

# Importance of Reasons for Stocking Adult Vaccines

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**A**lthough vaccination rates for childhood vaccines are high in the United States, rates are lower for adult vaccines.<sup>1</sup> The United States has achieved the Healthy People 2020 (HP2020) target of 30% for the shingles vaccine but not the adult influenza or pneumococcal immunization targets.<sup>1,2</sup> The HP2020 target is for 70% of noninstitutionalized adults to be vaccinated for influenza,<sup>2</sup> but just 43.3% of adults were immunized at the end of the 2016-2017 season.<sup>3</sup> The HP2020 targets for pneumococcal vaccination are 60% for high-risk adults aged 18 to 64 years and 90% for noninstitutionalized adults 65 years or older,<sup>2</sup> yet coverage rates are stagnant at 24% and 67%, respectively.<sup>4</sup> Estimates from Medicare claims data show even lower pneumococcal vaccine coverage for adults 65 years or older, at 59% for any pneumococcal vaccine and just 24% for both the pneumococcal polysaccharide vaccine (PPSV23) and the pneumococcal conjugate vaccine (PCV13).<sup>5</sup>

Provider recommendations are a key predictor of adult vaccination; however, providers are less likely to recommend vaccines they do not stock.<sup>6,7</sup> A survey conducted in 2009 of family practice and internal medicine physicians found that many do not stock all adult vaccines and that reimbursement was a barrier to stocking adult vaccines.<sup>8</sup> A survey conducted in 2012 of primary care providers found that financial barriers were important to decisions about recommending and stocking vaccines for adults.<sup>9</sup> More recent surveys of providers have reported dissatisfaction with reimbursement levels in relation to their costs and profitability varying widely between payers.<sup>10,11</sup> A survey conducted in 2015 of obstetricians and gynecologists found that many adult vaccines were not stocked and that financial barriers were most important to stocking decisions.<sup>12</sup> Most of these studies have focused on general internal medicine and family medicine providers, and several have asked about how these barriers affect both recommending and stocking vaccines. The majority of these studies also relied on a Likert scale to understand how providers feel about the barriers. In the time since those studies were published, there have been changes in insurance reimbursement for vaccines with the Affordable Care Act, vaccination has expanded in pharmacies, and pharmacists are able to administer vaccines in all 50 states.<sup>13</sup>

## ABSTRACT

**OBJECTIVES:** To identify the most important reasons underlying decisions to stock or not stock adult vaccines.

**STUDY DESIGN:** US physicians, nurses, pharmacists, and administrators of internal medicine, family medicine, obstetrics/gynecology, and multispecialty practices who were involved in vaccine stocking decisions (N = 125) completed a best-worst scaling survey online between February and April 2018.

**METHODS:** Sixteen potential factors influencing stocking decisions were developed based on key informant interviews and focus groups. Respondents selected factors that were most and least important in vaccine stocking decisions. Relative importance scores for the best-worst scaling factors were calculated. Survey respondents described which vaccines their practice stocks and reasons for not stocking specific vaccines. Subgroup analyses were performed based on the respondent's involvement in vaccine decision making, role in the organization, specialty, and affiliation status, as well as practice characteristics such as practice size, insurance mix, and patient age mix.

**RESULTS:** Relative importance scores for stocking vaccines were highest for "cost of purchasing vaccine stock," "expense of maintaining vaccine inventory," and "lack of adequate reimbursement for vaccine acquisition and administration." Most respondents (97%) stocked influenza vaccines, but stocking rates of other vaccines varied from 39% (meningococcal B) to 83% (tetanus-diphtheria-pertussis). Best-worst scaling results were consistent across respondent subgroups, although the range of vaccine types stocked differed by practice type.

**CONCLUSIONS:** Economic factors associated with the purchase and maintenance of vaccine inventory and inadequate reimbursement for vaccination services were the most important to decision makers when considering whether to stock or not stock vaccines for adults.

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In this current study, we seek to identify the most important reasons underlying decisions to stock adult vaccines. We focus on provider stocking decisions and expand the pool of providers beyond those studied in the past to include pharmacists. We also expand beyond general internal medicine and family medicine physicians to survey physicians specializing in obstetrics and gynecology (OB/GYN) and multispecialty practices. This study uses an innovative best-worst scaling methodology from the field of marketing to quantify the ranking of importance of these barriers.<sup>14</sup>

## METHODS

Best-worst scaling is a survey approach used to identify the relative values associated with objects.<sup>14</sup> It does so by repeatedly asking respondents to identify the most important and least important objects from different lists of objects. Best-worst scaling has been shown to be more reliable than Likert rating scales<sup>15</sup> and can be used to avoid scale biases.<sup>16,17</sup> In this analysis, the objects that we are interested in ranking are the factors that may influence vaccine stocking decisions.

### Survey Development, Design, and Administration

We used qualitative data from 3 focus groups (n = 12 total participants) and key informant interviews (n = 9 key informants) along with relevant literature<sup>6-12</sup> to identify 16 factors potentially influencing vaccine stocking decisions (Table 1). The focus groups and key informant interviews involved vaccine stocking decision makers in medical practices and pharmacies and were conducted from January to October 2017 using a standardized interview guide to identify potential factors influencing these decisions.

Based on the results from the focus groups and key informant interviews, we developed a survey to assess the importance of factors in stocking vaccines. The survey included an introduction to the factors and their definitions, as shown in Table 1. Each respondent was asked to assess 4 sets of 6 factors selected from the overall 16 that were developed using a balanced incomplete block design methodology to ensure even representation of factors across survey versions (Figure 1).<sup>18</sup> For each question,

## TAKEAWAY POINTS

- ▶ Prior research has shown that many providers do not stock adult vaccines and this can be a barrier to patients receiving recommended vaccinations.
- ▶ We surveyed US physicians, nurses, pharmacists, and administrators involved in vaccine stocking decisions to understand barriers to stocking vaccines for adults.
- ▶ We used novel best-worst scaling methods (from marketing) to quantify how decision makers rank the relative importance of different barriers.
- ▶ Relative importance scores for stocking vaccines overall were highest for “cost of purchasing vaccine stock,” “expense of maintaining vaccine inventory,” and “lack of adequate reimbursement for vaccine acquisition and administration.”

**TABLE 1.** Best-Worst Scaling Factor Definitions

Factor	Definition
1. Cost of purchasing vaccine stock	The up-front costs associated with buying vaccines
2. Expense of maintaining vaccine inventory	The costs associated with stocking and managing vaccine supplies, including the cost of refrigeration and alarms and personnel time to manage inventory
3. Loss due to expired vaccines	The cost of vaccines that must be discarded because they are expired due to either overestimated demand or the requirement to buy in bulk
4. Lack of adequate reimbursement for vaccine acquisition and administration	Providers being not paid or partially paid by insurance for the full cost of the vaccines they purchase and administer
5. Number of competitors in your catchment area that administer vaccine	The number of organizations that give a vaccine in your area (including pharmacies, minute clinics, etc)
6. Rewards for meeting immunization targets	Bonuses providers receive for a certain percentage of their patients getting immunizations
7. Prior authorization needed for some or all vaccines	Requirement to obtain permission from the insurance company before administering a vaccine
8. Time required for interacting with insurance concerning vaccine claims	The amount of time it takes to communicate with insurance about reimbursement policies
9. Problems with vaccine claims getting rejected	Insurance declining to pay for vaccines administered (eg, the claim might be denied because the vaccine wasn't covered by their insurance, the vaccine had been given previously by another provider, or the vaccine-related insurance claim was not filed correctly)
10. Patients not having consistent insurance coverage for vaccines	Some vaccines being covered by a patient's insurance plan, whereas other vaccines are not
11. Patients' insurance coverage out-of-network for vaccines	Insurance not paying or only partially paying for the vaccine because the patient is visiting a provider that is not in the insurance company's network for vaccines
12. Difficulty interpreting adult vaccination recommendations	Having a hard time understanding when and when not to give some adult vaccines
13. Time required for vaccination assessment and counseling with patients	The amount of time it takes for a clinician to determine what vaccines patients may or may not need, including the time it takes to determine when or if a patient was last vaccinated and to educate the patient on vaccines
14. Patient out-of-pocket costs for some vaccines	Patients having to pay some or all of the vaccine cost
15. Patient attitudes toward vaccination	Negative attitudes toward vaccination in the patient population
16. Little demand for vaccines from patients	Low patient interest in vaccines

## CLINICAL

respondents were asked to select the factors that were most and least important in the decision to stock vaccines in general. Respondents were randomized to 1 of 4 versions of the survey. Finally, survey respondents were presented with a list of 11 commonly used adult vaccines and asked which vaccines their practice stocks and the reasons for not stocking specific ones. We also collected information on each respondent's role in their organization, practice type, organization affiliation, characteristics of the practice, and at what organizational level the decisions to stock vaccines are made.

The survey underwent cognitive pretesting to ensure that respondents understood the questions as intended. In April 2018, the survey was administered online to a standing panel (Qualtrics;

Seattle, Washington) of US physicians, nurses, pharmacists, and administrators involved in vaccine stocking decisions. Although this was a convenience sample, respondents represented diverse regions across the United States.

### Analysis

We calculated relative importance scores for each of the 16 factors that influence vaccine decision making. For each factor, we obtained the number of times it was chosen as most important and the number of times it was chosen as least important. We subtracted the number of times a factor was chosen as least important from the number of times it was chosen as most important. We then divided this difference by the number of times each factor was available to be chosen as least or most important. The availability-adjusted relative importance scores were then ranked from the highest to the lowest to assess the relative importance of each of the 16 factors on vaccine decision making (Figure 2).<sup>19</sup>

### Subgroup Analyses

Subgroup analyses were performed based on the respondent's involvement in vaccine decision making, role in the organization, specialty, and affiliation status, as well as practice characteristics (ie, practice size, insurance mix, and patient age mix). We also performed stratified analysis by type of vaccine stocked to identify the factors that are important for stocking decisions.

### Regression Analysis

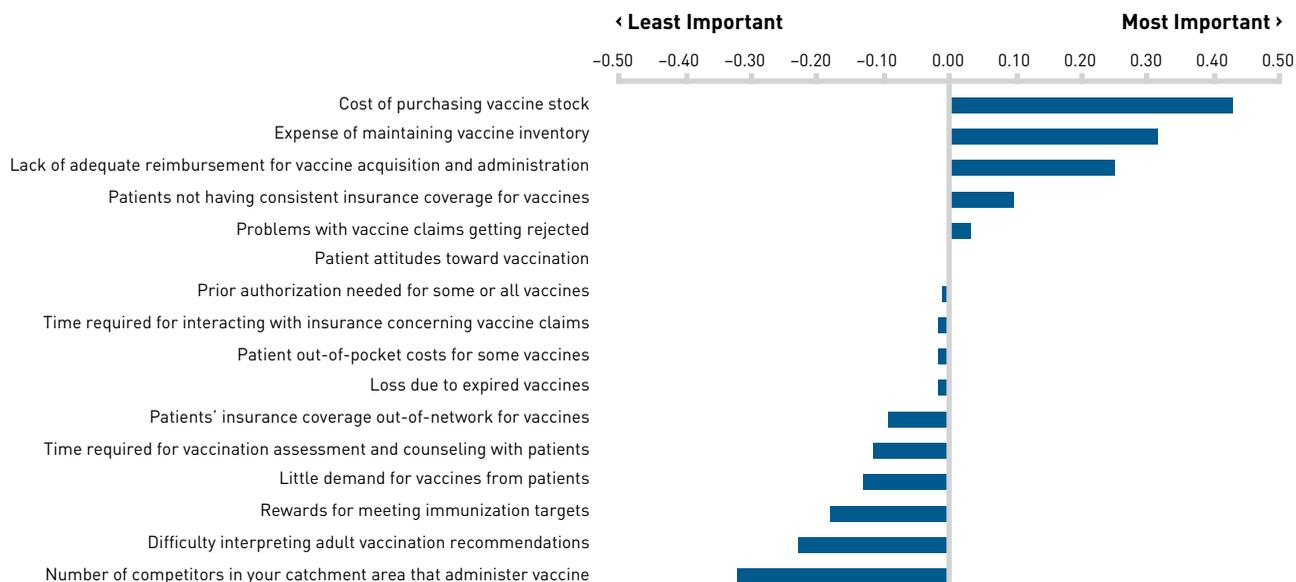
In order to examine the overall relationships between factors and stocking of specific vaccines, we conducted a set of logistic regressions evaluating the probability of stocking individual vaccines based on respondent characteristics and the respondent relative

**FIGURE 1. Sample Survey Question on Best–Worst Scaling**

Please select which *one* factor is the most important and which *one* is the least important in your decision to stock adult vaccines.

Most Important	Factor	Least Important
<input type="checkbox"/>	Expense of maintaining vaccine inventory	<input type="checkbox"/>
<input type="checkbox"/>	Loss due to expired vaccines	<input type="checkbox"/>
<input type="checkbox"/>	Lack of adequate reimbursement for vaccine acquisition and administration	<input type="checkbox"/>
<input type="checkbox"/>	Time required interacting with insurance concerning vaccine claims	<input type="checkbox"/>
<input type="checkbox"/>	Time required for vaccination assessment and counseling with patients	<input type="checkbox"/>
<input type="checkbox"/>	Little demand for vaccines from patients	<input type="checkbox"/>

**FIGURE 2. Most and Least Important Factors in Deciding to Stock Adult Vaccines**



importance scores of the factors determined to be most important from the best–worst scaling analysis. Because we conducted multiple regressions, we used the Bonferroni correction to assess statistical significance.

## RESULTS

A total of 125 providers completed the survey. Most respondents (56%) were physicians, 19% were pharmacists, 14% were nurses, and a combined 10% were practice managers or health system administrators (Table 2). Many were in private, independent organizations (44%) and/or hospitals/academic medical centers (38%). There were a wide variety of specialties represented, with most in OB/GYN (36%), pharmacy (19%), family medicine (18%), and internal medicine (14%).

Physician office respondents were from a broad array of practice sizes, with 13% in a solo practice and 29% in organizations with 13 or more providers (Table 2). Of pharmacists, 29% were in organizations that filled 100,000 or fewer prescriptions per year and 25% were in organizations that filled more than 250,000 per year. Additional respondent characteristics can be found in eAppendix Table 1 (eAppendix available at [ajmc.com](http://ajmc.com)).

### Vaccine Stocking

Most respondents' organizations stocked at least 1 type of the 11 vaccines considered in this study. The most common vaccine stocked (97% of organizations) was for influenza (Table 2). However, other vaccines, such as meningococcal B, were stocked by fewer than 50% of organizations.

As seen in Table 3, some respondent characteristics were associated with higher stocking rates. Pharmacists were more likely to stock pneumococcal and zoster vaccines than physicians. Internal medicine/family medicine physicians were significantly more likely to stock almost all vaccines (except influenza and tetanus-diphtheria-pertussis [Tdap]) than OB/GYN physicians. Clinics affiliated with hospitals and/or academic medical centers were also significantly more likely to stock almost all vaccines (except influenza, Tdap, and hepatitis A and B) than private, independent clinics. Larger practices with 6 or more physicians were significantly more likely to stock PCV13, zoster, hepatitis A, hepatitis A and B, and meningococcal ACWY and B vaccines than smaller practices.

Of those respondents who replied that they did not stock a specific vaccine, we asked for reasons why that was the case. By far the most common reason across all vaccines was that stocking that vaccine was “not a priority for our practice/organization” (between 54% and 80% of responses). The second most common response for not stocking influenza, PCV13, PPSV23, Tdap, tetanus-diphtheria (Td), and hepatitis B vaccines was that it was “challenging to keep up with the changes to recommendations for this vaccine” (between 8% and 25% of responses). For other vaccines (zoster, hepatitis A, hepatitis A and B, meningococcal ACWY, and meningococcal B), the second most common response was that the “vaccine is too

**TABLE 2.** Characteristics of Respondents (N = 125)

	n	%
Level of involvement in stocking decisions		
Directly involved	60	48.0
Indirectly involved	65	52.0
Role within organization		
Physician	70	56.0
Practice manager	6	4.8
Health system administrator	7	5.6
Nurse	18	14.4
Pharmacist	24	19.2
Specialty		
Pharmacy	24	19.2
Internal medicine	18	14.4
Family medicine	22	17.6
Obstetrics/gynecology	45	36.0
Multispecialty	6	4.8
Other	10	8.0
Type of organization*		
Retail clinic or pharmacy	11	8.8
Private, independent organization	55	44.0
Hospital/academic medical center	47	37.6
Practice network/independent practice association	2	1.6
Health maintenance organization (staff or group model)	2	1.6
Federally qualified health center/rural health clinic/ community health center	11	8.8
Other	1	0.8
Practice size (nonpharmacists)		
1	13	13.4
2-5	34	35.1
6-12	19	19.6
≥13	28	28.9
Unsure	3	3.1
Number of prescriptions filled annually (pharmacists)		
25,001-100,000	7	29.2
100,001-250,000	6	25.0
>250,000	6	25.0
Unsure	5	20.8
Patient insurance		
Patients with Medicare, %		
0	5	4.0
1-25	61	48.8
26-50	43	34.4
51-100	14	11.2
Unsure	2	1.6
Patients with Medicaid, %		
0	9	7.2
1-25	59	47.2
26-50	44	35.2
51-100	11	8.8
Unsure	2	1.6

(continued)

**TABLE 2.** (Continued) Characteristics of Respondents (N = 125)

	n	%
Patients with private insurance, %		
0	1	0.8
1-25	41	32.8
26-50	42	33.6
51-100	39	31.2
Unsure	2	1.6
Patients uninsured, %		
0	19	15.2
1-25	81	64.8
26-50	10	8.0
51-100	4	3.2
Unsure	11	8.8
Patient demographics		
Patients 18 years or younger, %		
0	7	5.6
1-25	101	80.8
26-50	11	8.8
51-100	4	3.2
Unsure	2	1.6
Patients aged 19-64 years, %		
0	2	1.6
1-25	8	6.4
26-50	61	48.8
51-100	52	41.6
Unsure	2	1.6
Patients 65 years or older, %		
0	7	5.6
1-25	36	28.8
26-50	49	39.2
51-100	31	24.8
Unsure	2	1.6
Type of vaccine stocked (n = 117)		
Influenza	113	96.6
Tetanus-diphtheria-pertussis	97	82.9
Pneumococcal polysaccharide	82	70.1
Hepatitis B	76	65.0
Pneumococcal conjugate	71	60.7
Zoster	66	56.4
Tetanus-diphtheria	65	55.6
Hepatitis A	63	53.8
Hepatitis A and B	56	47.9
Meningococcal ACWY	53	45.3
Meningococcal B	45	38.5
Other	37	31.6

\*Respondents could respond with more than 1 type of organization, so the percentages do not add up to 100%.

costly/purchase and inventory management costs” (between 9% and 22% of responses). Details can be found in [eAppendix Figure 1](#).

### Importance of Barriers to Stocking Vaccines

The best–worst scaling analysis revealed that the most important reasons were the “cost of purchasing vaccine stock,” “expense of maintaining vaccine inventory,” and “lack of adequate reimbursement for vaccine acquisition and administration” (Figure 2). Other insurance-related issues were of medium or lower importance: “Patients not having consistent insurance coverage for vaccines” was more likely to be listed as most important than least important, whereas “problems with vaccine claims getting rejected,” “prior authorization needed for some or all vaccines,” and “time required interacting with insurance concerning vaccine claims” were about equally likely to be listed as most important or least important. “Patients’ insurance coverage out-of-network for vaccines” was more likely to be chosen as least important than most important. Of non–insurance-related issues, “patient attitudes toward vaccination,” “patient out-of-pocket costs for some vaccines,” and “loss due to expired vaccines” were about as likely to be listed as most important or least important. Other issues were more likely to be ranked as least important.

### Subgroup Analyses

We examined the best–worst rankings by characteristics of the respondents, as well as whether they stocked specific vaccines. Although the rankings of medium- or lower-importance factors changed, the top 3 factors remained the “cost of purchasing vaccine stock,” “lack of adequate reimbursement for vaccine acquisition and administration,” and the “expense of maintaining vaccine inventory” regardless of subgroup analyzed ([eAppendix Figure 2](#)). The best–worst scaling of barriers was also not different based on whether the respondents stocked or did not stock specific vaccines ([eAppendix Figure 3](#)).

Patient demand and patient attitudes about vaccines were generally of minor importance or the least important barriers to stocking, suggesting that patient interest is sufficiently high across the various specialties to not adversely affect stocking decisions. The potential exceptions to this are pharmacists, practice managers, and administrators, for whom “little demand for vaccines from patients” and “patient attitudes toward vaccination” were of moderate importance. Also of potential interest, practices with more than 50% of their patients 65 years or older ranked patient demand as being of the least concern.

### Regression Analysis

We evaluated 10 logistic regressions for each vaccine, with the exception of the influenza vaccine because variation in stocking was so low. The most important relative importance factors included in the regression were cost of purchasing, expense of maintaining inventory, and inadequate reimbursement. In these regressions, some factors were associated with stocking of particular vaccines ([eAppendix Table 2](#)). The OB/GYN group had lower stocking of

**TABLE 3.** Percentage of Respondents Stocking Specific Vaccines by Respondent Characteristic

		Influenza	PCV13	PPSV23	Tdap	Td	Zoster	Hepatitis A	Hepatitis B	Hepatitis A and B	Meningococcal ACWY	Meningococcal B
Involvement in stocking decisions	Directly involved	97	60	70	75	51	53	56	61	46	40	39
	Indirectly involved	97	62	70	90	60	60	52	68	50	50	38
Role	Physician	97	55 <sup>a</sup>	58 <sup>a</sup>	88	51	46 <sup>a</sup>	45	55	43	43	33
	Pharmacist	100	95	95	86	62	81	71	81	57	57	38
	Nurse	93	57	79	79	50	64	57	79	50	50	43
	Manager/admin/other	93	40	80	60	73	60	67	73	53	33	60
Specialty	Internal medicine/family medicine	100	83 <sup>b</sup>	95 <sup>b</sup>	80	75 <sup>b</sup>	68 <sup>b</sup>	73 <sup>b</sup>	80 <sup>b</sup>	63 <sup>b</sup>	70 <sup>b</sup>	60 <sup>b</sup>
	Obstetrics/gynecology	95	26	31	83	29	31	26	38	26	19	17
Affiliation	Private, independent	96	44 <sup>c</sup>	56 <sup>c</sup>	78	42 <sup>c</sup>	44	42 <sup>c</sup>	52 <sup>c</sup>	36	30 <sup>c</sup>	24 <sup>c</sup>
	Hospital/academic medical center	96	68	77	86	71	57	64	75	52	52	52
Number of physicians	1-5	98	36 <sup>d</sup>	55	74	43	38 <sup>d</sup>	38 <sup>d</sup>	50	26 <sup>d</sup>	29 <sup>d</sup>	17 <sup>d</sup>
	≥6	96	70	72	87	62	62	60	66	64	57	57
Insurance distribution	>25% Medicare	96	69	82 <sup>e</sup>	80	62	66 <sup>e</sup>	62	73	51	58 <sup>e</sup>	46
	>25% Medicaid	96	57	65	88	53	53	55	61	49	47	39
	>25% private	95	55	62 <sup>e</sup>	84	50	49 <sup>e</sup>	49	59	42	45	34
	>25% uninsured	93	71	93 <sup>e</sup>	86	79	64	86 <sup>e</sup>	79	71 <sup>e</sup>	57	43
Patient age distribution	>50% aged 0-18 years	100	50	100	50	50	50	50	50	50	50	50
	>50% aged 19-64 years	94	43 <sup>f</sup>	53 <sup>f</sup>	86	39 <sup>f</sup>	35 <sup>f</sup>	45	55	37	37	16 <sup>f</sup>
	>50% aged ≥65 years	97	71	84 <sup>f</sup>	84	77 <sup>f</sup>	55	71 <sup>f</sup>	71	68 <sup>f</sup>	61 <sup>f</sup>	61 <sup>f</sup>

PCV13 indicates pneumococcal conjugate; PPSV23, pneumococcal polysaccharide; Td, tetanus-diphtheria; Tdap, tetanus-diphtheria-pertussis.

<sup>a</sup>Significant ( $P < .05$ ) difference in percentage stocking the vaccine between physicians and pharmacists.

<sup>b</sup>Significant ( $P = .001$ ) difference in percentage stocking the vaccine between internal medicine/family medicine physicians and obstetrics/gynecology physicians.

<sup>c</sup>Significant ( $P < .05$ ) difference in percentage stocking the vaccine between private, independent providers and hospital/academic medical center–affiliated providers.

<sup>d</sup>Significant ( $P < .05$ ) difference in percentage stocking the vaccine between practices with 1 to 5 physicians and practices with 6 or more physicians.

<sup>e</sup>Significant ( $P < .05$ ) difference in percentage stocking the vaccine in each line compared with 25% or less.

<sup>f</sup>Significant ( $P < .05$ ) difference in percentage stocking the vaccine in each line compared with 50% or less.

both pneumococcal vaccines, Td, hepatitis A, hepatitis B, and both meningococcal vaccines. Hospitals/academic medical centers were more likely to stock Td and meningococcal B vaccines. Providers with 51% to 100% of their patients aged 19 to 64 years were less likely to stock the zoster vaccine.

## DISCUSSION

Using novel best–worst scaling survey methods and surveying a wide range of providers, we found that issues directly related to

the revenue and expenses associated with vaccination were the most important barriers to stocking adult vaccines. The overall reimbursement level compared with the costs of purchasing and maintaining inventory were consistently rated as the most important factors, regardless of subgroup analyzed. Challenges dealing with insurance companies, lack of patient demand, and difficulty understanding recommendations were not as important barriers to deciding to stock vaccines for adults.

These results are similar to those of other studies.<sup>8-12</sup> Those studies found that general internal medicine, family medicine, and OB/

GYN practices identified financial barriers as the most important barriers to recommending and stocking vaccines. We found this to be the case when focusing on just stocking vaccines but also when surveying a broader set of providers, including pharmacists. The best–worst scaling methodology seems to yield similar results as the Likert scale questions used in other studies. We also find that issues such as patients refusing vaccines or lack of vaccine demand are of low importance as barriers. This is consistent with the findings of other publications that demonstrated that adults are interested in vaccines in general but often report that their provider did not mention vaccines during their visit.<sup>20</sup>

Although influenza vaccines were stocked by almost all providers, other adult vaccines were stocked to varying extents. Pharmacists had high rates of stocking most vaccines, but they were particularly more likely to stock pneumococcal and zoster vaccines, both of which are recommended for older adults. In our sample, pharmacists were the group with the highest proportion of patients older than 65 years (**Appendix Table 3**). The live zoster vaccine is recommended at 60 years or older; however, it is covered under Medicare Part D (a pharmacy benefit), which may be challenging for medical providers to bill but can be billed with less difficulty by pharmacists. In 2018, the Advisory Committee on Immunization Practices (ACIP) recommended a new inactivated zoster vaccine for individuals 50 years or older.<sup>21</sup> This new recommendation may result in more adults being vaccinated at a younger age and before they are on Medicare, which may affect stocking of zoster vaccines by practices that are less able to bill Medicare Part D. Meanwhile, although OB/GYN physicians were less likely to stock most vaccines, they frequently reported stocking influenza and Tdap vaccines, which are the only 2 vaccines routinely recommended during pregnancy.<sup>22,23</sup>

We found some slight differences between our results and the prior literature. Studies conducted in 2012<sup>9</sup> and 2015<sup>12</sup> found that about 60% of providers listed “difficulty determining if a patient’s insurance will reimburse for a vaccine” and “patients not having insurance coverage for vaccines” as being “major barriers” or “moderate barriers.” We did not ask the exact same questions used in prior studies, but we found that “patients not having consistent insurance coverage” was somewhat more likely to be listed as most important than least important and that “time required interacting with insurance concerning vaccine claims” was about equally likely to be listed as most important as least important than in prior studies. It is possible that as time has passed since the passage of Affordable Care Act, some of those issues have become less important as health insurers and nongrandfathered health plans must cover immunizations recommended by the ACIP. However, issues of claims rejection and inadequate payment appeared to be highest among respondents who reported having more than 25% of their patients on Medicaid. Medicaid payments for vaccines and vaccination vary widely by state and may be more of a barrier in some areas.<sup>24</sup>

It is challenging to compare respondent reasons for not stocking specific vaccines with their answers to the best–worst scaling questions about barriers in general. When answering about not

stocking specific vaccines, between 54% and 80% of respondents noted that the vaccine was not a priority. Between 4% and 25% of respondents noted that it was challenging to keep up with changes to recommendations for that specific vaccine. In addition, the fraction of respondents saying that the reason for not stocking was that the “vaccine is too costly/purchase and inventory management costs” varied from 0% for influenza to 22% for zoster. Similarly, 0% of respondents said that “insufficient payment” was a barrier for influenza, but 20% said it was a barrier for zoster. However, when responding to the best–worst scaling questions about barriers in general, financial barriers were most important and difficulty interpreting guidelines was not ranked highly. This apparent contradiction is possibly because respondents may have subsumed financial considerations into the “not a priority” category when answering about specific vaccines.

### Implications for Practice

This study can shed some light on actions to encourage stocking of vaccines for adults. From our results, arrangements that mitigate the up-front and maintenance costs of vaccine inventories could result in increased stocking of adult vaccines by providers. Higher insurance reimbursement levels for both the vaccine and its administration, or lower costs to administer vaccines, may reduce financial barriers to stocking adult vaccines. Reimbursement levels vary by payer and costs to vaccinate vary by provider, so appropriate solutions for a given practice likely depend on payer mix and type of vaccination provider.

Problems with claims being rejected were listed as a moderate concern. More accurate claims submission and processing—potentially assisted by third-party vaccine billing solutions for provider offices that require such assistance—may help. In addition, better knowledge about reasons for and rates of vaccine nonpayment may help providers to make better decisions about stocking vaccines and improve billing accuracy.

Other strategies may not be as effective at encouraging stocking of vaccines. Healthcare Effectiveness Data and Information Set (HEDIS) measures are commonly used in the insurance industry and can be used to incentivize providers.<sup>25</sup> Although there are several HEDIS measures that pertain to vaccination, in this provider population surveyed, lacking rewards for meeting immunization targets was not perceived to be an important barrier to stocking vaccines. However, at the time of the survey, only influenza and pneumococcal vaccination HEDIS measures were available for adults. HEDIS 2019 will include additional adult vaccination measures (a prenatal composite vaccination measure with Tdap and influenza and an adult composite measure for influenza, pneumococcal, Td/Tdap, and zoster vaccines).<sup>26</sup> It may be that some of the factors that we found to be less important contribute indirectly to adult vaccination. For example, rewards or penalties for meeting immunization targets may encourage providers to recommend vaccines.

Nevertheless, there may be some barriers that are insurmountable for certain medical providers. In those cases, there are benefits of having places like a local pharmacy available to refer patients for

immunizations. Continuing efforts should be made to ensure that those referral processes are seamless.

## Limitations

Our survey used a convenience sample of physicians, nurses, pharmacists, and administrators from an existing internet panel. Therefore, responses may not be representative of all vaccination providers in the United States. With that said, rates of stocking were similar to those reported by Hurley et al,<sup>9</sup> who used quota sampling of family medicine and internal medicine physicians.

This study focused only on stocking vaccines, but there may be other important provider-related barriers to patient immunization even if their providers stock required vaccines. These could include incorporation of patient vaccine needs assessment and recommendations into patient flow, as well as adequate staff time to implement vaccination services.<sup>27</sup> Additional barriers not closely related to providers may include mistaken assumptions by patients (eg, healthy people do not need immunizations), fear of adverse events, and infrequent provider visits.<sup>20</sup>

Our best–worst scaling questions asked about vaccines in general. To minimize survey burden, we did not ask these questions about each vaccine individually. This makes it more difficult to make conclusions about barriers to stocking specific vaccines.

## CONCLUSIONS

Not all adult vaccines are stocked by providers who care for adults. This new study finds that financial barriers are reported as the most important issues influencing decisions about which vaccines to stock among a wide range of providers, including pharmacists and OB/GYN physicians. Efforts to reduce the actual and perceived risks of insurance claim rejection and address issues of vaccine payment adequacy might help encourage more providers to stock the full complement of routinely recommended vaccines for their adult patients. ■

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**eAppendix Table 1. Respondent Characteristics**

<b>Question</b>	<b>Category</b>	<b>Percent*</b>
<b>How many physicians are in your practice/facility (answered by non-pharmacists)</b>	1	13.5
	2-5	35.6
	6-12	18.3
	13 or more	28.9
	Unsure	3.9
<b>How many prescriptions does your organization fill annually? (answered by pharmacists)</b>	<25,000	3.5
	25,001 – 100,000	31.0
	100,001 – 250,000	24.1
	>250,000	20.7
	Unsure	20.7
<b>Estimate the percentage of your patients/clients with each type of insurance</b>	<b>Medicare</b>	
	0%	4.4
	1-25%	48.9
	26-50%	33.3
	51-100%	10.4
	Unsure	3.0
	<b>Medicaid</b>	
	0%	7.4
	1-25%	47.4
	26-50%	34.1
	51-100%	8.2
	Unsure	3.0
	<b>Private</b>	
	0%	0.7
	1-25%	31.9
	26-50%	33.3
	51-100%	31.1
	Unsure	3.0
	<b>Uninsured</b>	
	0%	14.1
1-25%	63.0	
26-50%	8.2	
51-100%	4.4	
Unsure	10.4	

<b>Question</b>	<b>Category</b>	<b>Percent*</b>
<b>Estimate what percentage of your patients/clients are in the following age groups:</b>	<b>age 0-18</b>	
	0%	5.2
	1-25%	76.9
	26-50%	10.5
	51-100%	3.7
	Unsure	3.7
	<b>age 19-64</b>	
	0%	1.5
	1-25%	6.7
	26-50%	47.8
	51-100%	40.3
	Unsure	3.7
	<b>age 65 or older</b>	
	0%	5.2
	1-25%	28.4
26-50%	38.1	
51-100%	23.9	
Unsure	4.5	
<b>What is your age?</b>	18-29	5.2
	30-39	28.4
	40-49	22.4
	50-69	26.1
	60+	17.9

\*Percentages may not sum to 100% due to rounding.

**eAppendix Table 2. Regression Analysis of Factors Relating to Vaccine Stocking**

Outcome (Yes/No) →	Pneumococcal conjugate: PCV 13				Pneumococcal polysaccharide: PPSV23				Tetanus-diphtheria-pertussis (Tdap)				Tetanus-diphtheria (Td)				Zoster				Hepatitis A				Hepatitis B				Hepatitis A & B				Meningococcal ACWY				Meningococcal B			
Predictors	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value	Coef.	SE	P-value	Overall P-value
<b>Intercept</b>	1.350	1.273	0.289		3.213	1.508	0.033		-1.184	1.274	0.353		-0.578	0.996	0.562		2.598	1.082	0.016		0.576	0.974	0.554		0.794	1.149	0.490		-0.268	0.926	0.772		-0.565	1.033	0.585		-0.220	1.007	0.827	
<b>Role</b>																																								
Physicians	2.004	1.127	0.075		0.472	1.127	0.676		2.358	1.109	0.033		1.745	0.908	0.055		-0.828	0.897	0.356		0.120	0.839	0.886		0.048	0.965	0.960		0.755	0.834	0.365		1.015	0.941	0.281		0.334	0.909	0.713	
Pharmacist	16.180	1097.835	0.988		18.960	3998.087	0.996		15.078	1701.481	0.993		1.072	1.313	0.414		-0.415	1.292	0.748		2.010	1.422	0.158		1.124	1.519	0.459		1.003	1.189	0.399		0.527	1.224	0.666		1.190	1.336	0.373	
Nurses	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
Managers/Admin/Other	-0.930	1.078	0.389	0.0679	0.988	1.283	0.441	0.8969	-0.776	1.195	0.516	0.0238	1.493	1.087	0.169	0.2698	-0.713	1.017	0.483	0.8244	0.677	0.966	0.484	0.5551	0.575	1.135	0.612	0.8691	0.401	0.948	0.672	0.7232	-0.510	1.009	0.613	0.4042	1.452	1.119	0.194	0.6231
<b>Specialty/department</b>																																								
Internal medicine/family medicine	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
Ob/Gyn	-4.636	1.078	0.000		-4.453	1.089	0.000		-0.613	0.837	0.464		-2.321	0.722	0.001		-1.628	0.671	0.015		-2.155	0.678	0.001		-2.719	0.784	0.001		-1.627	0.661	0.014		-2.995	0.822	0.000		-2.264	0.810	0.005	
Pharm/Multi-specialty/other	-1.298	0.998	0.193	0.0001	-2.473	1.306	0.058	0.0002	1.417	1.296	0.274	0.3534	-0.188	0.991	0.850	0.0055	-0.544	0.947	0.565	0.0526	-0.903	0.917	0.325	0.0056	-1.024	1.049	0.329	0.0024	-0.487	0.891	0.585	0.0474	-1.719	0.967	0.076	0.0006	-2.208	1.130	0.051	0.0071
<b>Ownership/affiliation</b>																																								
Private/independent organization	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
Hospital/academic medical center	2.049	0.758	0.007	0.0070	1.019	0.739	0.168	0.1680	1.745	0.864	0.043	0.0430	1.707	0.609	0.005	0.0050	0.464	0.582	0.425	0.4250	0.792	0.559	0.156	0.1560	1.283	0.617	0.038	0.0380	0.807	0.545	0.139	0.1390	1.902	0.703	0.007	0.0070	1.934	0.685	0.005	0.0050
<b>Patient Distribution: Age 0-18</b>																																								
0-50%	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
51-100%	-3.452	1.908	0.070	0.0700	15.468	8089.731	0.998	0.9980	-1.682	1.885	0.372	0.3720	-2.098	1.807	0.246	0.2460	-0.827	1.609	0.607	0.6070	-1.869	1.610	0.246	0.2460	-1.755	1.649	0.287	0.2870	-1.075	1.674	0.521	0.5210	-1.808	1.798	0.314	0.3140	-1.711	1.843	0.353	0.3530
<b>Patient Distribution: Age 19-64</b>																																								
0-50%	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
51-100%	-0.975	0.760	0.199	0.1990	-0.405	0.755	0.592	0.5920	0.032	0.816	0.969	0.9690	-0.303	0.590	0.608	0.6080	-1.771	0.622	0.004	0.0040	0.402	0.595	0.499	0.4990	0.348	0.655	0.595	0.5950	-0.266	0.554	0.631	0.6310	-0.269	0.641	0.675	0.6750	-1.108	0.657	0.092	0.0920
<b>Patient Distribution: Age 65 or older</b>																																								
0-50%	Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.				Ref.			
51-100%	-0.936	0.838	0.264	0.2640	-1.032	1.004	0.304	0.3040	-0.105	0.936	0.910	0.9100	0.253	0.666	0.704	0.7040	-1.062	0.660	0.108	0.1080	0.193	0.626	0.758	0.7580	-0.770	0.726	0.289	0.2890	0.515	0.583	0.378	0.3780	0.464	0.658	0.480	0.4800	0.750	0.672	0.265	0.2650
<b>Importance of Scaling Factors</b>																																								
Cost of purchasing	-0.798	0.839	0.342	0.3420	-1.040	0.905	0.251	0.2510	1.305	0.870	0.134	0.1340	-0.764	0.736	0.299	0.2990	0.364	0.653	0.577	0.5770	-0.388	0.635	0.541	0.5410	0.964	0.691	0.163	0.1630	-1.002	0.638	0.116	0.1160	0.332	0.711	0.640	0.6400	-0.538	0.745	0.471	0.4710
Expense of maintaining inventory	-0.189	0.708	0.790	0.7900	-0.218	0.793	0.783	0.7830	0.477	0.680	0.483	0.4830	0.157	0.604	0.795	0.7950	-1.176	0.592	0.047	0.0470	-0.202	0.541	0.709	0.7090	-0.015	0.618	0.980	0.9800	0.249	0.539	0.643	0.6430	-0.373	0.614	0.544	0.5440	-0.308	0.626	0.623	0.6230
Inadequate reimbursement	-0.204	0.680	0.764	0.7640	0.696	0.678	0.305	0.3050	0.520	0.676	0.442	0.4420	-0.087	0.577	0.881	0.8810	-0.367	0.569	0.520	0.5200	-0.488	0.556	0.380	0.3800	0.257	0.605	0.671	0.6710	0.181	0.559	0.745	0.7450	-0.104	0.681	0.878	0.8780	-0.325	0.680	0.632	0.6320

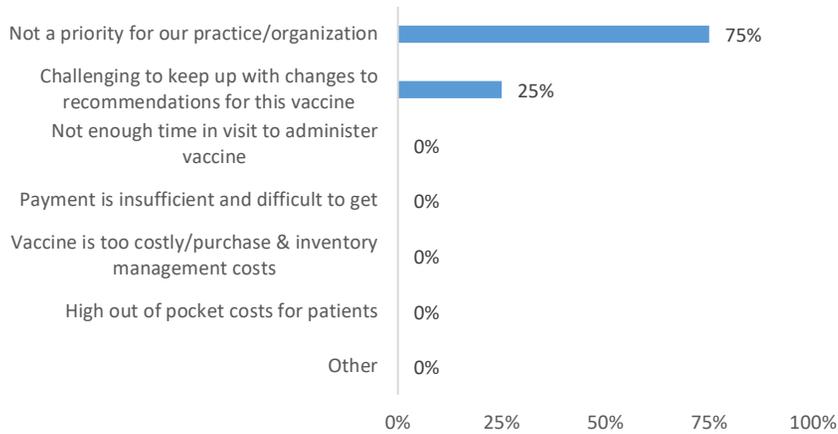
**eAppendix Table 3.** Cross-Tabulation of Role and Percentage of Patients over Age 65

**Estimate what percentage of your practices' patients/clients are in the following age group: 65+ years**

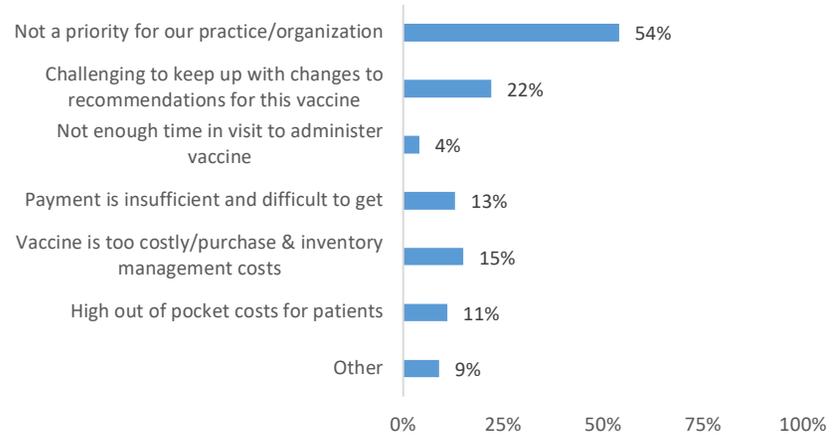
	<b>0%</b>	<b>1%-25%</b>	<b>26%-50%</b>	<b>51%-100%</b>	<b>Unsure</b>	<b>Total</b>
<b>What is your role within your organization?</b>						
<b>Physician</b>	4.3%	37.1%	37.1%	20%	1.4%	100%
<b>Practice Manager</b>	0%	50%	33.3%	16.7%	0%	100%
<b>Health System Administrator</b>	0%	0%	50%	50%	0%	100%
<b>Nurse</b>	20%	6.7%	46.7%	26.7%	0%	100%
<b>Pharmacist</b>	4.2%	20.8%	41.7%	29.2%	4.2%	100%
<b>Other</b>	0%	25%	25%	50%	0%	100%
<b>Total</b>	<b>5.6%</b>	<b>28.8%</b>	<b>39.2%</b>	<b>24.8%</b>	<b>1.6%</b>	<b>100%</b>

## eAppendix Figure 1. Reasons for not stocking specific vaccines

(a) Influenza (N=4)



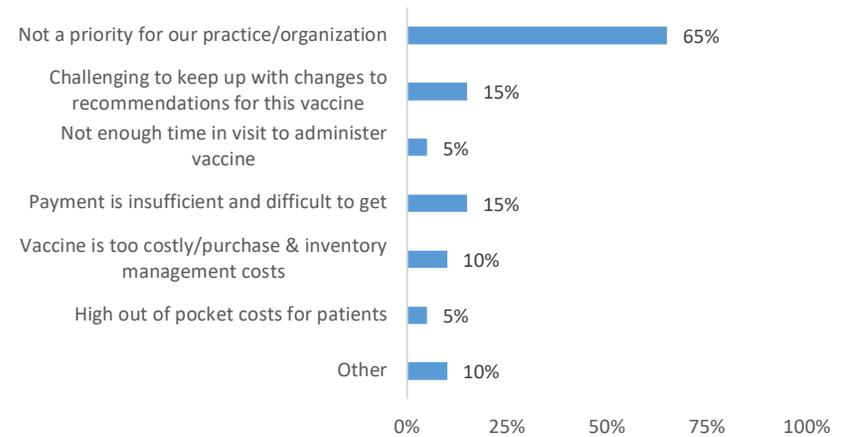
(b) Pneumococcal (PCV13) (N=46)



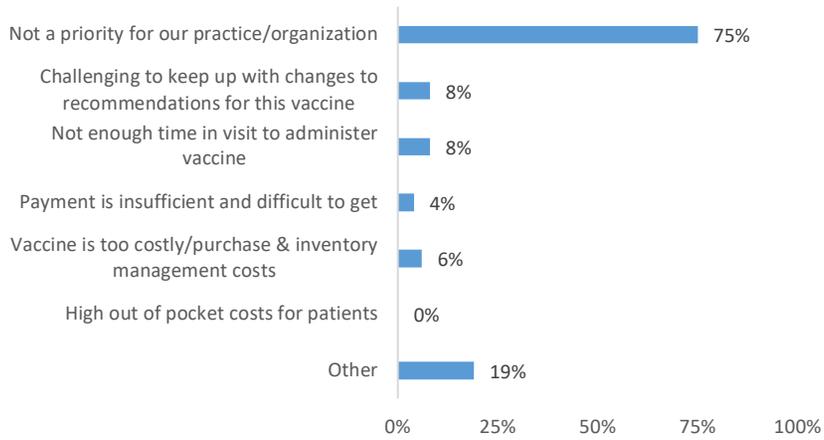
(c) Pneumococcal (PPSV23) (N=35)



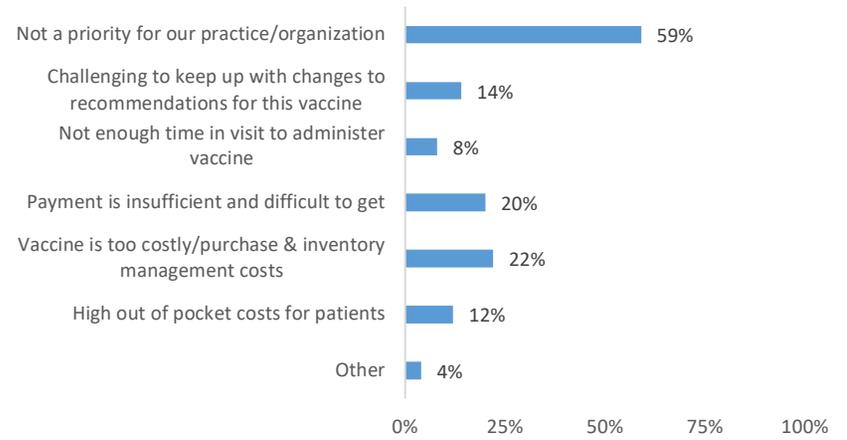
(d) Tdap (N=20)



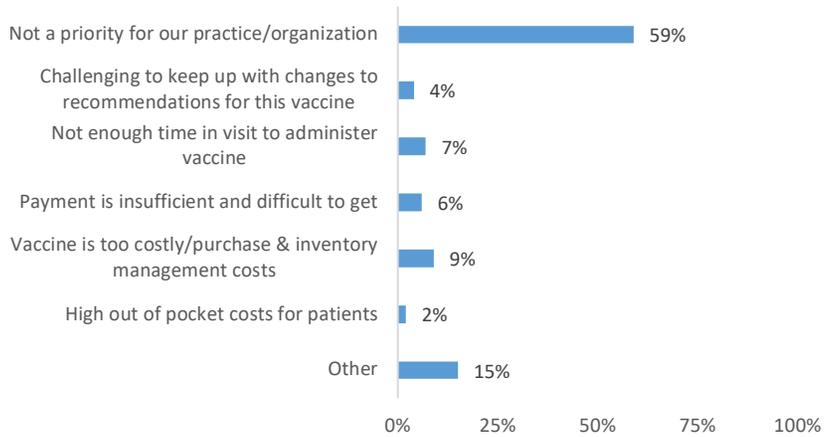
(e) Td (N=52)



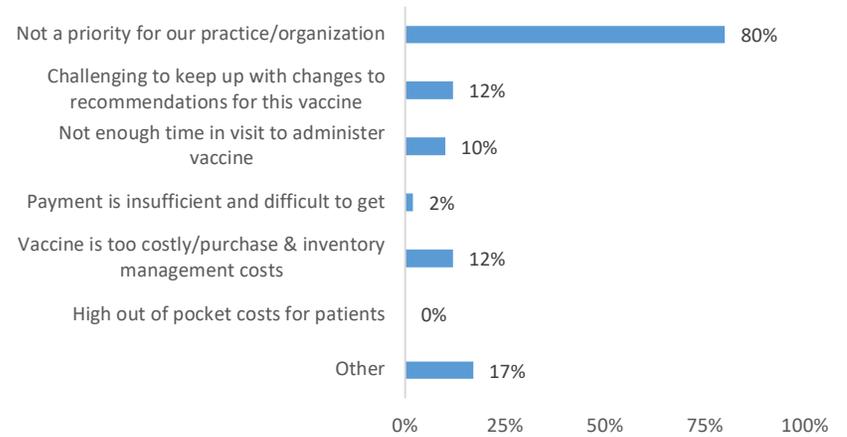
(f) Zoster (N=51)



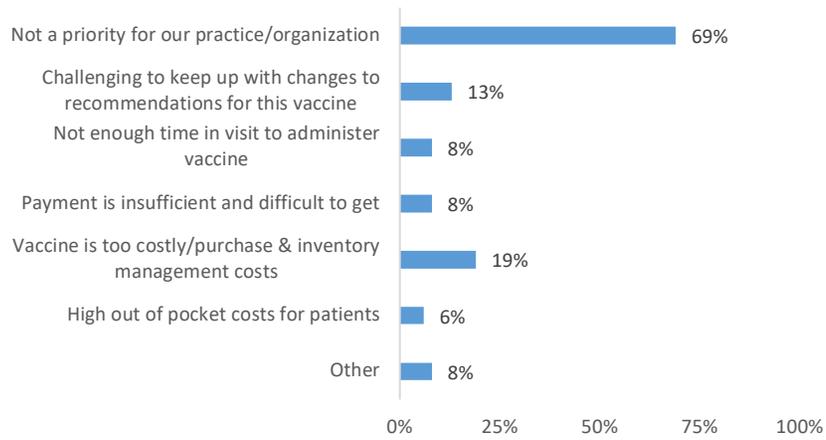
(g) Hepatitis A (N=54)



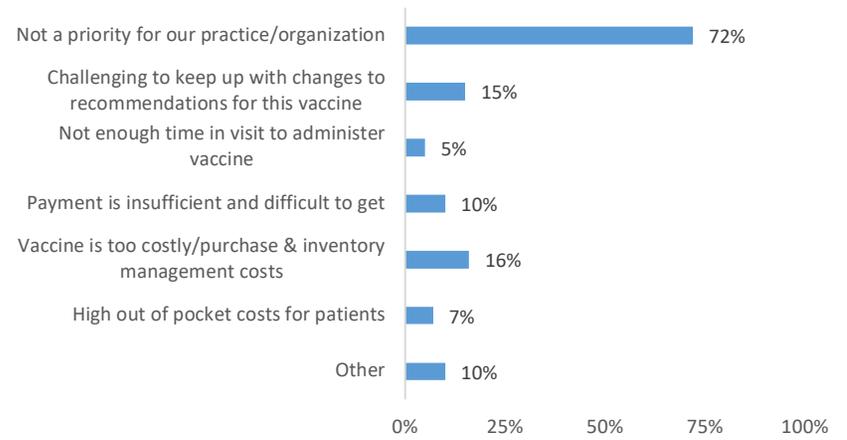
(h) Hepatitis B (N=41)



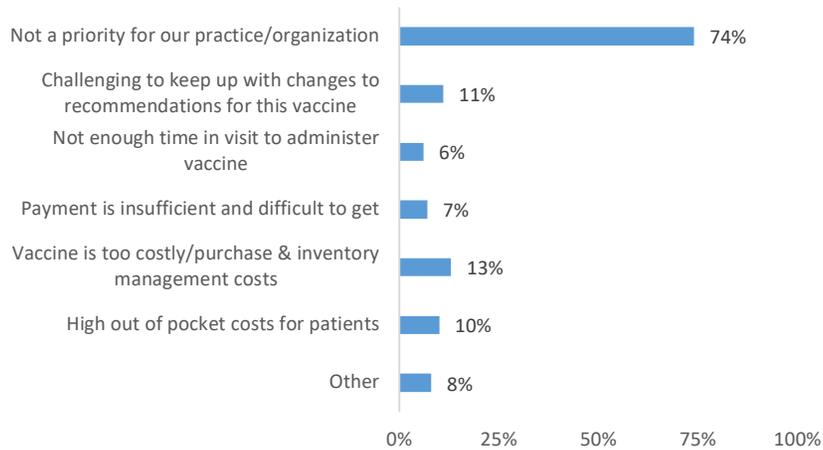
**(i) Hepatitis A and B (N=61)**



**(j) Meningococcal ACWY (N=64)**

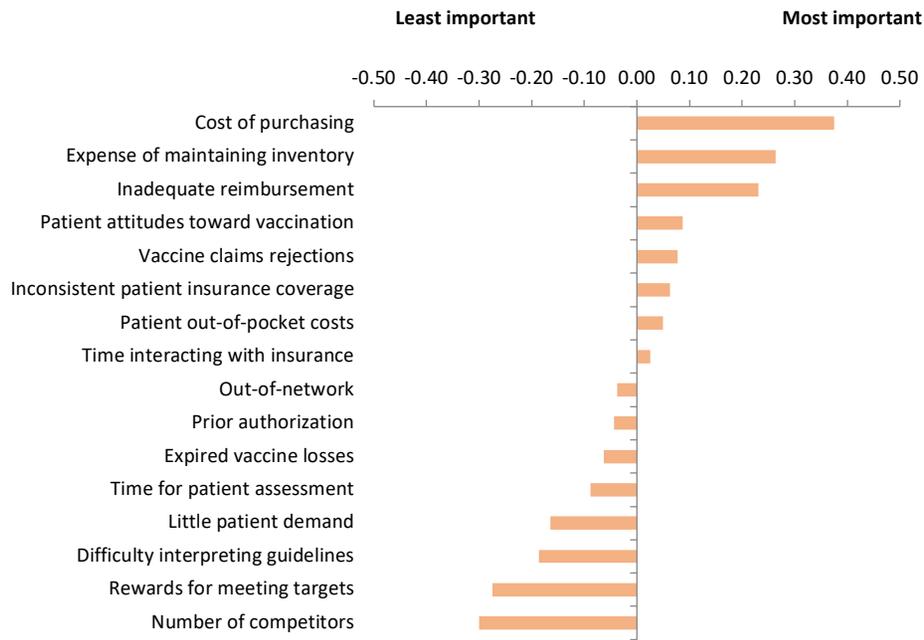


**(k) Meningococcal B (N=72)**

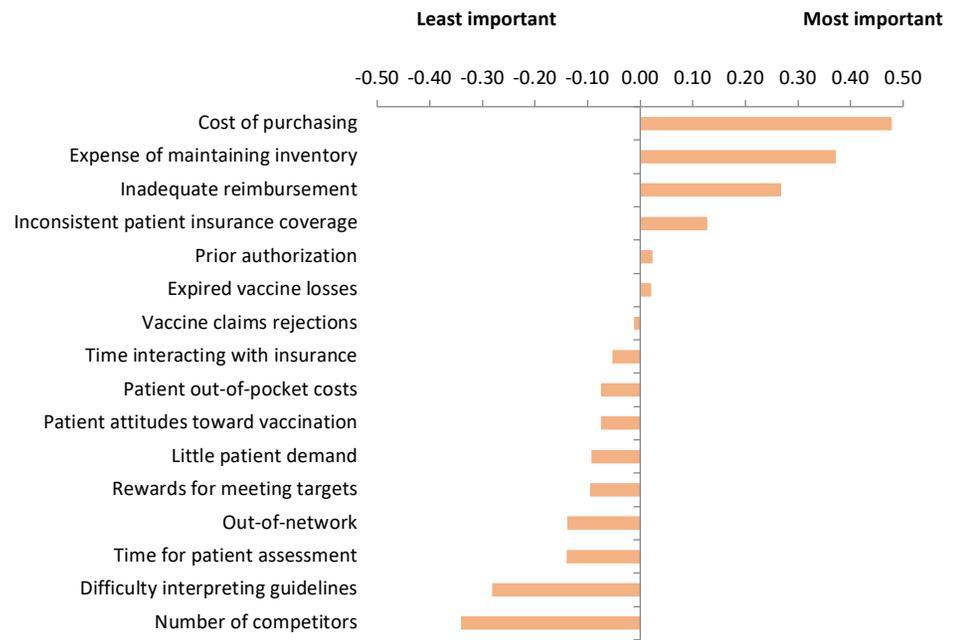


**eAppendix Figure 2. Best-worst scaling of barriers by respondent characteristics**

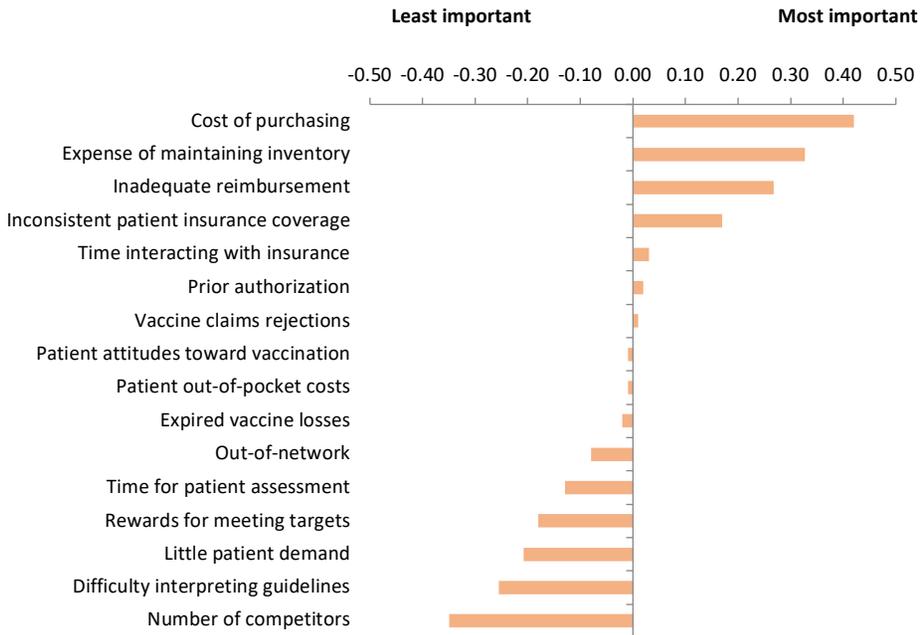
(a) Directly Involved in Stocking (N=60)



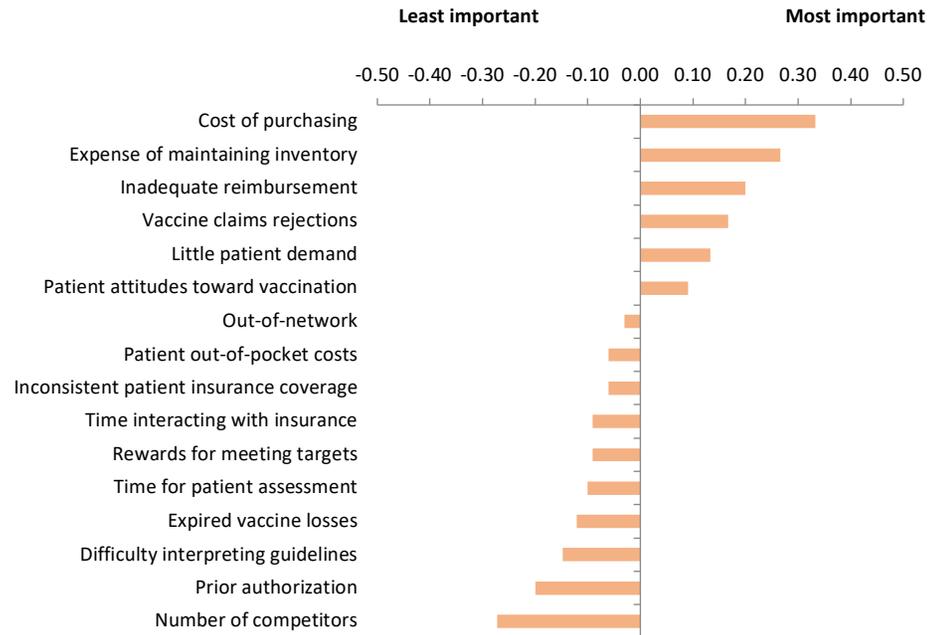
(b) Indirectly Involved in Stocking Decisions (N=65)



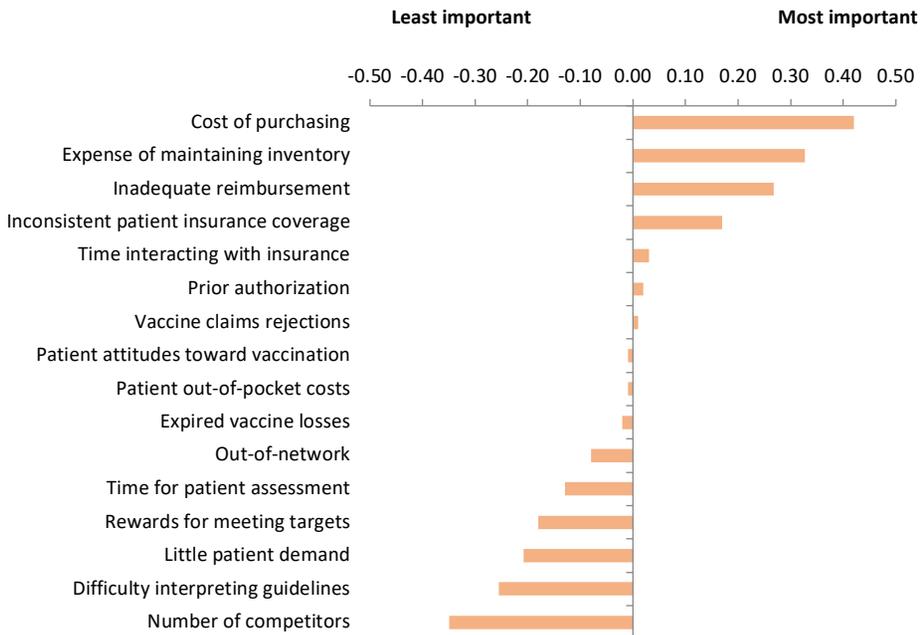
(c) Role: Physicians (N=70)



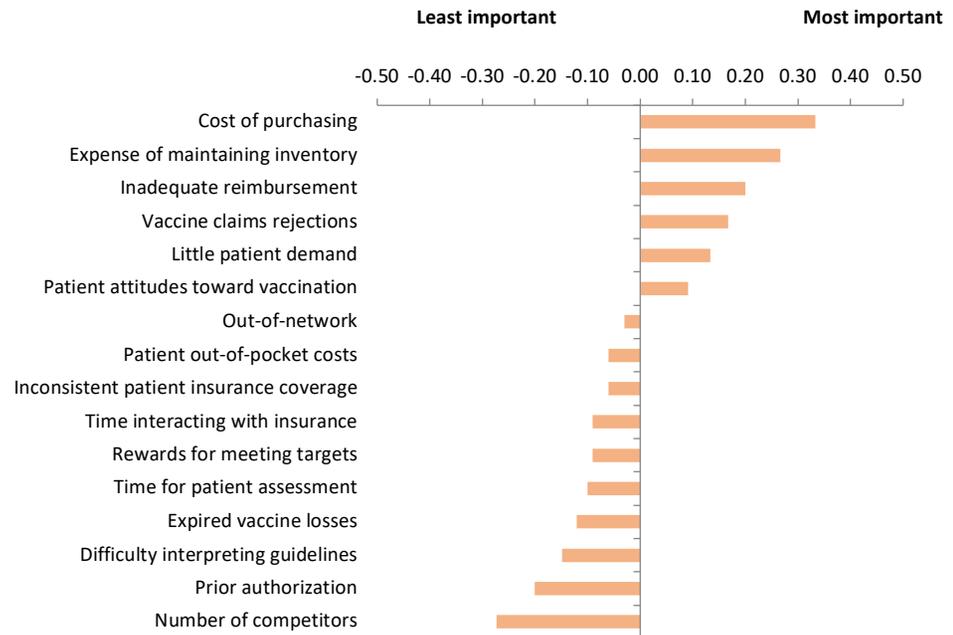
(d) Role: Pharmacists (N=24)



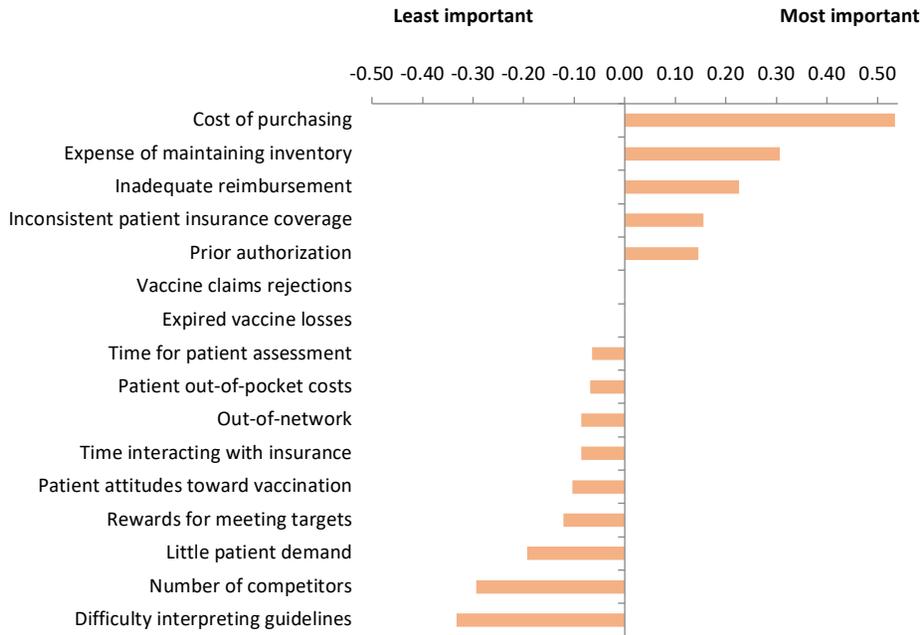
(e) Role: Nurses (N=15)



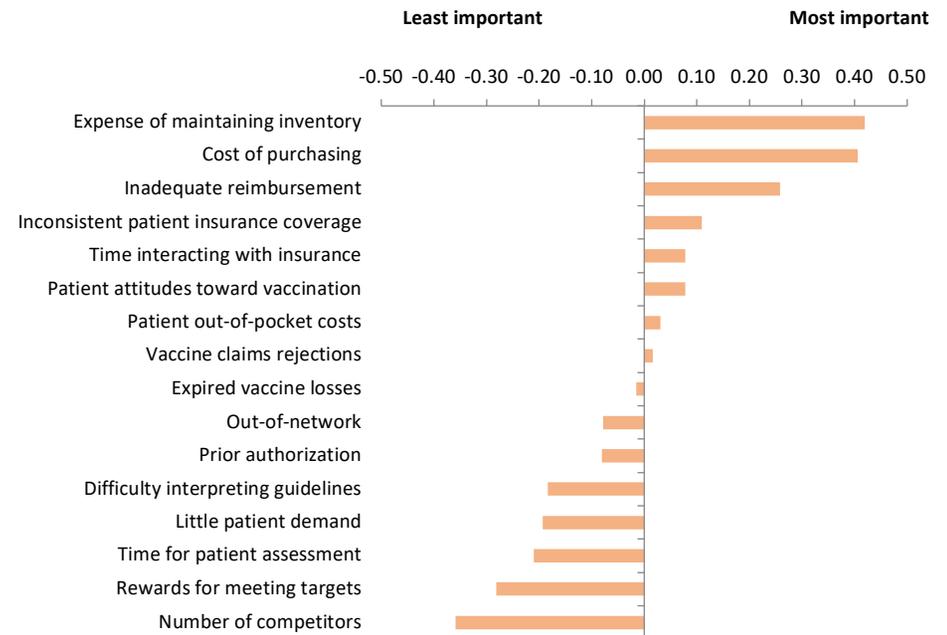
(f) Role: Manager/Administrator/Other (N=16)



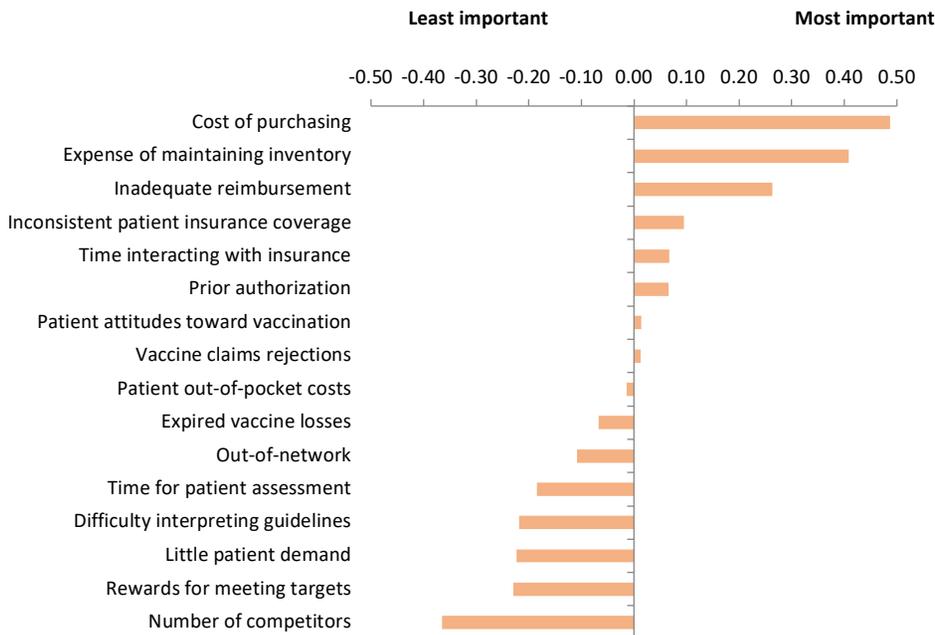
(g) Department: Internal medicine/Family medicine (N=40)



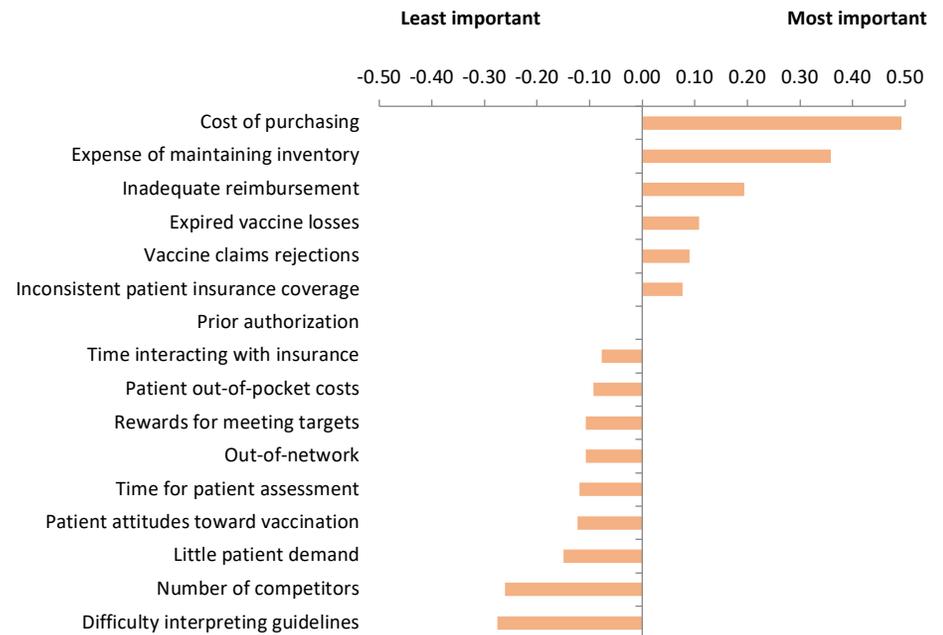
(h) Department: Ob-Gyn (N=45)



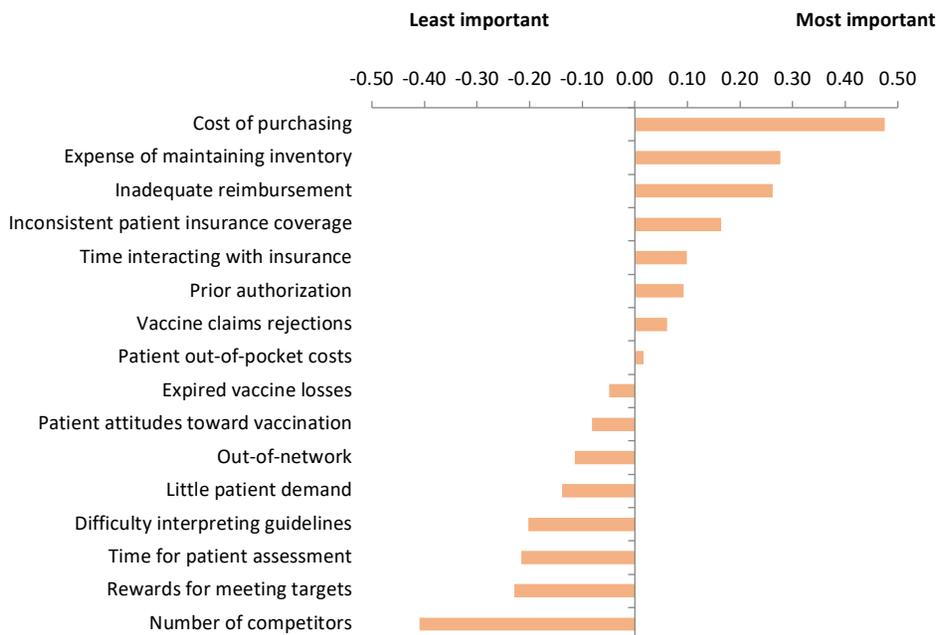
(i) Affiliation: Private/independent organization (N=55)



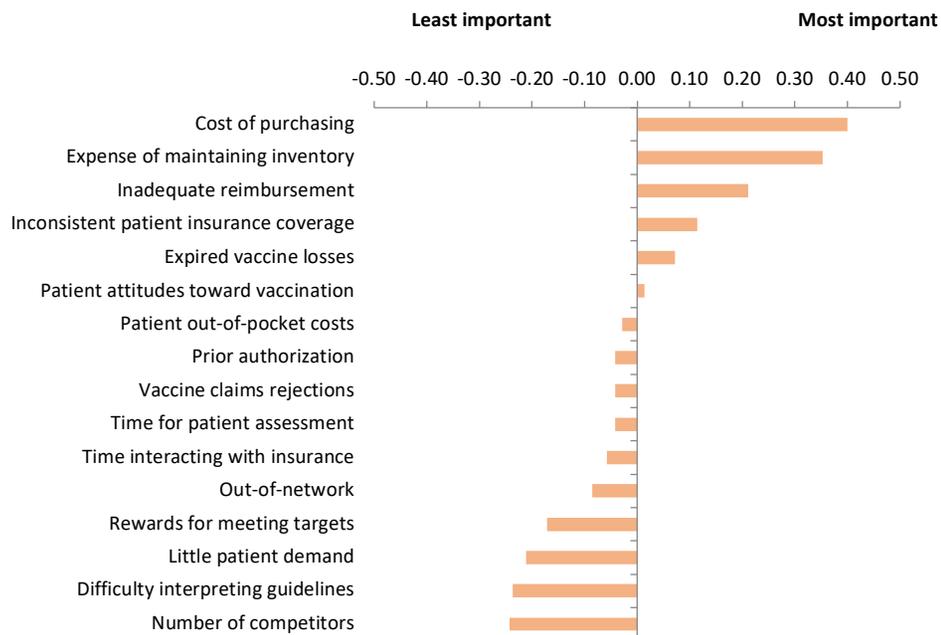
(j) Affiliation: Hospital/academic medical center (N=47)



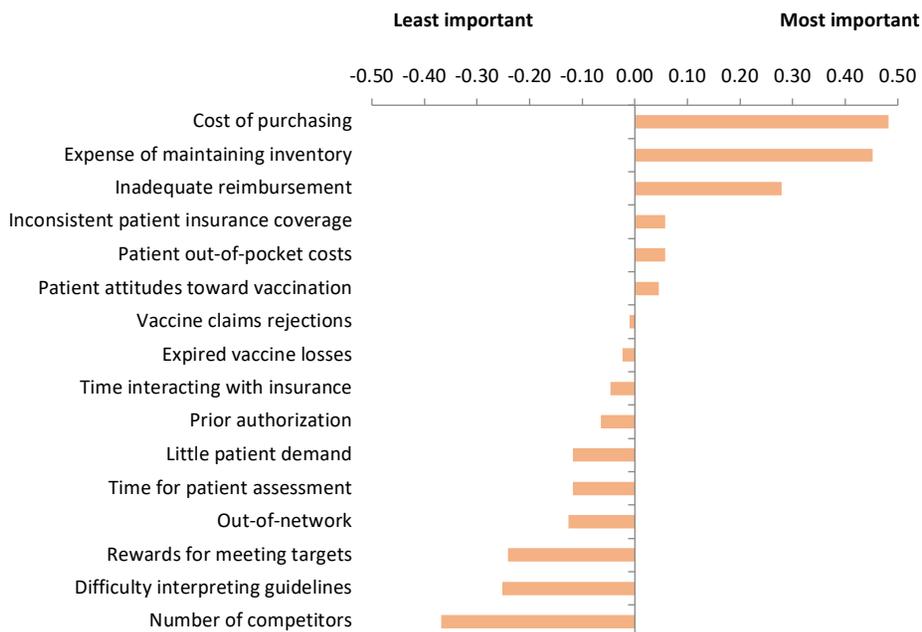
(k) Number of Physicians: 1-5 (N=47)



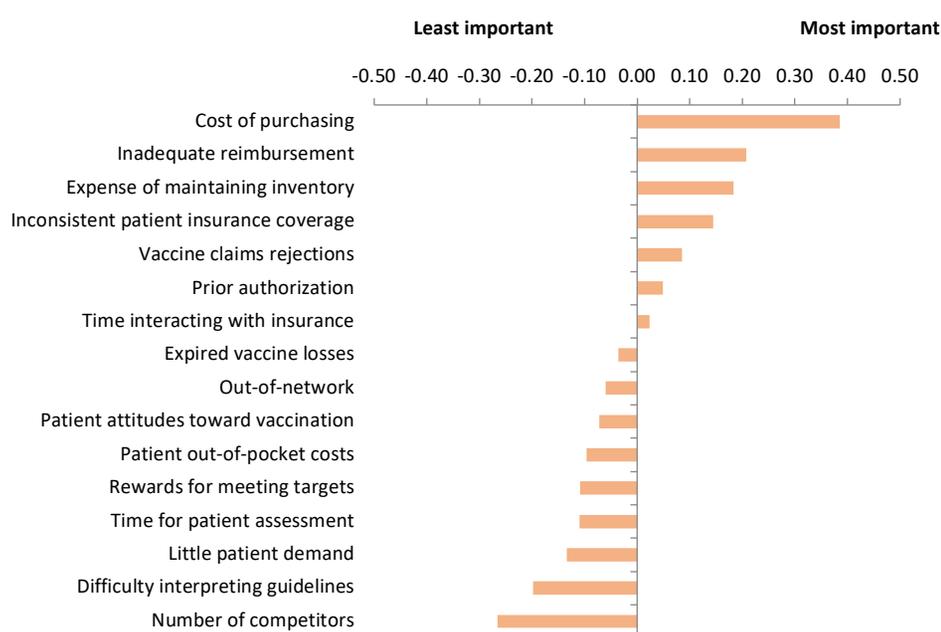
(l) Number of Physicians: 6+ (N=47)



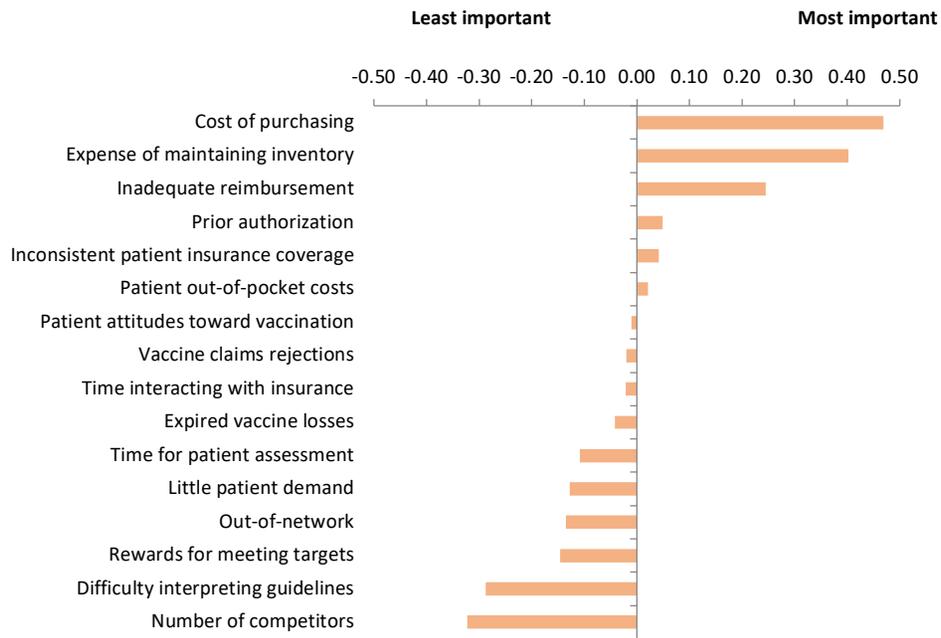
(m) Insurance Distribution: <=25% Medicare (N=66)



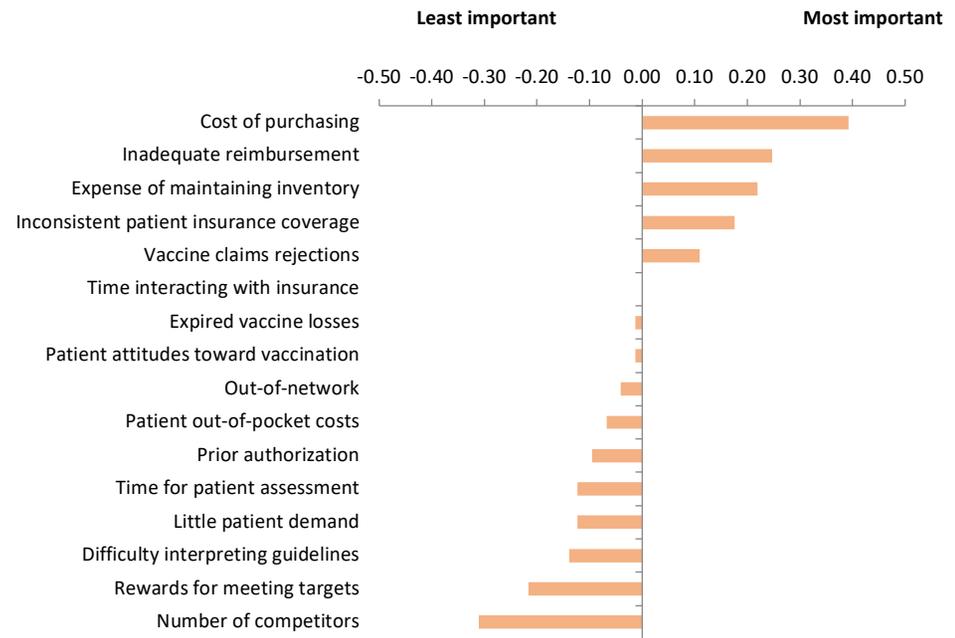
(n) Insurance Distribution: >25% Medicare (N=57)



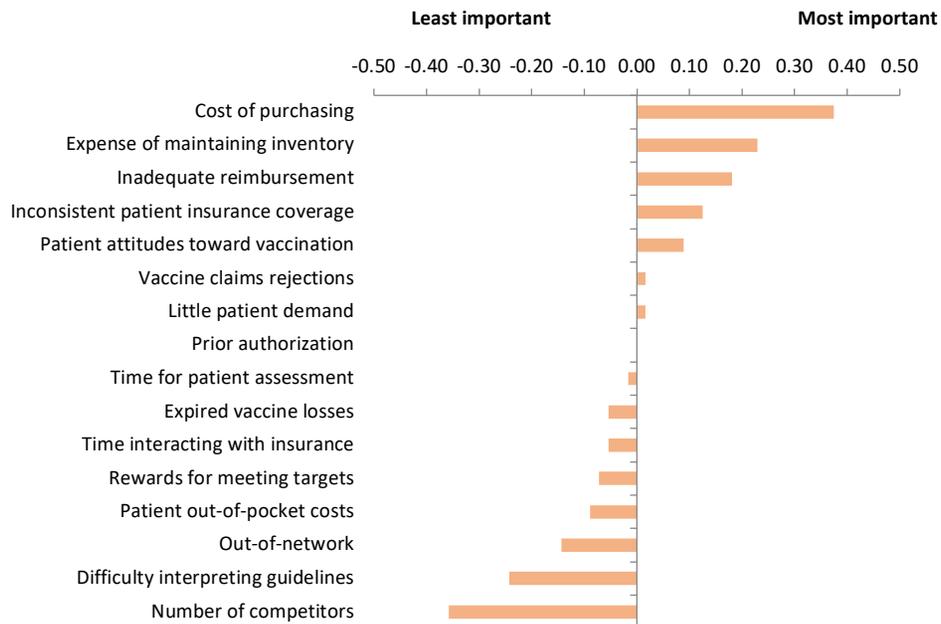
(o) Insurance Distribution:  $\leq 25\%$  Medicaid (N=68)



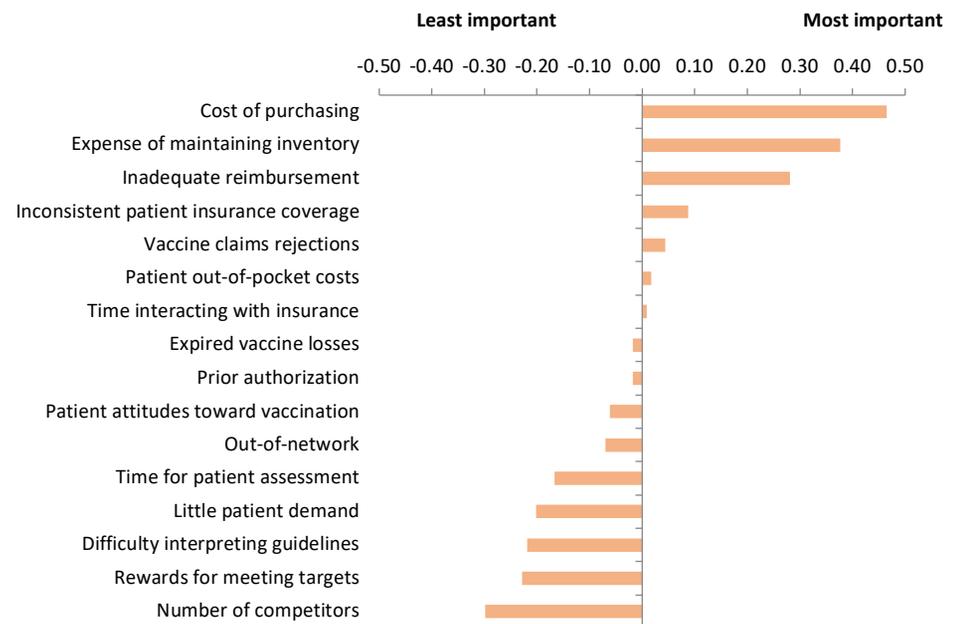
(p) Insurance Distribution:  $> 25\%$  Medicaid (N=55)



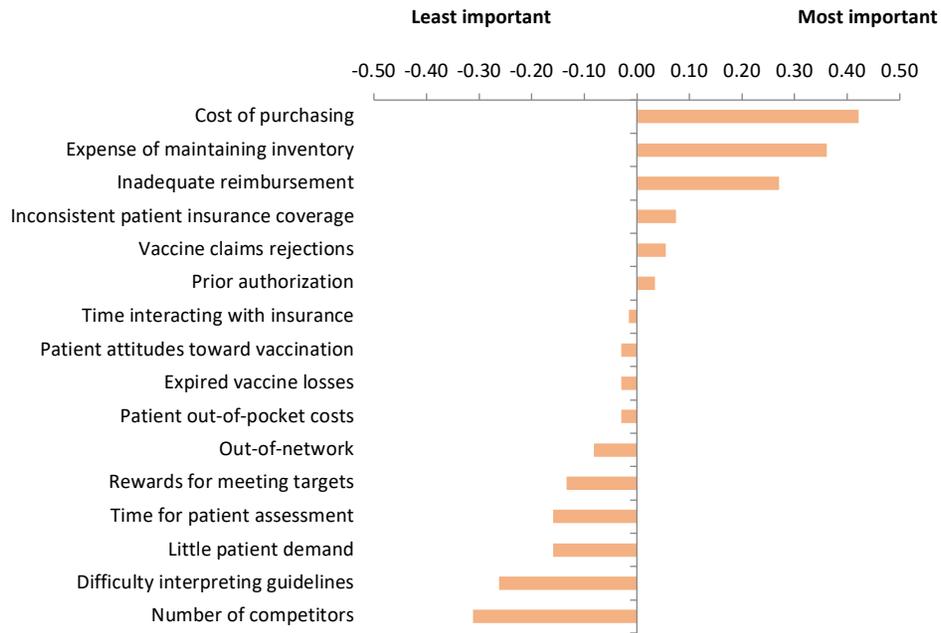
(q) Insurance Distribution:  $\leq 25\%$  Private (N=42)



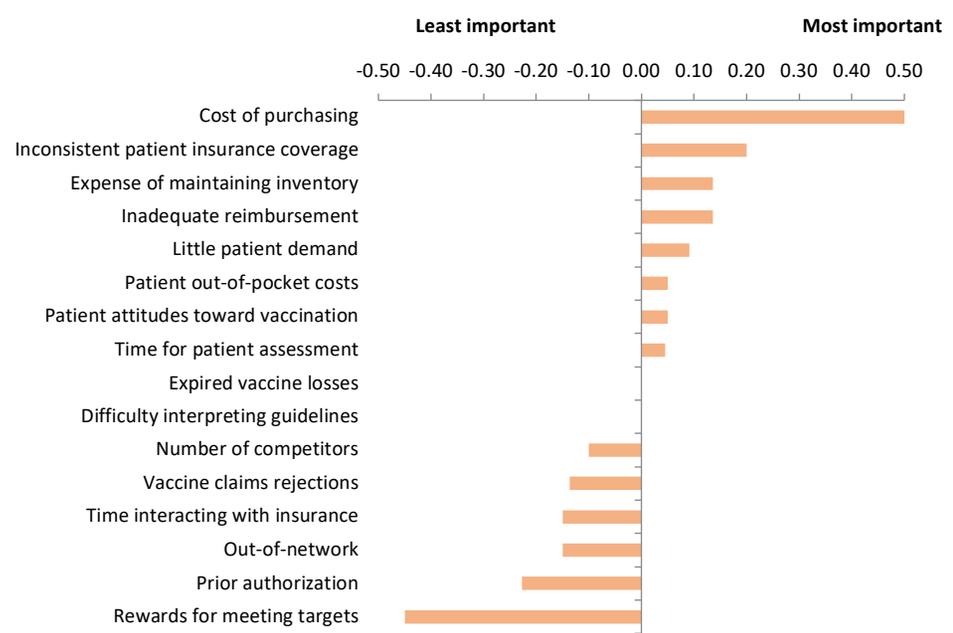
(r) Insurance Distribution:  $> 25\%$  Private (N=71)



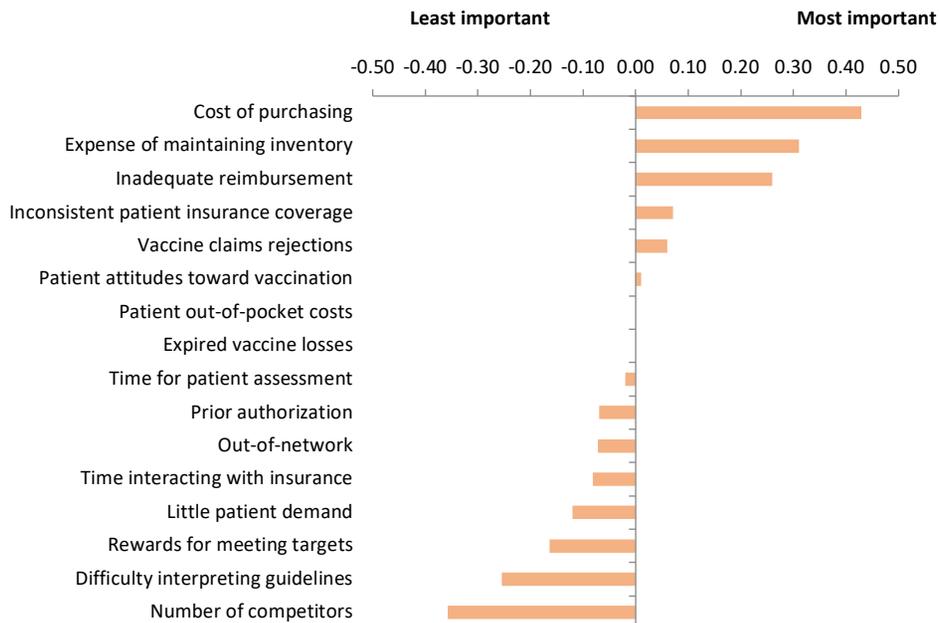
(s) Insurance Distribution:  $\leq 25\%$  Uninsured (N=100)



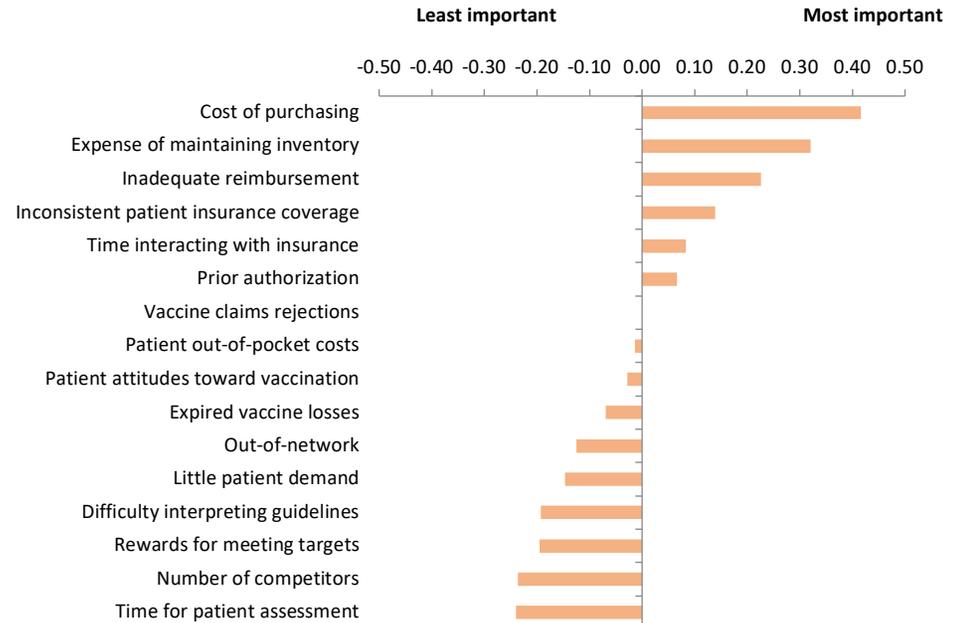
(t) Insurance Distribution:  $>25\%$  Uninsured (N=14)



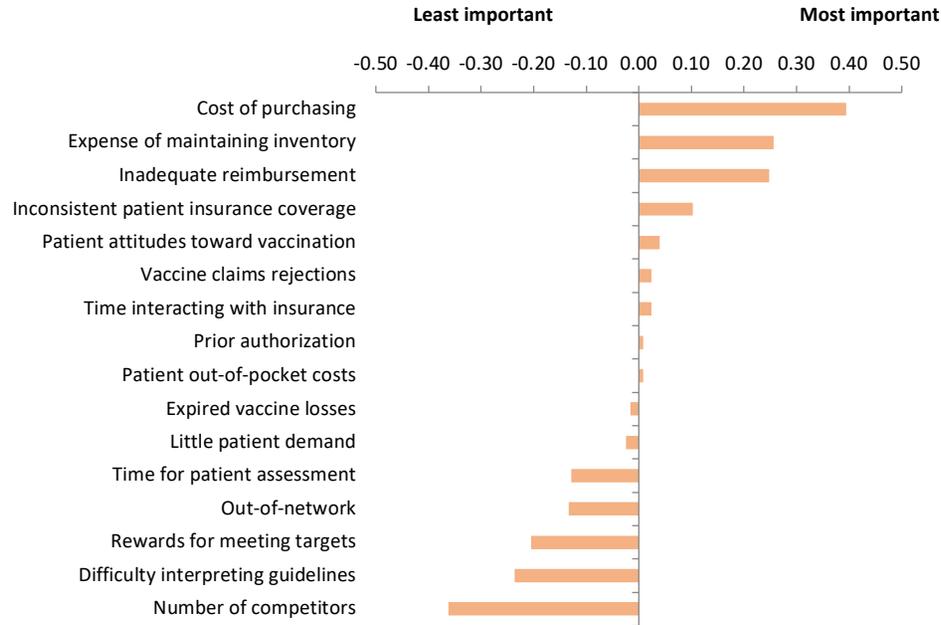
(u) Patient Age Distribution: 0-50% age 19-64 (N=71)



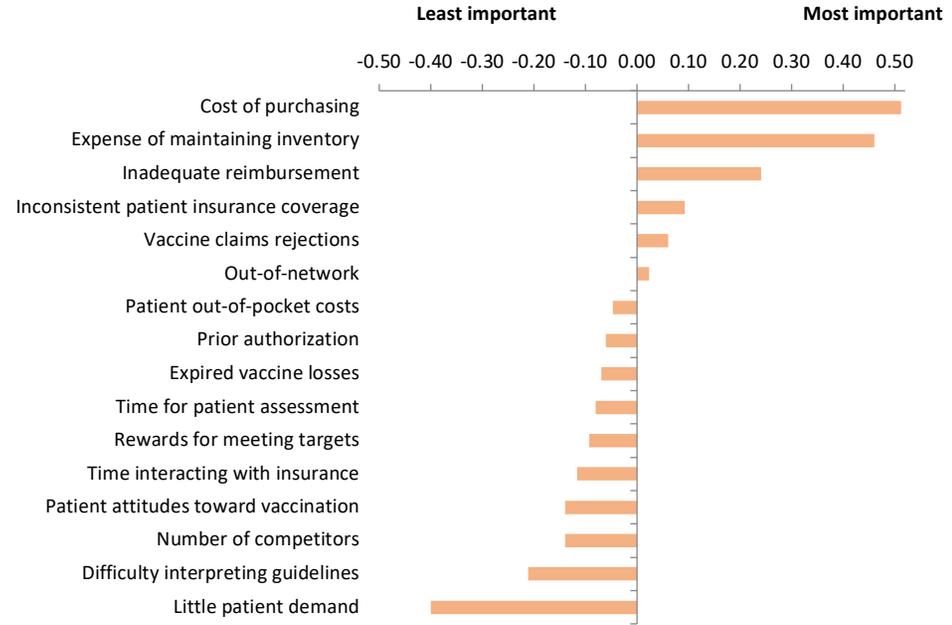
(v) Patient Age Distribution:  $>50\%$  age 19-64 (N=52)



(w) Patient Age Distribution: 0-50% age 65+ (N=92)

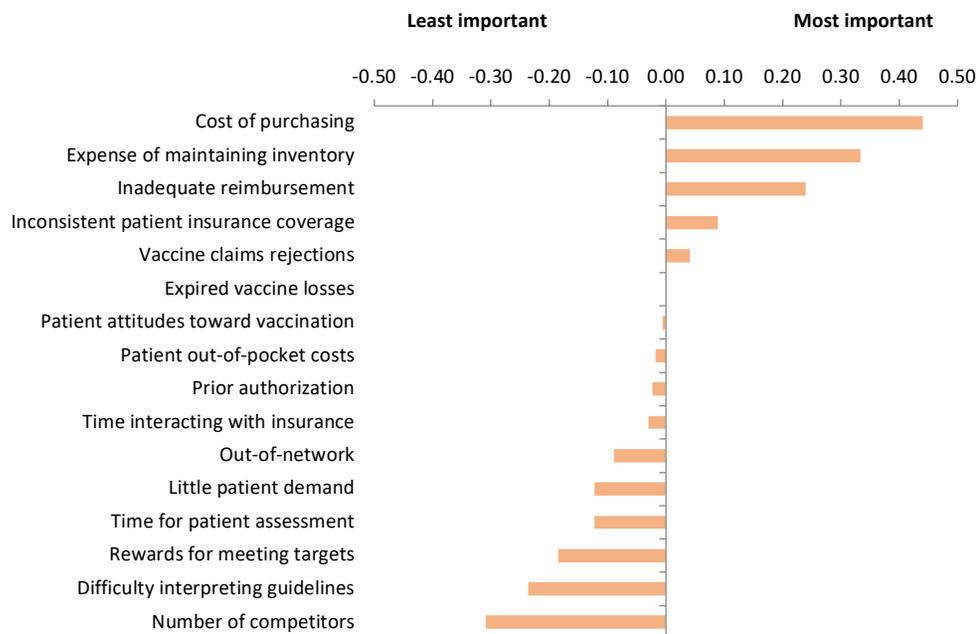


(x) Patient Age Distribution: >50% age 65+ (N=31)



### Appendix Figure 3. Best-worst scaling of barriers based on stocking specific vaccines

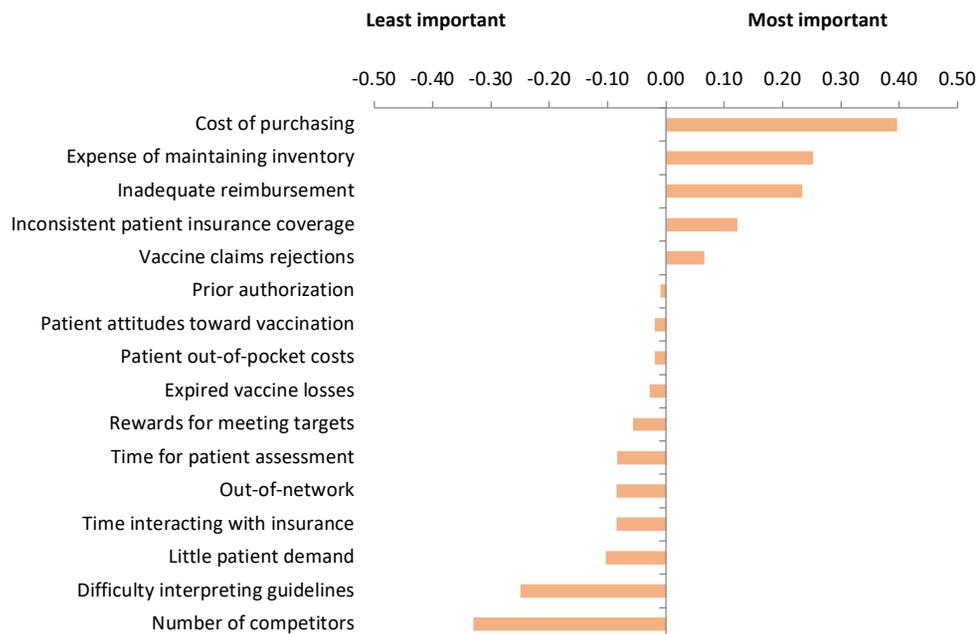
(a) Stocked influenza (N=113)



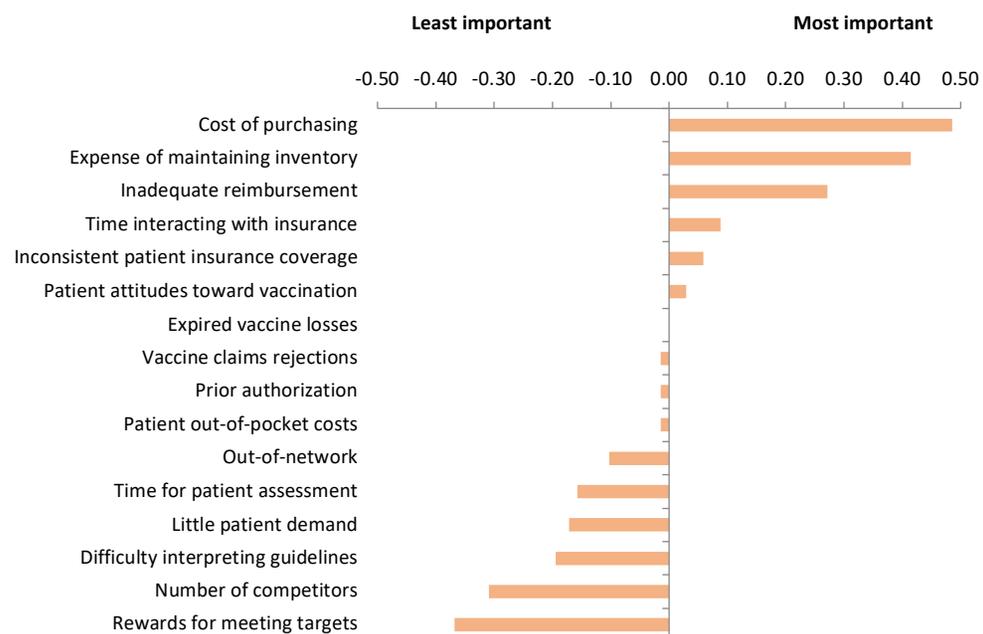
(b) Did not stock influenza (N=4)



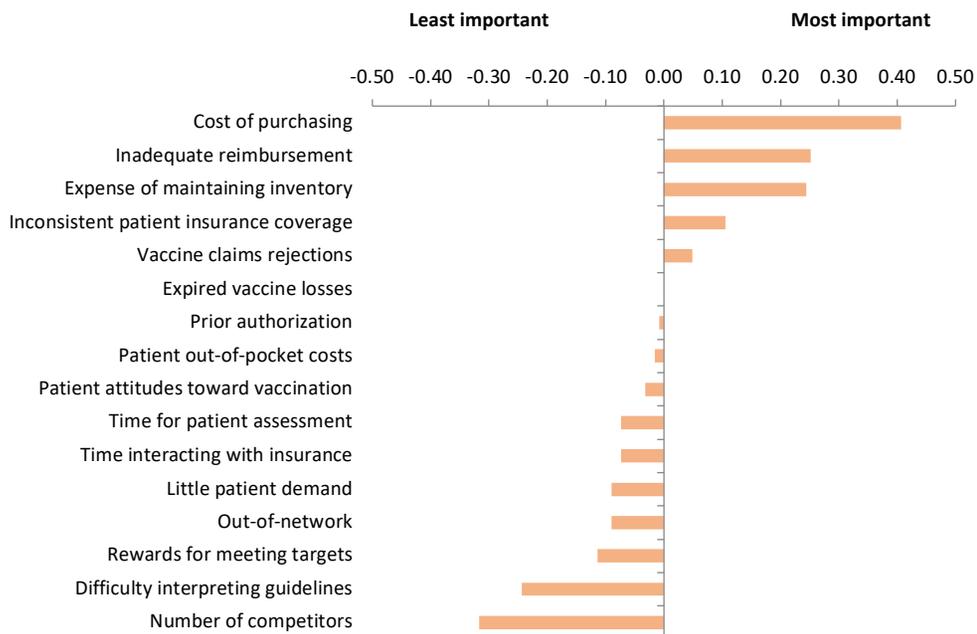
(c) Stocked PCV13 (N=71)



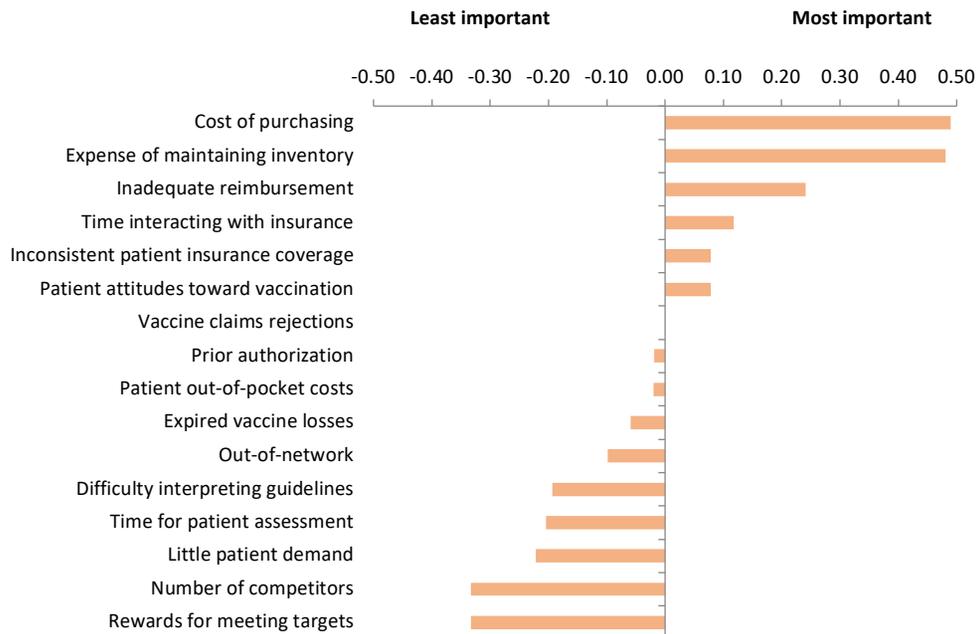
(d) Did not stock PCV13 (N=46)



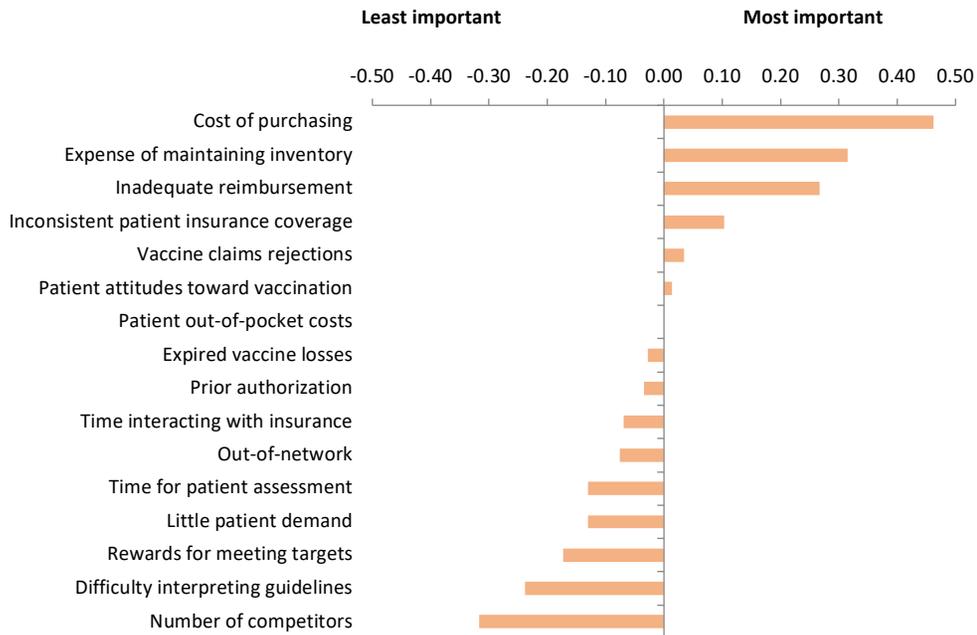
(e) Stocked PPSV23 (N=82)



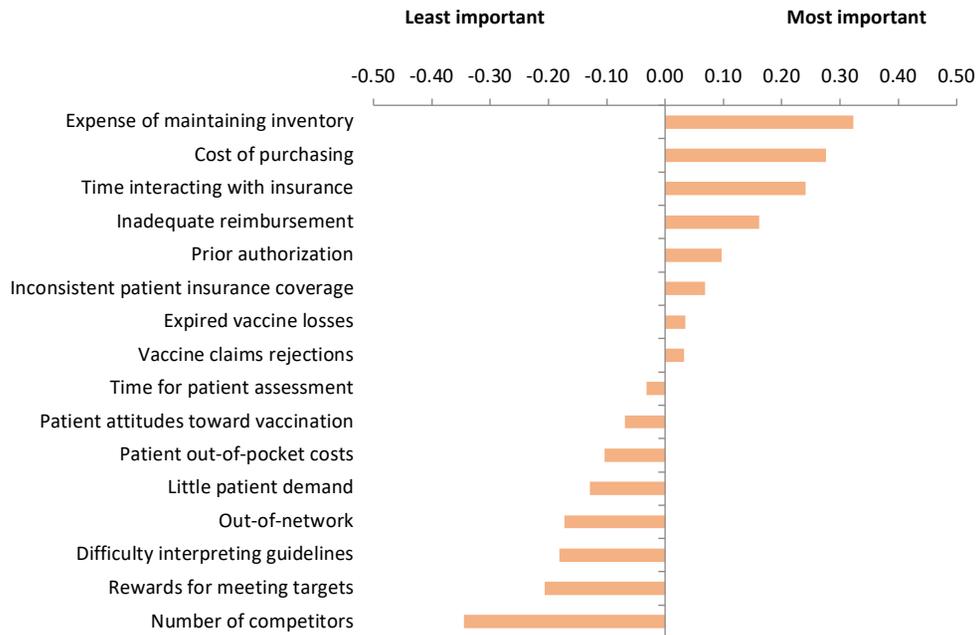
(f) Did not stock PPSV23 (N=35)



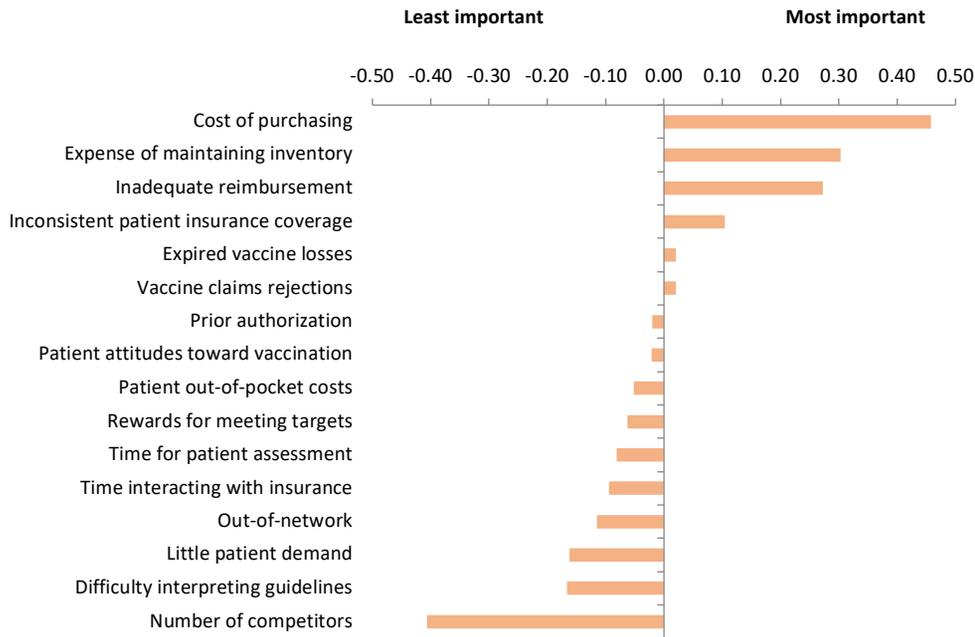
(g) Stocked Tdap (N=97)



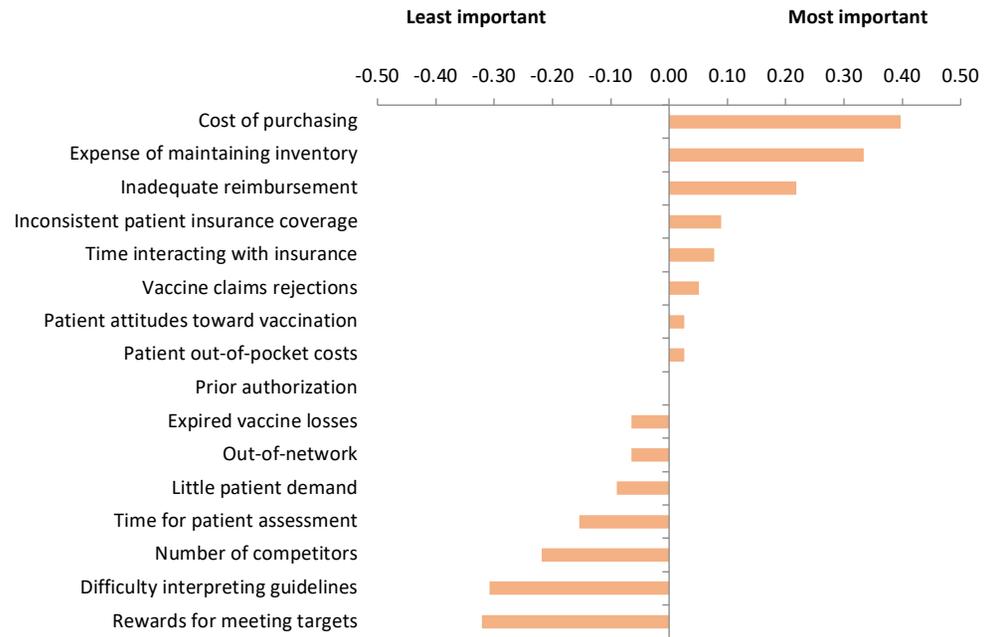
(h) Did not stock Tdap (N=20)



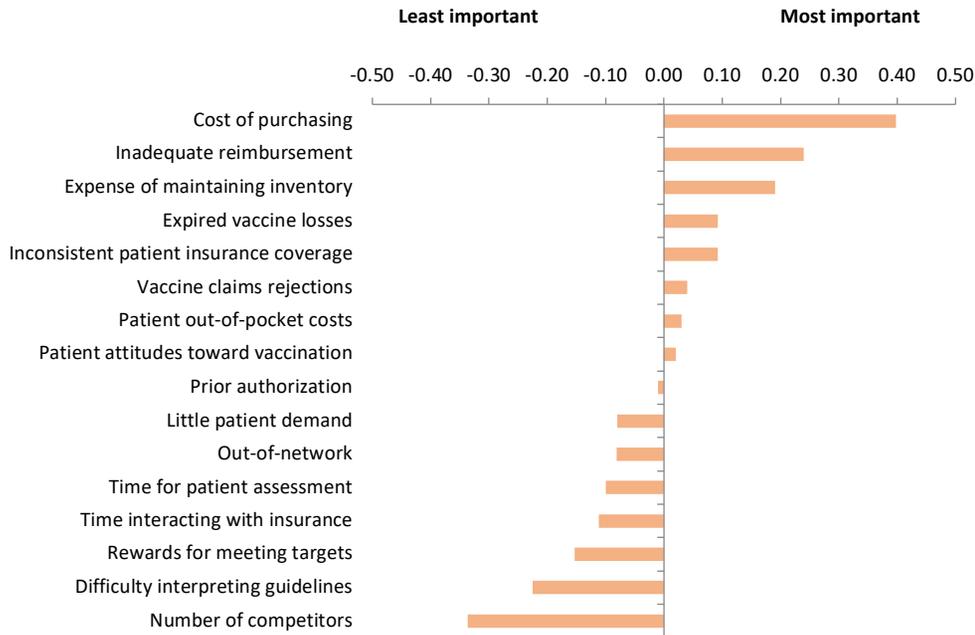
(i) Stocked Td (N=65)



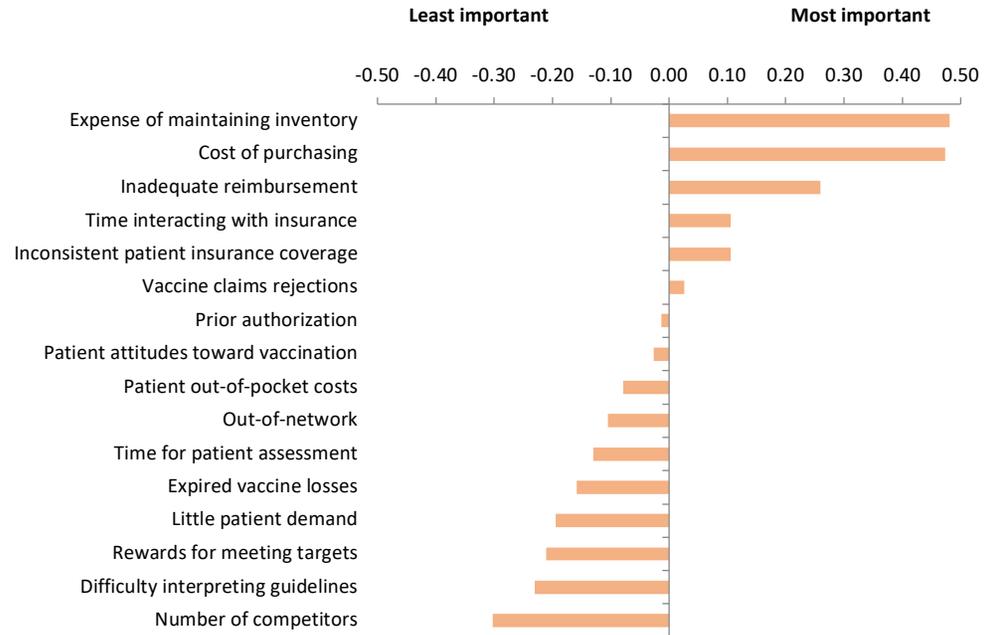
(j) Did not stock Td (N=52)



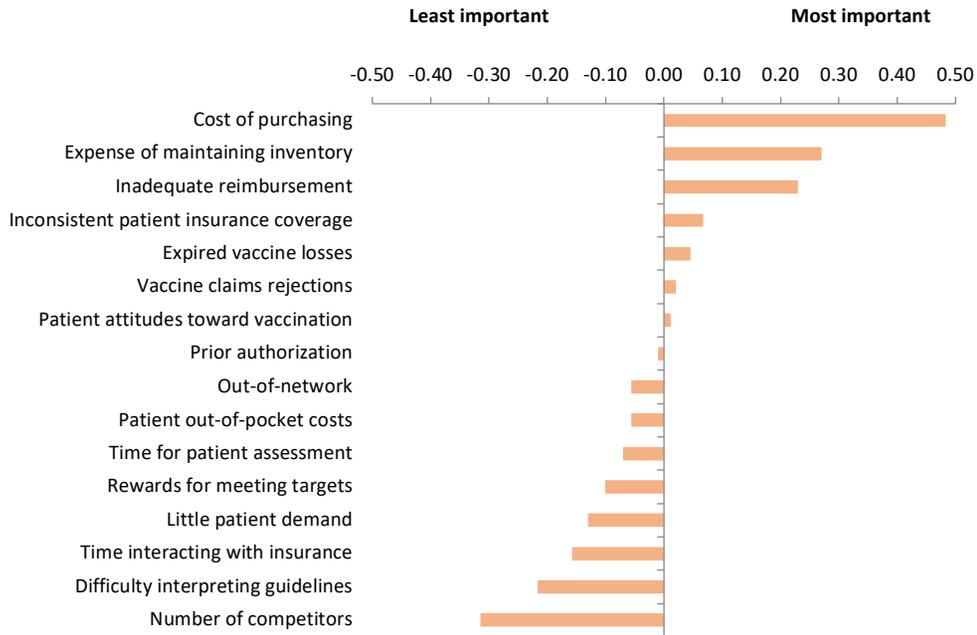
(k) Stocked Zoster (N=66)



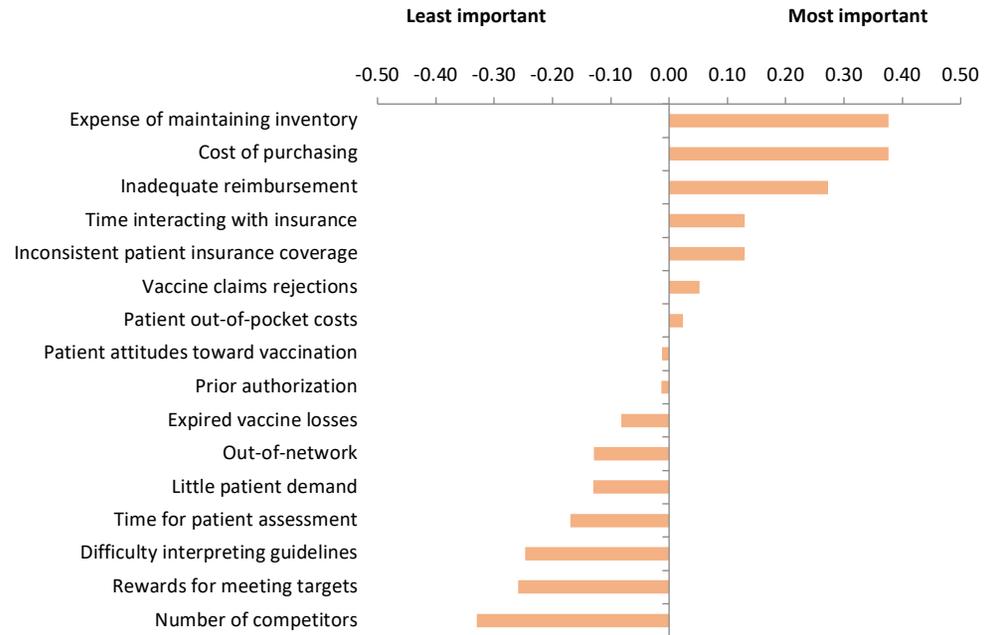
(l) Did not stock Zoster (N=51)



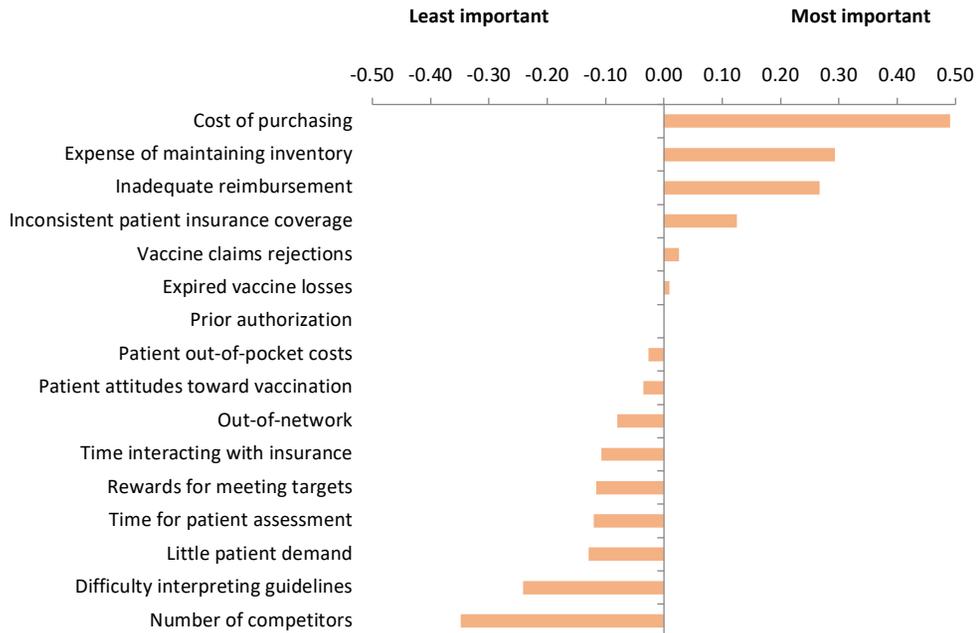
(m) Stocked hepatitis A (N=63)



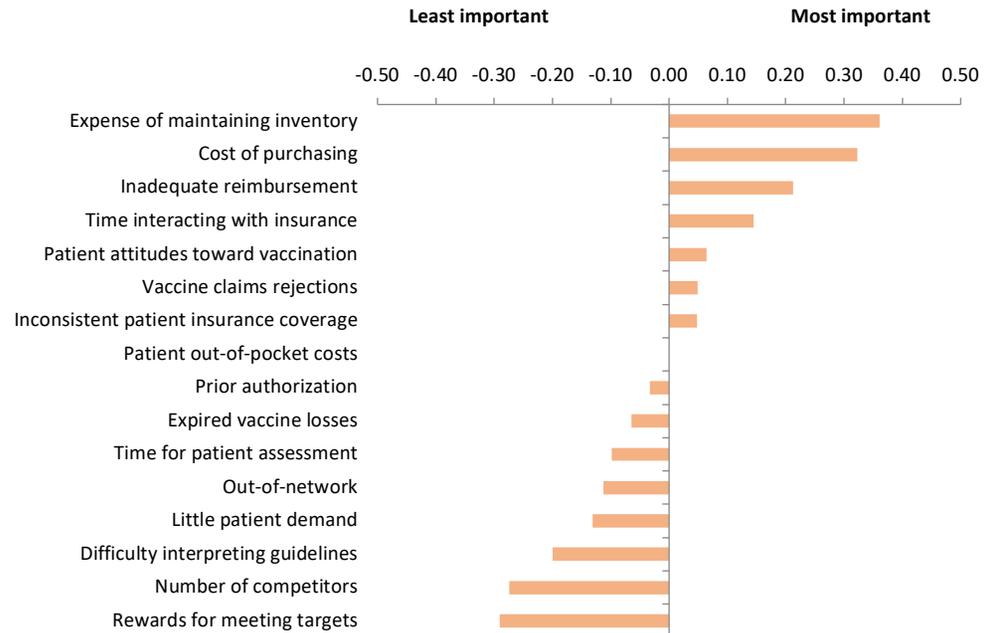
(n) Did not stock hepatitis A (N=54)



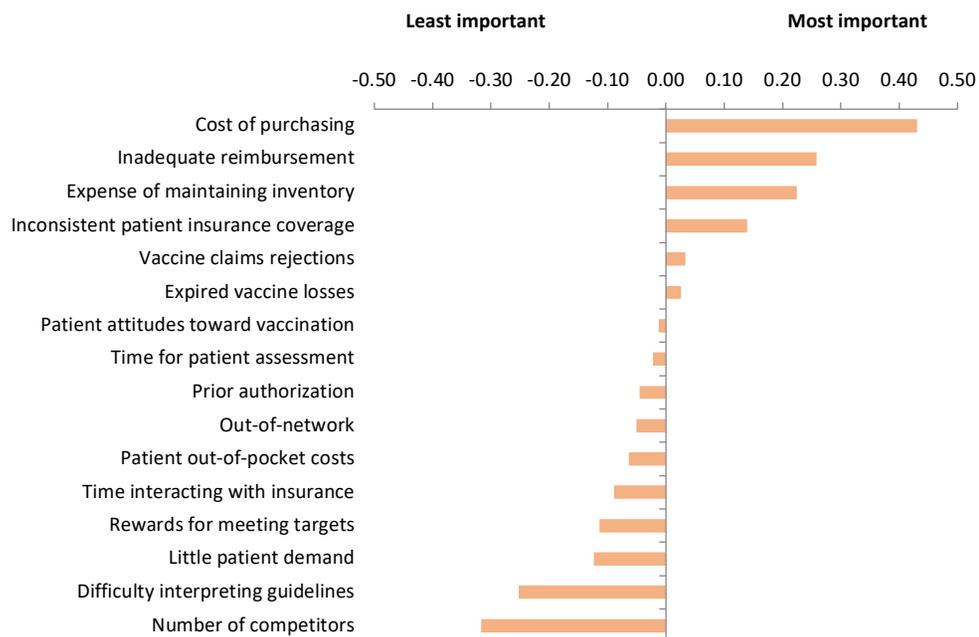
(o) Stocked hepatitis B (N=76)



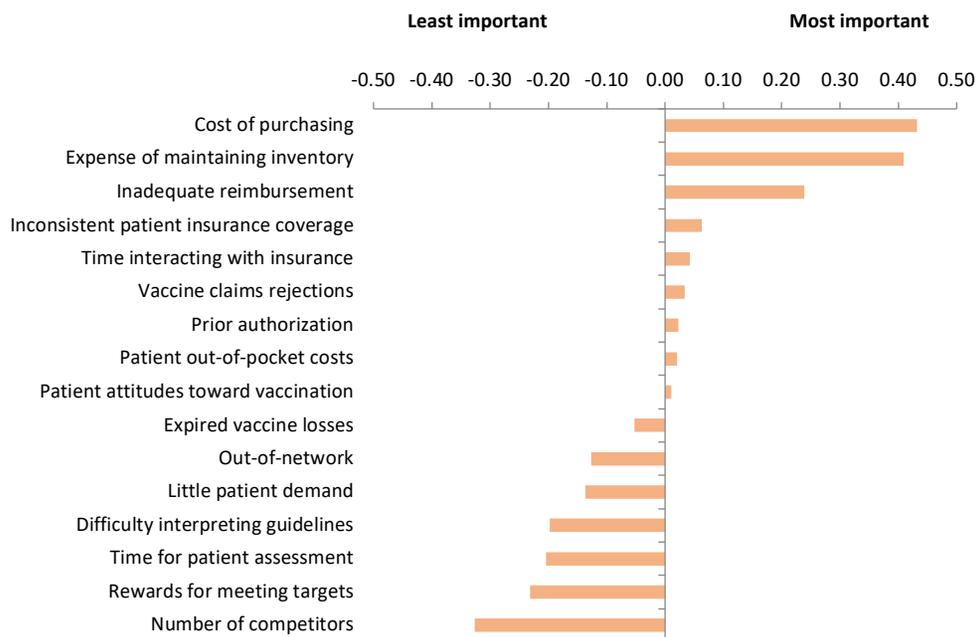
(p) Did not stock hepatitis B (N=41)



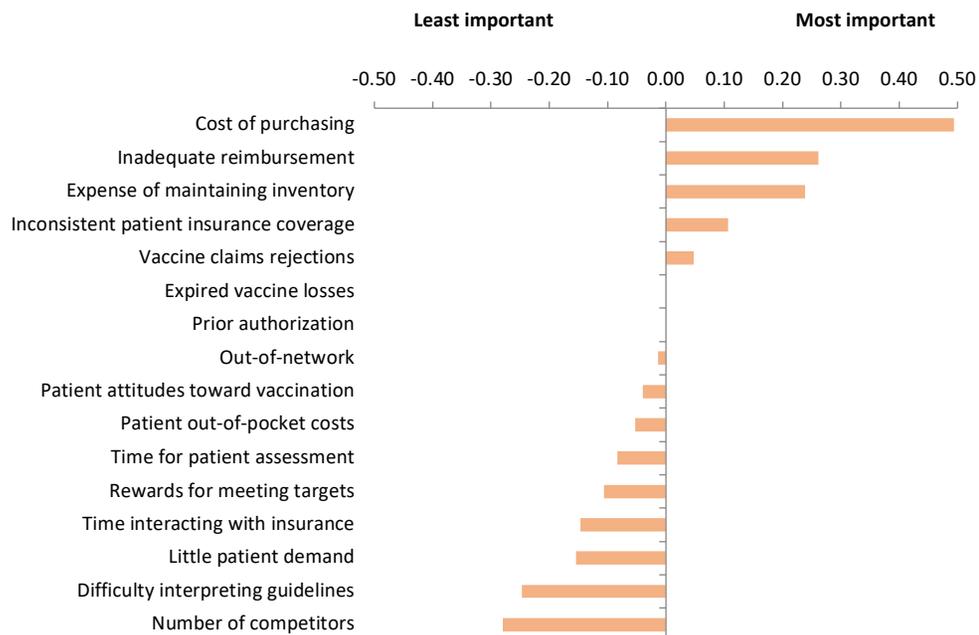
(q) Stocked hepatitis A and B (N=56)



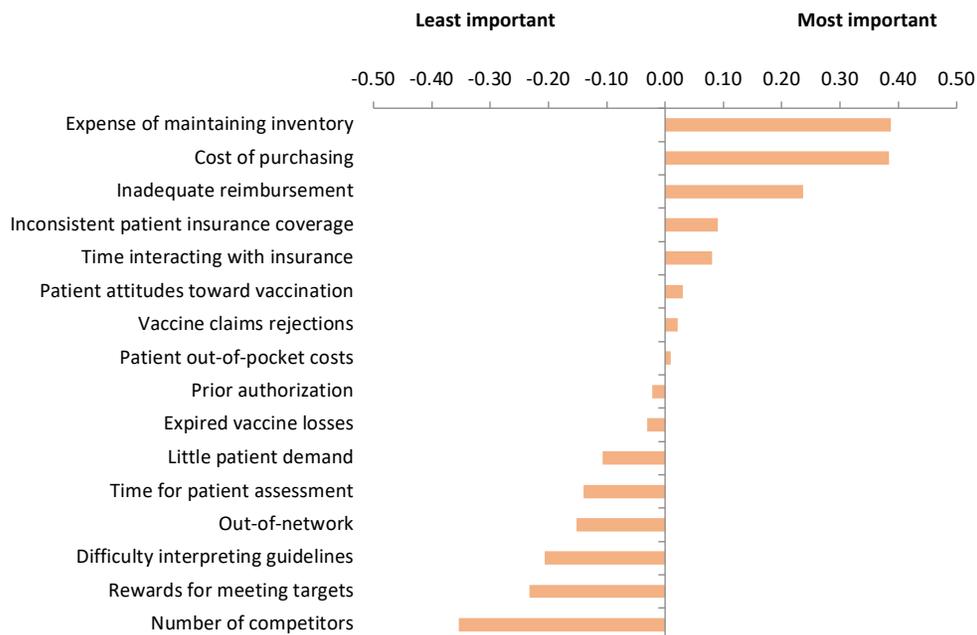
(r) Did not stock hepatitis A and B (N=61)



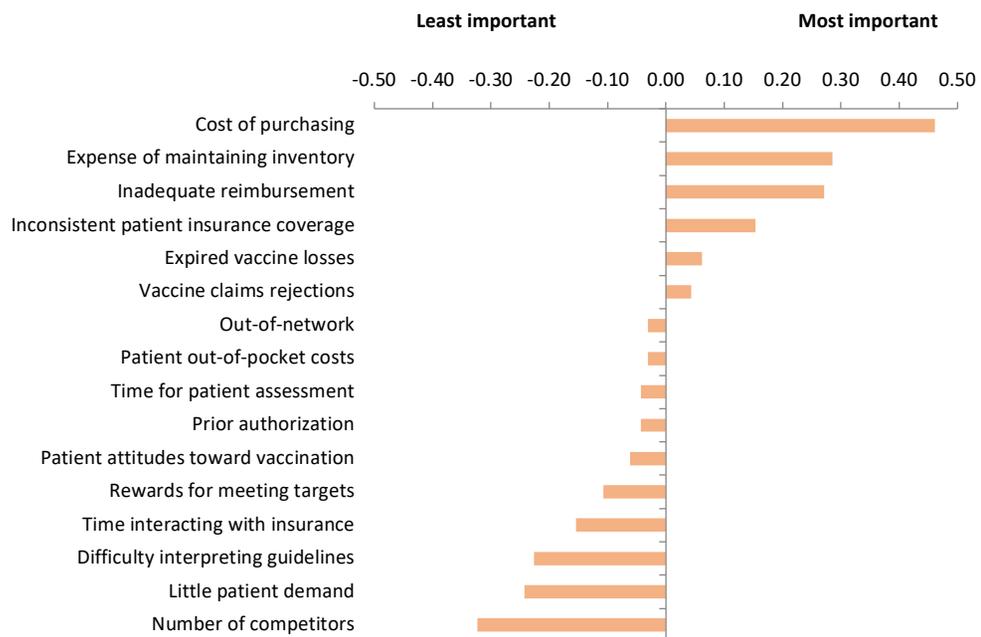
(s) Stocked meningococcal ACWY (N=53)



(t) Did not stock meningococcal ACWY (N=64)



(u) Stocked meningococcal B (N=45)



(v) Did not stock meningococcal B (N=72)

