Supplemental materials for

Chien AT, Leyenaar J, Tomaino M, et al. Difficulty obtaining behavioral health services for children: a national survey of multiphysician practices. *Ann Fam Med*. 2022;20(1):42-50.

Supplemental Appendix 1. Survey Sample and Item Non-Response

A. Selecting a sample of practices serving children

To select our sample of practices for this analysis of practice difficulty obtaining care for children with behavioral disorders, we focus on the behavioral healthcare module of the NSHOS practice survey. The behavioral healthcare module starts with a statement before question # 17 clarifying how we defined "behavioral health" by stating, "**Behavioral health** includes depression, anxiety, other mental illness, or substance use disorders." Our sample is drawn based on responses to question 19 from the survey, presented as shown in **Appendix Figure 1a** below. Respondents are urged to skip to question 20 if they do not see children. The remaining practices are asked about difficulty obtaining 1) family-based treatment, 2) evidence-based psychotherapy or 3) medication advice from a child psychiatrist or psychiatric nurse practitioner.

Supplemental Figure 1a. NSHOS practice survey question used to define multiphysician primary care and multispecialty practices that serve children.

IF YOUR PRACTICE DOES NOT SEE CHILDREN, PLEASE SKIP TO QUESTION 20.

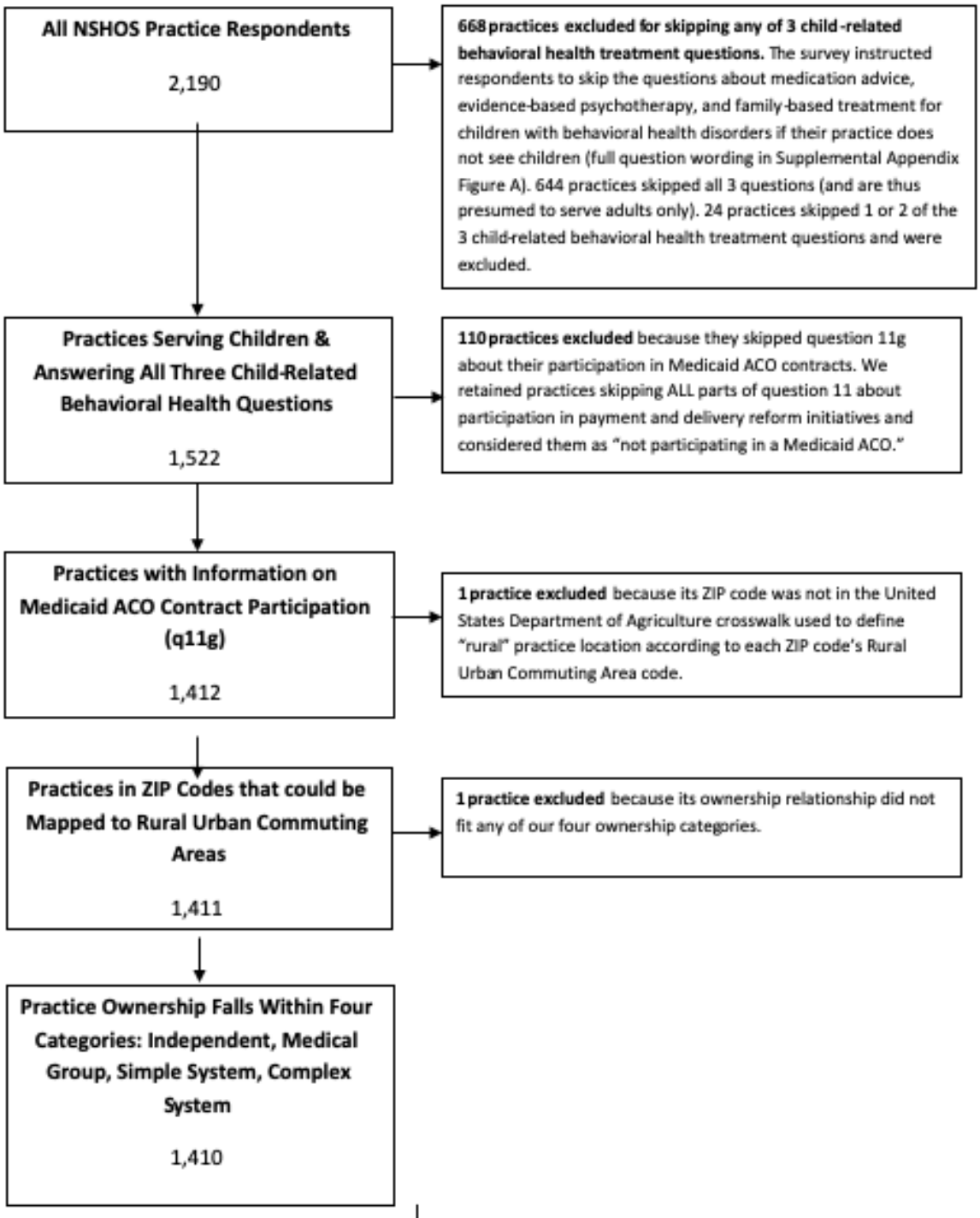
19. For children with behavioral disorders, how difficult is it to obtain:

	Very difficult	Somewhat difficult	Slightly difficult	Not at all difficult
Family-based treatment	☐	☐	☐	☐
Evidence-based psychotherapy	☐	☐	☐	☐
Medication advice from a child psychiatrist or psychiatric nurse practitioner	☐	☐	☐	☐

B. Consort Diagram

Appendix Figure 1b shows a consort diagram of our sample selection. From the 2,190 NSHOS practice survey respondents, 644 skipped all of question 19 (as instructed for practices not serving children). From the remaining 1546 practices, we excluded a small number of practices, 24, missing responses for part of question 19. Of the remaining 1522 practices, we excluded 110 practices that skipped the question about Medicaid ACO contract participation (q11g), although they may have answered other parts of question 11 on participation in payment and delivery reform initiatives. Finally, from the 1411 practices remaining, we excluded one practice because its ownership type did not fit into any of the four ownership categories.

Appendix Figure 1b. Consort Diagram



C. Item Non-Response

The item % missing for all 2190 NSHOS practice respondents, and among the 1410 practice respondents retained for our study are shown below in **Appendix Table 1c**.

Appendix Table 1c. Item Non-Response

Practice NSHOS Non-Response	% Missing in Our Sample N=1410 practices in sample	% Missing Overall N=2190 practices in NSHOS
NSHOS Items		
For children with behavioral disorders, how difficult is it to obtain:		
Family-based treatment (q19a)	0.0%	29.8%
Evidence-based psychotherapy (q19b)	0.0%	30.0%
Medication advice from a child psychiatrist or psychiatric nurse practitioner (q19c)	0.0%	30.0%
FQHC or Look-Alike (q5)[a]	1.1%	1.3%
Has your practice ever participated in any of these payment and delivery reform initiatives?		
Primary care improvement programs (q11b)	3.5%	4.5%
Pay for performance programs (q11c)	3.9%	6.4%
Capitated contracts with commercial health plans (q11d)	4.3%	8.0%
Medicaid ACO contracts (q11g)	1.9%	9.8%
Commercial ACO contracts (q11h)	4.0%	10.5%
Please give your best estimate about what percentage of your practice's annual patient care revenues come from:		
Commercial health insurance (q61a)	0.0%	0.0%
Medicare (q61b)	0.0%	0.0%
Medicaid (q61c)	0.0%	0.0%
Self-Pay (q61d)	0.0%	0.0%
Other (Tricare, VA, worker's compensation, etc.) (q61e)	0.0%	0.0%

[a] Label edited for length. Full question asks, "Is your practice 1) A Federally Qualified Health Center (FQHC) 2) A FQHC "look-alike" (do not select unless you have this designation) 3) Not designated as either 4) Don't know. This item describes practices that selected response 1 or 2. NSHOS=National Survey of Healthcare Organizations and Systems.
FQHC=federally qualified health center.

Supplemental Appendix 2. Variable Definitions and Sources

Appendix Table 2a. Variable definitions and sources

Variable	Description	Source
Practice Ownership Structure, as defined in Fisher et al. 2020.	We defined four mutually exclusive categories based on the ownership relationships between practices and their health systems. We considered all but independent practices to be "system-owned." **Independent**: practices that are not owned by another organization. **Medical Group**: practices are owned by a health system which owns practices but no hospitals. **Simple System**: practices are owned by a health system which owns practices and at least one hospital. **Complex System**: practices are owned by an organization that itself owns a medical group or another system (i.e., a system within a system). Complex systems own practices and at least 1 hospital.	IQVIA OneKey Database
Practice Size	Our physician counts come from 2017 IQVIA OneKey and NPPES data linked by NPI. We used IQVIA OneKey data connecting NPIs with practices to count the number of physicians in each practice, coded into 4 size categories: very small - 3 or fewer physicians, small – 4 to 9 physicians, medium i- 10 to 19 physicians, and large - 20 or more physicians.	IQVIA OneKey; National Plan and Provider Enumeration System (NPPES)
Specialists included in practice: General Psychiatrist Child Psychiatrist General Pediatrician Specialist Pediatrician	Our physician specialties come from 2017 IQVIA OneKey and NPPES data linked by NPI. □ First, we mapped the provider taxonomy codes available from NPPES to the corresponding physician specialties as categorized by the American Board of Medical Specialties (ABMS) certification system. For example, providers with a taxonomy code, "Pediatrician, general" were considered a "General Pediatrician," but those with "Infectious disease, pediatric" were considered "Specialist Pediatrician."	IQVIA OneKey Database; National Plan and Provider Enumeration System (NPPES)

	□ Any physician with an ABMS specialty counted towards the total number of physicians for practices and systems using information. □ After mapping physicians to their ABMS category, we grouped physicians into two groups, one representing the type of pediatric training they may have (family medicine, OB-GYN, and medicine-pediatrics) and the other representing the degree to which they may be particularly able to address pediatric behavioral health issues (general psychiatrists, child psychiatrists, general pediatricians, specialist pediatricians). Practices were determined to have a general psychiatrist, child psychiatrist, general pediatrician, or specialist pediatrician if one or more NPIs with that specialty were affiliated with the practice in IQVIA data.	
Practice is a federally qualified health center (FQHC)	Question 5 from the NSHOS survey was used. Practices who answered that they were an FQHC or FQHC look-alike were coded as FQHCs (1). Practices that answered "Not designated as either" or "don't know" were coded as not FQHCs (0). We included "don't know" with the no category because federal payment to FQHCs differs from other practices, so it is implausible that a practice manager for an FQHC or lookalike does not know their practice's FQHCs designation. Those who don't know most likely aren't FQHCs.	National Survey of Healthcare Organizations and Systems (NSHOS)
Share of revenue from Medicaid is in the top quartile across practices	The NSHOS survey asked respondents, "Please give your best estimate about what percentage of your practice's annual patient care revenues come from Medicaid?" (they are also asked about percentage from commercial health insurance, Medicare, self-pay, and other sources (0-100). We split practices into four quartiles based on their responses, with those in the top quartile of Medicaid revenue percentage (25% of respondents reported a Medicaid percentage at or above 25%) coded as 1 and those in the bottom three quartiles	National Survey of Healthcare Organizations and Systems (NSHOS)

	coded as 0. We coded those who answered "Don't know" to this question as not in the top quartile of revenue, because practices who receive a large portion of their revenue from Medicaid are generally aware of it due to Medicaid's relatively low payment rates.	
Practice is located in a rural zip code	We linked the USDA's Rural-Urban Commuting Area Codes to the practice zip code from OneKey. This variable was defined using the primary RUCA code, which is the first digit (excluding what comes after the decimal) of the RUCA code. We defined a practice as rural if it was in an isolated rural, small town, or micropolitan area (RUCA codes 4-10). Metropolitan practices were not rural (RUCA codes 1-3).	IQVIA OneKey, USDA RUCA 2010 Zip Code Crosswalk
Practice participates in CMS' Comprehensive Primary Care+ (CPC+)	CPC+ practices were flagged by identifying practices from the CMS participant list in IQVIA OneKey data as in Fraze et al."Comparison of Populations Served in Hospital Service Areas With and Without Comprehensive Primary Care Plus Medical Homes*," JAMA Network Open*, 2018 1:e182169.	IQVIA OneKey, 2017 Comprehensive Primary Care Plus (CPC+) Participant List from the Centers for Medicaid and Medicare Services
Practice participates in Medicaid ACO contract	This variable is derived from NSHOS question 11, which asks, "Has your practice ever participated in any of these payment and delivery reform initiatives?" Those who answered that they were currently participating in a Medicaid ACO contract (q11g) were coded as 1, and those who participated previously or never were coded as 0. In our sample of 1410 practices, 27 practices that skipped all parts of question 11 (participation in payment and delivery reform initiatives) were presumed to have participated in no alternative payment and coded as 0.	National Survey of Healthcare Organizations and Systems (NSHOS)

Supplemental Appendix 3: Supporting tables to Figure 1 in main manuscript.

Appendix Table 3a: Distribution of Outcome Variable Responses

	Independent	Medical Group	Simple System	Complex System
How difficult to obtain family-based treatment				
Not difficult	16.6%	10.6%	8.8%	10.9%
Slightly difficult	22.9%	26.0%	27.1%	22.3%
Somewhat difficult	38.2%	37.5%	33.8%	38.1%
Very difficult	22.3%	25.8%	30.3%	28.7%
How difficult to obtain evidence-based psychotherapy				
Not difficult	14.9%	16.0%	9.0%	14.9%
Slightly difficult	22.4%	26.4%	27.6%	20.9%
Somewhat difficult	35.4%	34.6%	34.0%	36.6%
Very difficult	27.2%	23.0%	29.4%	27.6%
How difficult to obtain medication advice from a child psychiatrist or psychiatric NP				
Not difficult	16.8%	13.4%	13.4%	15.0%
Slightly difficult	18.5%	20.7%	22.8%	22.1%
Somewhat difficult	34.0%	32.3%	34.3%	33.4%
Very difficult	30.7%	33.6%	29.5%	29.4%

Appendix Table 3b: Supporting table to the Figure[a]

	Point Estimate (SE])	95% CI	Point Estimate (SE)	95% CI	Mean Diff	P Value
Overall						
Medication Advice	85.9 (1.3)	(83.4, 88.4)	NA		NA	
Evidence-based Psychotherapy	86.8 (1.3)	(84.3, 89.3)	NA		NA	
Family-based Treatment	88.5 (1.2)	(86.2, 90.9)	NA		NA	
By ownership structure:	**System[b]**		**Independent**			
Medication Advice	88.6 (2.4)	(83.9, 93.3)	77.6 (5.9)	(66.1, 89.2)	+10.0	.220
Evidence-based Psychotherapy	88.2 (1.4)	(85.4, 91.1)	83.5 (3.2)	(77.4, 89.7)	+4.7	.600
Family-based Treatment	91.4 (2.2)	(87.1, 95.8)	80.0 (5.7)	(68.8, 91.2)	+11.4	.115
By participation in Medicaid ACO contract:	**Participated**		**Did not participate**			
Medication Assistance	80.5 (2.8)	(75.0, 85.9)	89.3 (1.9)	(85.6, 93.0)	-8.8	.021
Evidence-based Psychotherapy	81.0 (2.5)	(76.0, 85.9)	90.4 (1.8)	(87.0, 93.9)	-9.4	.006
Family-based Treatment	85.1 (2.4)	(80.4, 89.9)	90.6 (1.8)	(87.2, 94.1)	-5.5	.107

[a]Estimates based on those presented in Table 2 in the main paper. SE=Standard Error. CI=Confidence Interval.

[b] The "System" point estimates and 95% CI are based on model estimates for medical groups, simple systems and complex systems reported in Table 2. They represent the weighted average of point estimates, lower 95% CI and upper 95% CI. The p-value comparing System to Independent practices is taken from statistical tests for joint significance of the coefficients on medical group, simple system, and complex system (relative to independent practices) from the models estimated and displayed in Table 2 in the main text.

In the main text, Table 2 reflects models that account for the hierarchical nature of our survey data, in which all but independent practices are nested within a parent organization (medical group, simple system, complex system). The generalized linear models account for the correlation of practices within systems, and they employ multi-level survey weights (practice and system-level) to account for probability of selection and non-response. In this linear probability model set-up, the estimated coefficients are intuitive; they yield the difference in share of practices (presented as difference in percent of practices) reporting difficulty obtaining care for children with behavioral health needs comparing each characteristic (e.g. participates in Medicaid ACO contract) to a reference group (e.g. did not participate in Medicaid ACO contract). An alternative presentation of the data, using an estimator suited to binary outcome variables, logistic regression, but which is missing other features of estimation is presented below (Appendix Table E). For this alternative, we estimated logistic regression of each

outcome using the same independent variables as in Table 2, and we reported odds-ratios from this estimation. In this set up, we cannot fully account for the hierarchical nature of the data (and two levels of weights at practice and system level) because models estimated in STATA 16.1 using the MELOGIT procedure, analogous to our MEGLM procedure used to produce results in Table 2, do not converge. Instead, we estimated logistic regression, clustering at the system level (using Huber-White sandwich variance estimators), and a single weight (which multiplies the practice weight by the system weight in practices that are system-owned (i.e. medical group, simple system, or complex system practices). We present these results for the interested reader in Appendix Table E. Some p-values change, but the direction of findings in Table 2 are similar.

Appendix Table 3c: Adjusted odds-ratios from logistic regression models, compared with referent in difficulty obtaining pediatric behavioral health advice and services

	Odds-Ratios Difficulty Obtaining:					
	Medication Advice		Evidence-Based Psychotherapy		Family-Based Treatment	
	Odds Ratio	*SE*	*Odds Ratio*	*SE*	*Odds Ratio*	*SE*
Practice Ownership Structure[a], Independent as referent						
Medical Group	1.88	0.65	1.02	0.35	1.49	0.52
Simple System	1.30	0.51	1.68	0.76	1.89	0.73
Complex System	1.26	0.42	1.01	0.31	1.31	0.48
Practice Size[b], Very small (<4) as referent						
Small (4-9)	0.90	0.28	0.81	0.26	1.25	0.43
Medium (10-19)	1.74	0.71	1.12	0.42	2.13	1.00
Large (20+)	0.78	0.33	0.66	0.31	1.68	1.32
Practice has behavioral health expertise						
General psychiatrist	1.12	0.49	1.03	0.44	1.14	0.56
Child psychiatrist	0.18**	0.12	0.27	0.19	0.08**	0.06
General pediatrician	0.67	0.19	0.89	0.35	1.36	0.49
Specialist pediatrician	0.67	0.28	0.83	0.36	0.41	0.21

Practice is oriented towards socially-vulnerable populations						
Is a federally qualified health center	0.82	0.23	0.85	0.26	1.16	0.44
Share of revenue from Medicaid is in the top quartile across practices	1.72	0.53	1.61	0.48	0.81	0.33
Practice is in a rural zip code	2.28**	0.87	1.69	0.61	1.13	0.47
Practice participation in delivery and payment reforms expected to influence pediatric behavioral health care						
CMS Comprehensive Primary Care+	1.30	0.57	0.99	0.45	0.66	0.33
Medicaid ACO	0.81	0.20	0.82	0.21	0.94	0.30
Practices, N[c]	1,410		1,410		1,410	
Systems, N	944		944		944	

Abbreviations: SE: standard error. * p-value < .05; ** p-value <.01

Odds ratios presented are based on multivariate logistic regressions adjusting for each variable shown in this table. Models also included an indicator for state of practice location. Models were weighted using a single weight to account for sampling probability and non-response. To account for correlation of practices within systems (i.e. in this stratified sample structure, we sampled systems and, within systems, practices), we adjusted variance estimates for clustering at the system level (medical group, simple system, or complex system) using Huber-White sandwich estimators.

Annotation: [a] Ownership structures: Independent practice - does not have any ownership relationships beyond the practice itself; medical group practice – is owned by an organization that owns other practices but no hospital. Simple system practices are owned by an organization that owns other practices and at least one hospital; complex system practices are owned by an organization that owns a medical group or another system (i.e., a system within a system); complex systems include practices and at least one hospital.

[b] Practice size is defined based on number of physicians.

[c] In these logistic regressions, the “effective N”, or the observations contributing to estimates is lower than 1,410 because some control variables (i.e. state indicators) perfectly predicted success, leading some observations to be dropped from estimation. The effective Ns were 1392, 1369, and 1324 for medication advice, evidence-based psychotherapy, and family-based treatment, respectively.