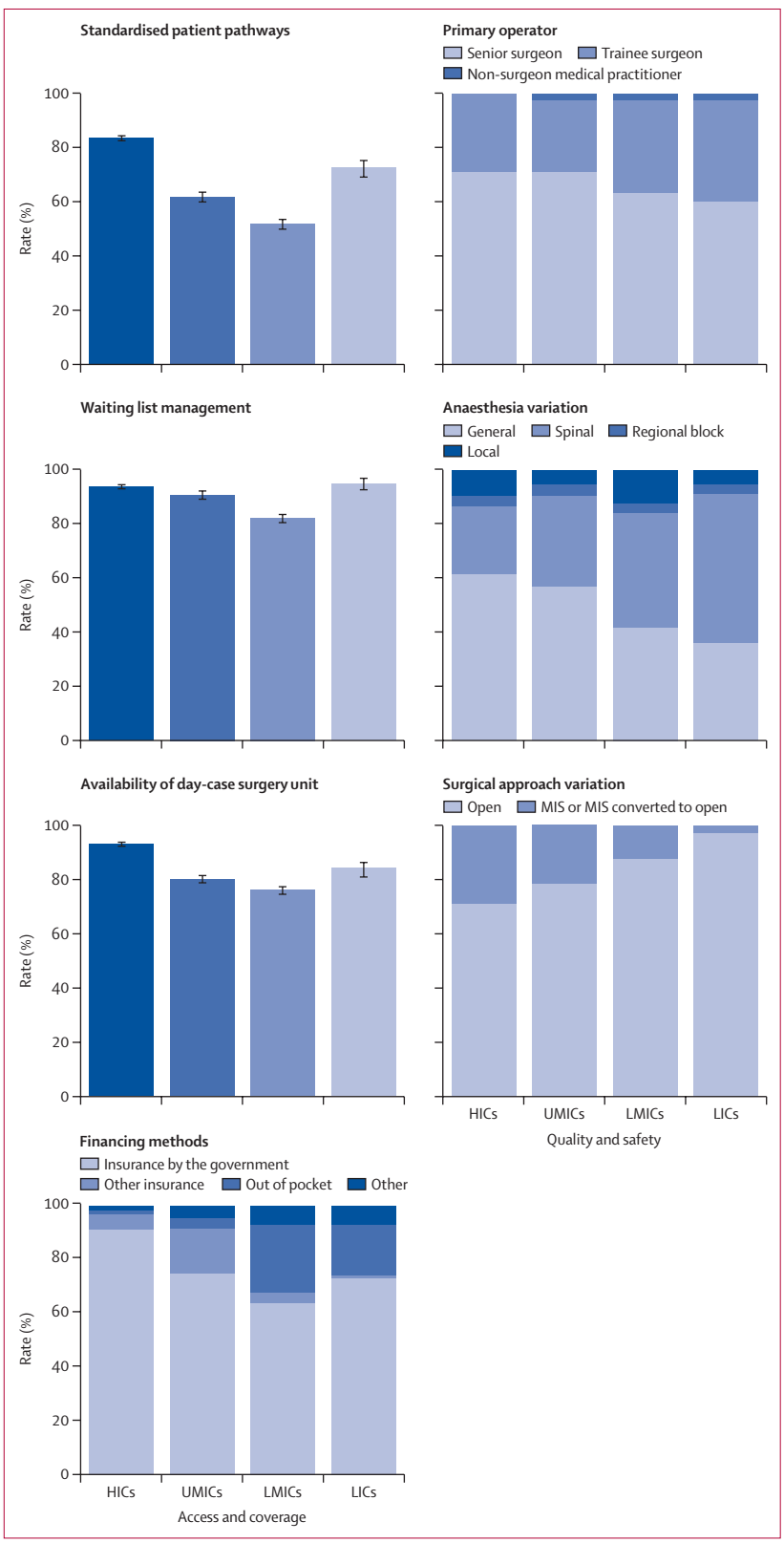


Figure 4: **Multilevel logistic regression model to test factors associated with complications at 30 days**
This model shows the factors associated with complications, reflecting a multilevel model with hospital and country as the two levels that were adjusted for. All patients were included in the model, except those with missing data for any of the variables (n=40). OR=odds ratio. HIC=high-income country. UMIC=upper-middle-income country. LMIC=lower-middle-income country. LIC=low-income country. ASA=American Society of Anesthesiologists Physical Status Classification System. *Includes infants (<1 year).

Overall, open surgery was used in most patients (14 117 [78·2%] of 18 041), with a decrease in minimally invasive surgery from higher to lower incomes (HICs 2723 [27·8%] of 9798, UMICs 759 [22·6%] of 3365, LMICs 433 [11·0%] of 3946, LICs 9 [1·0%] of 932). Laparoscopic surgery represented 3769 (96·0%) of all 3924 cases of minimally invasive surgery, with robotic approach being used in the remaining 155 (4·0%).

Discussion

This study shows that inguinal hernias are mostly a disease of working-age patients around the world, and when small, are treatable with simple, day-case surgery. If neglected, the more complex emergency surgery, which might require bowel resection, leads to slow recovery and far higher total health-care costs.[19] We also



found that most of the waiting time was before the diagnosis was made, especially in low-income settings, rather than waiting for treatment after seeing a surgeon. Using inguinal hernia as a tracer condition for elective care, this study showed multiple weaknesses in access and quality in current health-care systems, with a particular disadvantage in lower-income settings. As a result, there was higher emergency demand, which further reduced elective capacity and might create downward spirals. Without addressing these spirals, emergency care and crisis management become the norm with potentially worse outcomes for patients.[6,12] Policy makers can use this study as a proxy for other elective conditions, which are likely to suffer from the same weaknesses.[2] If weak access and quality persist over several electively treatable conditions, both surgical and non-surgical, multimorbidity can also become established, which makes future elective care harder and emergency care even more complicated.[20]

We showed that inguinal hernia is a low-risk procedure that can be provided by a range of practitioners and with a range of anaesthetic types, while maintaining safety. Most complications were minor. However, emergency surgery was associated with more complications. We did not capture the most complex emergency surgery performed though larger midline incisions, as these operations require different data capture.[13] It is thus likely that this study underestimates the true burden of emergency surgery.[12] This study also shows a clear global imbalance in access to mesh repair, which probably reflects poor access to simple medical devices in lower-income settings.[21] Mesh is well proven to reduce long-term hernia recurrence,[10,11] is simple to place, and is low-cost and should be scaled.

The following actionable targets supported by our findings are relevant to front-line teams and policy makers. In some lower-income settings, improving referral systems and increasing the use of mesh repair will improve access and quality. Educating communities and community health workers around the symptoms of hernias and establishing referral pathways might facilitate timely evaluation by a surgeon. A global quality improvement programme in mesh placement for hernias is justified. This would involve strengthening industrial supply chains, making mesh affordable to patients, and increasing training to ensure safe and effective placement. In all income settings, boosting day-case surgery will improve capacity for simple, cost-effective surgery while also making systems resilient against

Figure 5: **Additional descriptive measures panel**
This figure shows the variation of additional descriptive data across income groups. The error bars represent the 95% CIs for the rates. Missing data are excluded from this figure and are reported in appendix 1 (p 47). HIC=high-income country. UMIC=upper-middle-income country. LMIC=lower-middle-income country. LIC=low-income country. MIS=minimally invasive surgery.

external threats.[22] Mesh placement and use of available anaesthetic resources would fit with the latest guidelines from the HerniaSurge Collaborative and for future global burden of disease studies with a focus on inguinal hernias, mesh and anaesthetic use could be taken into account during the modelling exercises.[10]

These targets might also strengthen other areas of simple, common elective health care, as identified through the *Lancet* Commission on Surgery and the *Lancet* Commission on Diagnostics.[2,21] The assessment and referral pathway could be combined with a set of simple assessments to detect other common diseases that would benefit from timely diagnosis and management to reduce multimorbidity. At the point of first appointment, blood pressure checks, blood sugar checks, and HIV checks are all deliverable and effective, making surgery part of an embedded pathway rather than a standalone speciality.[23]

The strengths of this study include its prospective, dedicated nature, which creates a unique dataset, allowing us to report a measurement set that comprehensively evaluates the whole system, rather than focusing on a single outcome measure. By doing so, we provide more holistic evidence relevant to all stakeholders, from front-line teams to policy makers. The design also allows us to identify several actionable targets and thus solutions to global problems around elective health care.

This study has important limitations. Using inguinal hernia as a tracer condition is a limitation in itself, considering that the randomised controlled trials conducted so far have shown that the individual risk for emergency surgery seems to be low.[24] We did not capture patients who did not undergo surgery, meaning the societal burden of untreated hernia could be far higher than we can estimate.[25] As discussed, we did not capture hernia repair through a midline incision, which is often used for the most complex emergency situations, underestimating the true burden of emergency surgery. There might be under-representation from some countries where minimally invasive surgery rates are currently very high (eg, Denmark, Norway, and Sweden), skewing results for those parts of the world.[26] Interpretation of the findings in the context of secondary-level and primary-level hospitals needs to be carefully made as most participating hospitals were tertiary level. We did not explore variation of the approval processes conducted nor the detailed differences in primary operator across countries, and we recognise there might be hidden bias related to these differences. Some data captured at hospital level (eg, payment mechanism) might not fully describe each individual patient's journey. We did not contact patients routinely at 30 days after surgery, which can be impossible in some settings, but patients with major events would be likely to re-present in their hospitals within 30 days and be captured by this study. There is a risk of over-representation from some countries, which is inherent to a global cohort study such as HIPPO. There should be some caution around conclusions on the whole system as the results might not be completely representative of every country included in each income group.

This study has recognised topics for future research. Inguinal hernia is one of many potential tracer conditions, for both elective care and surgery. Future researchers can select their own tracer conditions and use these key performance measures to provide a whole-system assessment. Further research will be needed to evaluate waiting times in emergency surgery as it can highlight hidden problems. Qualitative studies would be helpful to understand the variation in asymptomatic patients having an operation. Finally, from a methodology perspective, it would be useful to clarify the differences in study approval processes in different countries to see if, in limited settings, they are subject to any bias.

This study has identified areas for intervention by policy makers. Financing these pathways will be a challenge, especially if elective care needs to compete with emergency care. The additional descriptive measures in this study show the importance of affordable health insurance (whether government-funded or individually funded), which should be increased for common conditions around the world. Relying on out-of-pocket payments is likely to limit elective care to those with savings, or plunge families into catastrophic expenditure.[27,28]

Contributors

MP, AOA, AA, AEA, JAC, DC, RC, ACD, ME, AG, DG, JG, PH, EH, AI, IJ, SKK, OK, IL, SL, VL, EL, JM, AMB, DM, DN, FN, OO, SZYO, RO, FP, ARM, MSA, JFFS, MS, ST, and AB were involved in study design, coordination of the study, manuscript concept, and editing. MP, RA, DB, AC, JGGN, RRG, BK, SRK, SL, OO, KSYO, RO, and CV were involved in data chasing and accuracy of the data. BK, OO, MP, and AB conducted the data analysis. OO, MP, and AB accessed and verified the data. Dissemination Committee co-authors were involved in the dissemination of the study, coordination at a national level, and data collection. Hospital-lead co-authors were involved in coordination of the study at a hospital level and data collection. Collaborator co-authors were involved in data collection. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Equitable partnership declaration

The authors of this paper have submitted an equitable partnership declaration (appendix 2). This statement allows researchers to describe how their work engages with researchers, communities, and environments in the countries of study. This statement is part of *The Lancet Global Health*'s broader goal to decolonise global health.

See **Online** for appendix 2

Declaration of interests

MP reports a project research grant from the Portuguese Hernia and Abdominal Wall Society (Sociedade Portuguesa de Hernia e Parede Abdominal). AB reports a Global Health Research Unit grant from the National Institute for Health and Care Research (NIHR). All other authors declare no competing interests.

Data sharing

Anonymised data are available upon request from the corresponding authors and successful completion of a data sharing agreement through an Application Programming Interface linked to the REDCap data server hosted at the University of Birmingham, Birmingham, UK.

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