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From hospital availability to patient access: affordability-related barriers to clinician recommendation of innovative medical technologies in Shanghai, China

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Abstract

Background

Innovative medical devices and medicines can expand treatment options, but hospital availability does not necessarily translate into patient access. Clinicians are a critical interface between available technologies and patient-facing recommendations. This study examined whether patient affordability constrains this service pathway by leading clinicians to forego recommending innovative medical technologies.

Methods

We conducted a cross-sectional survey among practising clinicians in Shanghai in December 2025 using the Clinical Adoption Behavior and Cognition Scale for Innovative Medical Devices and Medicines. A total of 824 valid questionnaires were analysed. The primary outcome was frequent affordability-related foregone recommendation, defined as clinicians reporting that they often refrained from prescribing or recommending innovative medical devices or medicines because of patients' economic reasons. Modified Poisson regression with robust variance was used to estimate adjusted prevalence ratios (aPRs) and 95% confidence intervals (CIs).

Results

Among 824 clinicians, 306 (37.1%) reported frequent affordability-related foregone recommendation, and 678 (82.3%) reported that this occurred at least sometimes. High price or patient out-of-pocket burden was the highest-rated barrier, with 62.9% rating it as serious or very serious. In the fully adjusted model, high perceived price or out-of-pocket burden (aPR = 1.38, 95% CI: 1.09–1.74) and low patient acceptance due to economic or cognitive reasons (aPR = 1.74, 95% CI: 1.39–2.17) were associated with frequent foregone recommendation. Higher institutional support was associated with lower prevalence (aPR = 0.82, 95% CI: 0.70–0.97).

Conclusions

Affordability-related foregone recommendation of innovative medical technologies was common among clinicians in Shanghai. These findings identify clinician recommendation as an underexamined access point between hospital availability and patient use. Health services policies seeking to improve access to innovation should address patient out-of-pocket burden while strengthening institutional processes, reimbursement information and clinician support.

1 Background

Access to health care is not a single event but a pathway shaped by interactions among patients, providers, organisations and financing arrangements [1, 2]. A technology may be formally available in a hospital but still fail to reach patients if the service pathway is constrained by affordability, institutional procedures or uncertainty at the point of clinical recommendation. This distinction is central to health services research, where availability, acceptability, affordability and organisation jointly shape realised use [1–3].

Innovative medical devices and medicines are increasingly important to contemporary health systems. They may improve diagnosis, broaden treatment choices and improve clinical outcomes, yet they often enter practice with high prices, uncertain reimbursement and variable hospital-level adoption procedures [6–13]. For health systems pursuing both universal health coverage and innovation-led improvement, the policy challenge is not only whether innovative technologies are approved or introduced into hospitals, but whether they can move through service delivery pathways to become appropriate, affordable and patient-accessible options [4, 5].

China has expanded health insurance coverage and implemented policy reforms to improve access to innovative medicines and medical technologies [4, 5, 12]. These reforms have accelerated approval, reimbursement negotiation and clinical availability for selected innovations. However, an implementation gap may persist between formal policy support and routine patient use. In tertiary hospitals, clinicians often occupy a critical service interface: they appraise evidence, identify eligible patients, initiate prescriptions or recommendations, and help patients navigate treatment choices. When clinicians anticipate that patients cannot afford a technology, they may avoid recommending it even when it is clinically relevant.

Existing research has mainly examined affordability after treatment options have already been presented to patients, including catastrophic health expenditure, financial toxicity, cost-related non-adherence and treatment delay [14–25]. Studies of cost communication also show that clinicians and patients often struggle to discuss out-of-pocket burden in clinical encounters [21–25]. Less attention has been paid to an earlier access point: whether affordability concerns influence the set of innovative technologies that clinicians recommend in the first place. This is a health services question rather than a question of clinical appropriateness alone, because it concerns how financing and institutional conditions shape the translation of hospital availability into patient-facing access.

This study conceptualised affordability-related foregone recommendation as a provider-mediated access barrier in the service pathway for innovative medical technologies. Using a cross-sectional survey of clinicians in Shanghai, we aimed to estimate the prevalence of affordability-related foregone recommendation of innovative medical devices and medicines, describe its variation across clinical settings, and identify economic, professional and institutional factors associated with frequent foregone recommendation. By shifting the focus from technology availability to the recommendation interface, this study sought to identify a potentially hidden service delivery barrier to patient access.

2 Methods

2.1 Study design and data source

This was an observational study based on cross-sectional survey data. The data were derived from the Survey on Clinical Adoption Behaviors and Cognitions of Innovative Medical Devices and Medicines in Shanghai, conducted by the research team in December 2025. The survey was designed to assess clinicians' behaviours, perceptions and institutional experiences related to the clinical use of innovative medical devices and medicines.

The questionnaire was administered through a professional online survey platform and primarily targeted practising clinicians from health care institutions in Shanghai. Participation was anonymous and voluntary. Before completing the questionnaire, participants were informed of the study objectives, survey content and principles of data confidentiality, and provided informed consent. A total of 824 valid questionnaires were included in the final analysis.

2.2 Participants

The study population consisted of practising clinicians employed in general and specialty hospitals in Shanghai. Inclusion criteria were: (1) holding a practising physician licence; (2) being currently employed in a general or specialty hospital in Shanghai; and (3) voluntarily providing informed consent. Incomplete responses and duplicate submissions were excluded. All responses were exported to Microsoft Excel for data cleaning, coding and compilation into the final analytical dataset.

2.3 Survey instrument and item scoring

The core instrument was the self-developed Clinical Adoption Behavior and Cognition Scale for Innovative Medical Devices and Medicines. The initial item pool was generated through literature review and semi-structured interviews with eight clinical experts. Five theoretical dimensions were identified: clinical evidence appraisal, perceptions of the policy environment, perceived barriers, personal attitudes and behavioural intentions, and information channels and support systems.

Content validity was assessed through two rounds of Delphi consultation involving 12 experts. Item-level content validity indices exceeded 0.78, and the average scale-level content validity index was 0.92. A pilot test was conducted among 115 clinicians. Item analysis using the critical ratio method and homogeneity testing showed that item-total correlation coefficients for all retained items exceeded 0.40. A separate sample of 253 respondents was used for psychometric evaluation. The overall Cronbach's alpha coefficient of the scale was 0.91, and confirmatory factor analysis supported the proposed five-factor structure. The final structured questionnaire comprised 29 numbered questions covering demographic and professional characteristics, adoption experience, evidence appraisal, policy awareness, perceived barriers, institutional support, decision-support needs and research willingness.

Questionnaire items used for analytical composite scores were scored on five-point ordinal scales, with higher values indicating stronger perceived importance, higher familiarity, more serious perceived barriers, stronger support or greater willingness, depending on the item. No reverse-coded items were used. Composite scores were calculated as the mean of prespecified items derived from the questionnaire framework. Internal consistency was assessed using Cronbach's alpha in the full analytical sample. Details of item mapping and variable coding are provided in Additional file 1.

2.4 Outcome variables

The primary outcome was frequent affordability-related foregone recommendation of innovative medical devices and medicines. This was measured by the item: 'Have you ever refrained from prescribing or recommending innovative medical devices or medicines because of patients' economic reasons?' Response options were never, rarely, sometimes and often. For the primary analysis, 'often' was coded as 1 and all other responses were coded as 0. This strict definition was selected to capture a more stable and severe form of affordability-related restriction in clinician recommendation behaviour.

A secondary outcome was any affordability-related foregone recommendation, defined as reporting sometimes or often, with rarely and never coded as the reference category. In additional sensitivity analysis, the original four-level ordinal response was retained.

2.5 Main explanatory variables and covariates

The main explanatory variables were perceived economic barriers to the use of innovative medical devices and medicines. High price or high patient out-of-pocket share was measured on a five-point Likert scale. In the main analysis, responses of 4 or 5 were defined as high price or high out-of-pocket burden, and responses of 1–3 were defined as low-to-moderate burden. Low patient acceptance due to economic or cognitive reasons was measured on a five-point Likert scale and was similarly dichotomised into high versus low-to-moderate barrier. For descriptive summaries of all perceived barriers, scores of 4 or 5 were reported as serious or very serious barriers.

Covariates included hospital type, clinical department, professional title, participation in clinical research related to innovative medical devices or medicines during the previous three years, and frequency of clinical use or exposure to innovative medical devices and medicines. Three composite scores were also constructed. Evidence orientation was calculated as the mean score of items measuring the perceived importance of domestic clinical guidelines, high-quality international clinical studies, institutional experience and expert consensus. Policy literacy was calculated as the mean score of items measuring familiarity with relevant policy measures, reimbursement policies and internal hospital adoption procedures. Institutional support was calculated as the mean score of items assessing perceived policy effectiveness, the reasonableness and efficiency of hospital pharmacy or therapeutics committee review, and adequacy of clinical training. Higher scores indicated stronger evidence orientation, higher policy literacy or greater perceived institutional support.

2.6 Statistical analysis

Descriptive statistics were used to summarise participant characteristics, outcome distribution, perceived barriers and composite scores. Categorical variables were presented as frequencies and percentages. Continuous scores were presented as means and standard deviations. Group differences between clinicians who frequently reported affordability-related foregone recommendation and those who did not were assessed using chi-square tests for categorical variables and Welch t tests for continuous variables.

Because the primary outcome was common, odds ratios from logistic regression could overestimate the magnitude of association. Modified Poisson regression with robust variance was therefore used to estimate prevalence ratios (PRs), adjusted prevalence ratios (aPRs) and 95% confidence intervals (CIs) [33]. Three models were fitted. Model 1 included hospital type, department, professional title, research participation and use frequency. Model 2 further included high price or out-of-pocket burden and low patient acceptance due to economic or cognitive reasons. Model 3 additionally included policy literacy, evidence orientation and institutional support. Model 3 was treated as the fully adjusted model.

Sensitivity analyses were conducted by: (1) redefining the outcome as any affordability-related foregone recommendation; (2) treating the two economic barrier variables as continuous scores; (3) excluding clinicians who reported never using innovative medical devices or medicines; and (4) retaining the original four-level ordinal outcome. Statistical significance was defined as a two-sided P value < 0.05. Exact P values were reported for descriptive comparisons and sensitivity analyses. In the main regression table, statistical significance was denoted as *P < 0.10, **P < 0.05 and ***P < 0.01 to reduce table width.

2.7 Ethical considerations and reporting guideline

This study was conducted in accordance with the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Hospital (approval number: SHSY-IEC-6.0/25KY55/P01). All participants provided informed consent before participation. Data confidentiality and anonymity were maintained throughout the study.

This cross-sectional study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline [34].

3 Results

3.1 Participant characteristics

A total of 824 clinicians were included in the analysis (Table 1). Of these, 523 (63.5%) were from general hospitals and 301 (36.5%) were from specialty hospitals. The sample included clinicians from surgery (n = 240, 29.1%), internal medicine (n = 222, 26.9%), oncology (n = 65, 7.9%), imaging or interventional medicine (n = 43, 5.2%), intensive care medicine (n = 19, 2.3%) and other departments (n = 235, 28.5%).

Regarding professional title, 162 participants (19.7%) were resident physicians, 265 (32.2%) were attending physicians, 205 (24.9%) were associate chief physicians and 192 (23.3%) were chief physicians. Overall, 292 clinicians (35.4%) had participated in clinical research or research projects related to innovative medical devices or medicines during the previous three years. In terms of use frequency, 160 clinicians (19.4%) reported never using innovative medical devices or medicines, 363 (44.1%) rarely used them, 227 (27.5%) sometimes used them and 74 (9.0%) often used them.

Table 1
Participant characteristics by frequent foregone recommendation

Characteristic	Category	Total n (%)	Frequent n (%)	Not frequent n (%)	P value
Hospital type	General hospital	523 (63.5)	199 (38.0)	324 (62.0)	0.522
	Specialty hospital	301 (36.5)	107 (35.5)	194 (64.5)	
Clinical department	Internal medicine	222 (26.9)	79 (35.6)	143 (64.4)	0.578
	Surgery	240 (29.1)	90 (37.5)	150 (62.5)	
	Oncology	65 (7.9)	27 (41.5)	38 (58.5)	
	Imaging/intervention	43 (5.2)	19 (44.2)	24 (55.8)	
	Critical care	19 (2.3)	4 (21.1)	15 (78.9)	
	Other	235 (28.5)	87 (37.0)	148 (63.0)	
Professional title	Resident	162 (19.7)	54 (33.3)	108 (66.7)	0.008
	Attending	265 (32.2)	81 (30.6)	184 (69.4)	
	Associate chief	205 (24.9)	89 (43.4)	116 (56.6)	
	Chief	192 (23.3)	82 (42.7)	110 (57.3)	
Innovation-related clinical research	No	532 (64.6)	181 (34.0)	351 (66.0)	0.015
	Yes	292 (35.4)	125 (42.8)	167 (57.2)	
Use frequency of innovative technologies	Never	160 (19.4)	51 (31.9)	109 (68.1)	0.220
	Rarely	363 (44.1)	137 (37.7)	226 (62.3)	
	Sometimes	227 (27.5)	84 (37.0)	143 (63.0)	
	Often	74 (9.0)	34 (45.9)	40 (54.1)	

3.2 Prevalence of affordability-related foregone recommendation

Affordability-related foregone recommendation was common (Fig. 1). Among all participants, 306 clinicians (37.1%) reported that they often refrained from prescribing or recommending innovative medical devices or medicines because of patients' economic reasons. Another 372 clinicians (45.1%) reported that this sometimes occurred, while 110 (13.3%) rarely and 36 (4.4%) never reported this behaviour. Overall, 678 clinicians (82.3%) reported at least some affordability-related foregone recommendation.

The prevalence varied across clinical departments. The proportion reporting at least some affordability-related foregone recommendation was highest in oncology (90.8%), followed by internal medicine (84.2%), other departments (82.6%), surgery (80.4%), imaging or interventional medicine (76.7%) and intensive care medicine (63.2%). When the stricter definition of frequent affordability-related foregone recommendation was used, the proportion was highest in imaging or interventional medicine (44.2%), followed by oncology (41.5%), surgery (37.5%), other departments (37.0%), internal medicine (35.6%) and intensive care medicine (21.1%).

Panel A shows the distribution of responses to the item on affordability-related foregone recommendation. Panel B compares frequent foregone recommendation and any foregone recommendation across clinical departments. Any foregone recommendation was defined as reporting sometimes or often.

3.3 Perceived barriers to innovative technology use

Among perceived barriers, high price or high patient out-of-pocket share had the highest mean score (3.81 ± 0.95), and 62.9% of clinicians rated it as a serious or very serious barrier. Insufficient or unfamiliar evidence on clinical effectiveness and safety had a mean score of 3.76 ± 1.02, with 57.0% rating it as serious or very serious. Low patient acceptance due to economic or cognitive reasons had a mean score of 3.70 ± 0.96, with 56.6% rating it as serious or very serious (Table 2).

Other barriers were also common but less prominent. Lack of operational training or technical support had a mean score of 3.58 ± 1.08, with 51.6% rating it as serious or very serious. Complex and time-consuming internal application and approval procedures had a mean score of 3.41 ± 1.05, with 43.7% rating it as serious or very serious (Table 2). When asked about the most needed policy support, the most frequently selected option was accelerating reimbursement inclusion and increasing reimbursement levels (43.8%), followed by strengthening the synthesis and dissemination of clinical evidence (22.9%), simplifying internal hospital adoption procedures (20.1%), strengthening clinician training (7.8%) and establishing patient assistance funds or instalment payment mechanisms (5.3%).

Table 2
Perceived barriers to technology use

Barrier	Mean (SD)	Serious/very serious n (%)
High price or patient out-of-pocket share	3.81 (0.95)	518 (62.9)
Clinical effectiveness/safety evidence insufficient or unfamiliar	3.76 (1.02)	470 (57.0)
Low patient acceptance due to economic or cognitive reasons	3.70 (0.96)	466 (56.6)
Insufficient operational training or technical support	3.58 (1.08)	425 (51.6)
Complex internal application or approval process	3.41 (1.05)	360 (43.7)

3.4 Composite scores and group comparisons

The mean evidence orientation score was 4.39 ± 0.79, indicating that clinicians placed high importance on evidence when considering innovative medical devices and medicines. The mean policy literacy score was 2.84 ± 1.10, suggesting moderate-to-low familiarity with relevant policies, reimbursement arrangements and hospital adoption procedures. The mean perceived barrier score was 3.65 ± 0.76, while the mean economic barrier score was 3.76 ± 0.83. The mean institutional support score was 3.58 ± 0.62 (Table 3).

Internal consistency was acceptable to good for the main composite scores. Cronbach's alpha was 0.876 for evidence orientation, 0.898 for policy literacy and 0.805 for perceived barriers. The institutional support index had a lower exploratory reliability coefficient (Cronbach's alpha = 0.653) (Table 3). Compared with clinicians who did not frequently report affordability-related foregone recommendation, those who frequently reported this behaviour had higher perceived barrier scores, higher economic barrier scores and lower institutional support scores. The difference in policy literacy score was small and not statistically significant.

Table 3
Composite scores and group comparisons

Composite score	Items	Cronbach alpha	Total mean (SD)	Frequent mean (SD)	Not frequent mean (SD)	P value
Evidence orientation	Q7-Q10	0.876	4.39 (0.79)	4.44 (0.75)	4.36 (0.82)	0.128
Policy literacy	Q11-Q13	0.898	2.84 (1.10)	2.78 (1.13)	2.88 (1.08)	0.232
Perceived barriers	Q15-Q19	0.805	3.65 (0.76)	3.88 (0.75)	3.52 (0.73)	< 0.001
Economic barrier score	Q16, Q19	0.665	3.76 (0.83)	4.01 (0.81)	3.61 (0.80)	< 0.001
Institutional support	Q14, Q23, Q25	0.653	3.58 (0.62)	3.52 (0.67)	3.63 (0.59)	0.017
Adoption readiness	Q20, Q21, Q24, Q28	0.795	4.12 (0.60)	4.23 (0.57)	4.05 (0.61)	< 0.001

3.5 Factors associated with frequent foregone recommendation

In the fully adjusted modified Poisson regression model, both economic barrier variables were independently associated with frequent affordability-related foregone recommendation. Clinicians who perceived high price or high patient out-of-pocket share as a serious barrier were more likely to report frequent foregone recommendation than those perceiving low-to-moderate burden (aPR = 1.38). Low patient acceptance due to economic or cognitive reasons showed a stronger association (aPR = 1.74) (Table 4).

Institutional support was inversely associated with frequent foregone recommendation. Each one-point increase in institutional support score was associated with an 18% lower prevalence of frequent foregone recommendation (aPR = 0.82, 95% CI: 0.70–0.97). Participation in innovation-related clinical research was positively associated with the outcome (aPR = 1.30), suggesting that clinicians with greater exposure to innovative technologies may more often encounter affordability-related constraints in actual practice (Table 4; Fig. 2).

Policy literacy and evidence orientation were not independently associated with frequent affordability-related foregone recommendation after adjustment. These findings indicate that affordability-related recommendation restriction was more strongly associated with patient economic burden, patient acceptance and institutional support than with clinicians' general attention to evidence or familiarity with policy.

Table 4
Regression models for frequent foregone recommendation.

Variable	Model 1 PR (95% CI)	Model 2 PR (95% CI)	Model 3 aPR (95% CI)
Specialty hospital (vs general)	0.92 (0.74–1.13)	0.90 (0.73–1.10)	0.89 (0.72–1.08)
Surgery (vs internal medicine)	1.03 (0.81–1.31)	1.07 (0.85–1.35)	1.07 (0.85–1.34)
Oncology (vs internal medicine)	1.12 (0.79–1.59)	1.07 (0.77–1.49)	1.05 (0.76–1.45)
Imaging/intervention (vs internal medicine)	1.22 (0.83–1.79)	1.33 (0.91–1.95)	1.39 (0.95–2.05)*
Critical care (vs internal medicine)	0.61 (0.25–1.46)	0.57 (0.24–1.36)	0.56 (0.24–1.31)
Other departments (vs internal medicine)	1.11 (0.85–1.45)	1.14 (0.88–1.47)	1.16 (0.90–1.49)
Attending physician (vs resident)	0.89 (0.67–1.19)	0.85 (0.64–1.11)	0.86 (0.66–1.13)
Associate chief physician (vs resident)	1.21 (0.92–1.60)	1.14 (0.87–1.48)	1.14 (0.88–1.49)
Chief physician (vs resident)	1.22 (0.92–1.63)	1.14 (0.87–1.50)	1.16 (0.88–1.52)
Innovation-related clinical research (yes vs no)	1.18 (0.96–1.45)	1.24 (1.02–1.50)**	1.30 (1.07–1.58)***
Rarely use (vs never)	1.11 (0.85–1.46)	1.12 (0.86–1.46)	1.17 (0.89–1.54)
Sometimes use (vs never)	1.00 (0.73–1.36)	1.02 (0.75–1.38)	1.08 (0.79–1.48)
Often use (vs never)	1.20 (0.83–1.73)	1.14 (0.79–1.63)	1.22 (0.84–1.77)
High price/out-of-pocket barrier		1.41 (1.11–1.78)***	1.38 (1.09–1.74)***
Low patient acceptance barrier		1.77 (1.42–2.21)***	1.74 (1.39–2.17)***
Policy literacy score			0.96 (0.87–1.07)
Evidence orientation score			1.08 (0.96–1.22)
Institutional support score			0.82 (0.70–0.97)**

*P < 0.10, **P < 0.05, ***P < 0.01.

3.6 Sensitivity analyses

Sensitivity analyses supported the main findings. When the outcome was redefined as any affordability-related foregone recommendation, low patient acceptance due to economic or cognitive reasons remained significantly associated with the outcome, whereas the association for high price or high out-of-pocket burden was attenuated. This attenuation was expected because the broader outcome was highly prevalent.

When the two economic barrier variables were entered as continuous scores, each one-point increase in perceived price or out-of-pocket burden was associated with a 15% higher prevalence of frequent affordability-related foregone recommendation, and each one-point increase in low patient acceptance due to economic or cognitive reasons was associated with a 26% higher prevalence (Table 5). After excluding clinicians who reported never using innovative medical devices or medicines, high perceived price or out-of-pocket burden, low patient acceptance and institutional support remained associated with the outcome. The four-level ordinal model yielded similar directions for the main associations.

Table 5
Sensitivity analyses

Sensitivity analysis	Variable	Effect estimate (95% CI)	P value
Outcome redefined as any affordability-related foregone recommendation	High price/out-of-pocket barrier	1.02 (0.95–1.11)	0.531
	Low patient acceptance barrier	1.09 (1.01–1.18)	0.020
	Institutional support score	0.98 (0.92–1.04)	0.486
Economic barriers entered as continuous scores	Price/out-of-pocket burden score	1.15 (1.03–1.30)	0.016
	Patient acceptance barrier score	1.26 (1.13–1.41)	< 0.001
	Institutional support score	0.83 (0.71–0.97)	0.017
Excluding clinicians who never used innovative technologies	High price/out-of-pocket barrier	1.45 (1.12–1.86)	0.004
	Low patient acceptance barrier	1.74 (1.37–2.21)	< 0.001
	Institutional support score	0.82 (0.69–0.98)	0.029
Ordinal logistic model using four-level outcome	High price/out-of-pocket barrier	1.38 (1.02–1.87)	0.036
	Low patient acceptance barrier	2.09 (1.55–2.83)	< 0.001
	Institutional support score	0.78 (0.61–0.99)	0.042

4 Discussion

This cross-sectional survey of 824 clinicians in Shanghai found that affordability-related foregone recommendation of innovative medical devices and medicines was highly prevalent. More than one-third of clinicians reported that they often refrained from prescribing or recommending innovative technologies because of patients' economic reasons, and more than four-fifths reported that this occurred at least sometimes. In multivariable analysis, perceived high price or high patient out-of-pocket burden and low patient acceptance due to economic or cognitive reasons were independently associated with frequent foregone recommendation. Higher institutional support was associated with a lower prevalence of this behaviour, whereas evidence orientation and policy literacy were not independently associated with frequent foregone recommendation after adjustment.

These findings identify clinician recommendation as an underexamined access point between hospital availability and patient use. Affordability may shape the service delivery pathway before treatment uptake occurs, creating a less visible barrier between formal availability and realised patient access. This perspective is important for health services research because it shifts attention from whether innovative technologies are present in tertiary hospitals to whether they are translated into patient-facing options through routine clinical practice.

Health services research has long recognised that access depends on more than geographical or organisational availability [1, 2]. Our study adds a provider-mediated perspective by showing that patient affordability may influence whether innovative technologies are recommended to patients in the first place. Clinician recommendation is often the entry point through which patients become aware of advanced treatment options, discuss potential benefits and risks, and begin to navigate reimbursement and payment arrangements. If affordability concerns lead clinicians to avoid discussing or recommending clinically relevant technologies, access may be constrained before patients have an opportunity to consider these options.

The high prevalence of affordability-related foregone recommendation indicates that affordability is not only a downstream problem experienced after patients accept treatment. Instead, anticipated financial burden may alter the menu of clinical options presented to patients. This finding is consistent with broader evidence that out-of-pocket payments, catastrophic expenditure and financial toxicity influence service use, adherence and well-being [14–25]. It also suggests that cost-related barriers may operate through professional decision-making and service delivery processes, not only through patients' final treatment choices.

The two strongest factors associated with frequent foregone recommendation were perceived high price or out-of-pocket burden and low patient acceptance due to economic or cognitive reasons. This pattern suggests that clinicians respond not only to the price of innovative technologies but also to their expectations about whether patients will understand, accept and afford those technologies. Innovative medicines and devices may offer potential benefit but often involve uncertainty about reimbursement, final patient cost and long-term affordability. When clinicians anticipate substantial financial burden, they may avoid recommending a technology, especially if they expect limited patient acceptance. Although this behaviour may reflect an attempt to protect patients from financial harm, it can also restrict patient-facing access if it is not accompanied by transparent cost information and shared discussion of clinically appropriate options.

Previous research has argued that out-of-pocket costs should be discussed as part of treatment decision-making and that financial burden can be understood as a treatment-related side effect [21–25]. Our findings extend this argument by showing that cost considerations may affect whether innovative technologies are recommended at all. From a service delivery perspective, this means that improving cost communication should not be limited to the point at which patients are already considering treatment. It should also support clinicians before recommendation decisions are made, so that patients

can receive clear information about clinically appropriate options, expected costs, reimbursement pathways and available assistance.

Higher institutional support was associated with a lower prevalence of frequent foregone recommendation. This suggests that hospital-level processes may help mitigate the effect of affordability barriers on clinical recommendations. Institutional support may include clearer adoption procedures, more efficient pharmacy or therapeutics committee review, better clinician training, and more transparent information about reimbursement and eligible patient groups. This finding is consistent with implementation science frameworks that emphasize the interaction between innovation characteristics, the inner setting, the outer setting and individual professionals [26–30]. Expanding reimbursement is necessary but may not be sufficient if clinicians lack clear institutional pathways, training, cost information or decision-support tools. Conversely, supportive hospital systems may help clinicians assess value, identify suitable patients, communicate costs and navigate reimbursement or assistance pathways.

The findings have several implications for health services policy. First, policies promoting innovative medical devices and medicines should not focus solely on accelerating approval and hospital entry. They should also address patient out-of-pocket burden and ensure that reimbursement coverage is sufficient to prevent affordability-related exclusion from patient-facing options. Second, clinicians need practical support for cost-informed and access-oriented recommendation. Hospitals could develop transparent adoption pathways, provide reimbursement information, create decision-support tools and strengthen training on how to discuss cost-sensitive options with patients. Third, health technology assessment and reimbursement decisions should consider not only average value but also distributional and service delivery consequences [31, 32]. If high-value innovations remain unaffordable for some patients, their population-level benefit may be reduced and their distribution through the health service may become uneven. Improving access to innovation therefore requires coordination between payers, hospitals, clinicians and patient support programmes.

This study has several strengths. It used data from a relatively large survey of clinicians in Shanghai and focused on an underexamined point in the access pathway: clinician recommendation behaviour. The questionnaire was developed through a systematic process and underwent psychometric evaluation. The analysis used modified Poisson regression to estimate prevalence ratios, which are more interpretable than odds ratios for common outcomes [33].

Several limitations should be noted. First, the cross-sectional design prevents causal inference. Second, the outcome was self-reported and may be subject to recall bias or social desirability bias. Third, the study did not include patient-level information such as income, insurance type, disease severity or actual treatment uptake, so we could not directly measure patient-level access outcomes. Fourth, hospital identifiers were not available in the analytical dataset, preventing multilevel modelling or adjustment for hospital-level clustering. Fifth, innovative medical devices and innovative medicines were analysed together, although their adoption pathways, reimbursement mechanisms and institutional requirements

may differ. Finally, the study was conducted in Shanghai, a high-resource urban setting, and the findings may not be generalisable to primary care institutions or less-resourced regions.

5 Conclusions

Affordability-related foregone recommendation of innovative medical devices and medicines was common among clinicians in Shanghai. High price or patient out-of-pocket burden and low patient acceptance due to economic or cognitive reasons were independently associated with frequent foregone recommendation, while institutional support was associated with lower prevalence. These findings suggest that affordability may constrain access to innovative technologies at the clinician recommendation stage, before treatment uptake occurs. Improving patient access to innovative technologies requires not only regulatory approval and hospital availability, but also reimbursement protection, transparent institutional processes, clinician support and patient-centred cost communication.

Abbreviations

aPR
adjusted prevalence ratio
CI
confidence interval
PR
prevalence ratio
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology
UHC
universal health coverage.

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki. The study protocol was reviewed and approved by the Ethics Committee of Hospital (approval number: SHSY-IEC-6.0/25KY55/P01). All participants provided informed consent before participation.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analysed during the current study are not publicly available because they contain questionnaire responses collected under institutional confidentiality conditions, but are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: LCH conceived and designed the study. GW and WSZ developed the questionnaire and collected the data.GW cleaned and analysed the data. BW drafted the manuscript. All authors critically revised the manuscript and approved the final version.

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Figures

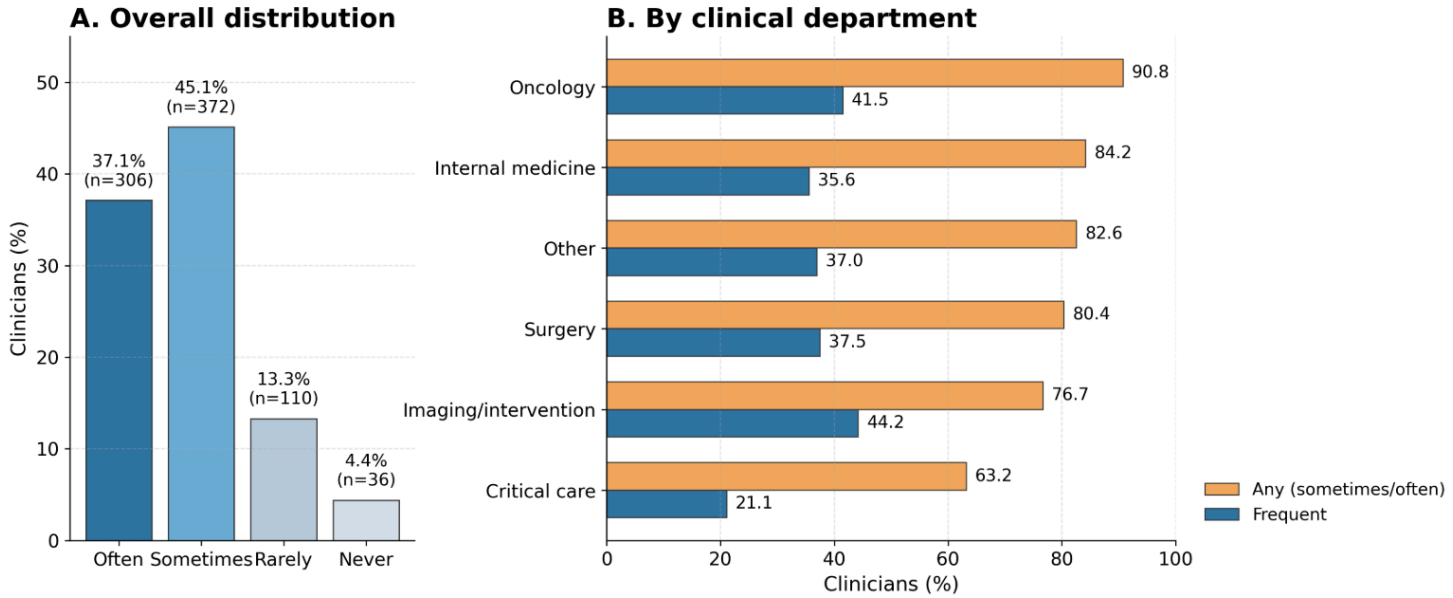


Figure 1

Foregone recommendation by response and department

Panel A shows the distribution of responses to the item on affordability-related foregone recommendation. Panel B compares frequent foregone recommendation and any foregone recommendation across clinical departments. Any foregone recommendation was defined as reporting sometimes or often.

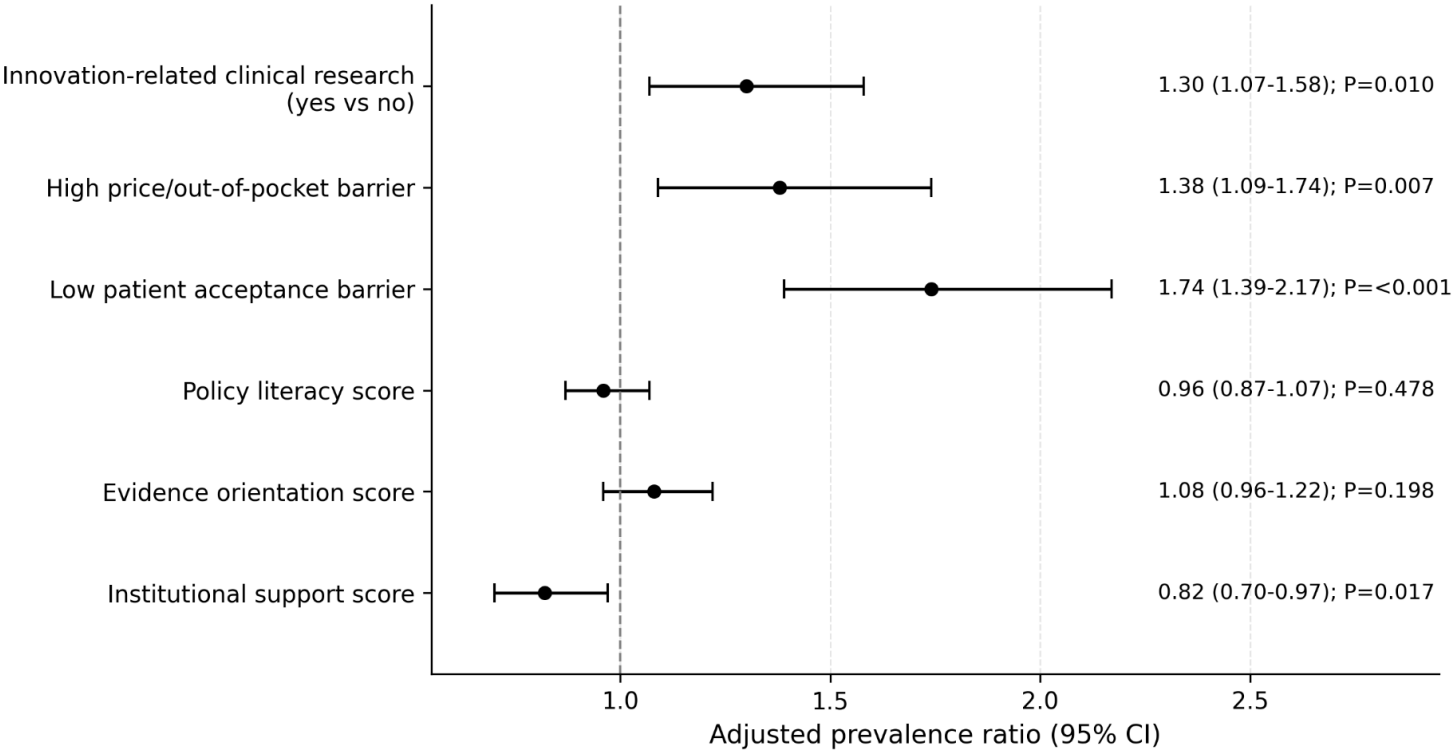


Figure 2

Factors associated with frequent foregone recommendation (The displayed variables are the main explanatory and institutional variables in Model 3.)

Supplementary Files

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