

# Service Delivery Indicators

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CROSS-COUNTRY COMPARISON OF MEDICAL KNOWLEDGE

GUINEA BISSAU, KENYA, UGANDA, MADAGASCAR, MALAWI,  
MOZAMBIQUE, NIGER, NIGERIA, SIERRA LEONE, TANZANIA, TOGO

# Facility Demography Summary

Facilities were selected in each country to provide a representative assessment of service delivery quality in public and private facilities located in rural and urban areas.

Facilities in the different countries were grouped into a common set of categories. Health posts were considered the lowest tier of health facility available, often staffed by a single individual and are without in-patient services. Health centers are larger, serving a greater population, but lack surgical services. Finally, hospitals are the top level of the health care system, typically able to provide all services an individual would seek.

	Urban vs. Rural		Private vs. Public		Facility Level			Total Facilities
	Urban	Rural	Private	Public	Hospital	Health Center	Health Post	
Guinea Bissau	48(37%)	82(63%)	1(1%)	129(99%)	6(5%)	124(95%)	0(0%)	130
Kenya 2012	86(30%)	200(70%)	128(45%)	157(55%)	51(18%)	139(49%)	96(34%)	286
Kenya 2018	789(26%)	2249(74%)	1276(42%)	1762(58%)	285(9%)	594(20%)	2159(71%)	3038
Madagascar	226(51%)	218(49%)	155(35%)	289(65%)	37(8%)	316(71%)	91(20%)	444
Mozambique	23(12%)	172(88%)	2(1%)	193(99%)	38(19%)	9(5%)	148(76%)	195
Malawi	342(31%)	749(69%)	525(48%)	566(52%)	100(9%)	838(77%)	153(14%)	1091
Niger	63(25%)	192(75%)	35(14%)	220(86%)	16(6%)	67(26%)	172(67%)	255
Nigeria	385(21%)	1435(79%)	182(8%)	2203(92%)	411(17%)	1458(61%)	516(22%)	2385
Sierra Leone	159(30%)	377(70%)	43(8%)	493(92%)	30(6%)	109(20%)	397(74%)	536
Togo	54(30%)	126(70%)	37(21%)	143(79%)	16(9%)	46(26%)	118(66%)	180
Tanzania 2014	115(34%)	219(66%)	119(31%)	261(69%)	27(7%)	83(22%)	270(71%)	380
Tanzania 2016	123(36%)	222(64%)	117(31%)	266(69%)	30(8%)	91(24%)	262(68%)	383
Uganda	91(24%)	285(76%)	158(40%)	236(60%)	9(2%)	133(34%)	252(64%)	394

Certain facilities contained missing data for the above categories

# Provider Demography Summary

Multiple providers were selected within a particular facility to complete the vignette module of the SDI survey. If the facility only had a single provider, that provider completed the module. Across the entire sample, 3 providers were surveyed from each facility, on average.

	Urban vs. Rural		Private vs. Public		Facility Level			Total Providers
	Urban	Rural	Private	Public	Hospital	Health Center	Health Post	
Guinea Bissau	48(37%)	82(63%)	1(1%)	129(99%)	6(5%)	124(95%)	0(0%)	130
Kenya 2012	1338(43%)	1800(57%)	1121(36%)	2012(64%)	1389(44%)	1314(42%)	435(14%)	3138
Kenya 2018	10247(42%)	14157(58%)	8692(36%)	15712(64%)	10381(43%)	5971(24%)	8052(33%)	24404
Madagascar	1697(77%)	503(23%)	968(44%)	1232(56%)	517(24%)	1522(69%)	161(7%)	2200
Mozambique	623(21%)	2349(79%)	57(2%)	2915(98%)	1733(58%)	186(6%)	1053(35%)	2972
Malawi	4191(32%)	9084(68%)	4716(36%)	8559(64%)	3769(28%)	8784(66%)	722(5%)	13275
Niger	1010(76%)	321(24%)	153(11%)	1178(89%)	606(46%)	416(31%)	309(23%)	1331
Nigeria	5689(39%)	8956(61%)	1535(7%)	19783(93%)	9463(44%)	10654(50%)	1201(6%)	21318
Sierra Leone	3050(60%)	2005(40%)	590(12%)	4465(88%)	1706(34%)	1190(24%)	2159(43%)	5055
Togo	746(55%)	618(45%)	326(24%)	1038(76%)	360(26%)	564(41%)	440(32%)	1364
Tanzania 2014	2456(63%)	1446(37%)	1789(40%)	2670(60%)	1215(27%)	1701(38%)	1543(35%)	4459
Tanzania 2016	2751(60%)	1819(40%)	2035(39%)	3125(61%)	1244(24%)	2216(43%)	1700(33%)	5160
Uganda	631(29%)	1556(71%)	842(36%)	1505(64%)	114(5%)	1359(58%)	874(37%)	2347

Certain providers contained missing data for the above categories

# Vignettes: Description

The enumerator delivers the initial script and providers are asked to proceed as though the actor were a real patient.

Gives pre-scripted:

- 1) Answers to history questions
- 2) Descriptions of what the provider would observe for a given physical exam
- 3) Results of a medical tests

Providers are then asked to make a diagnosis and may offer treatment recommendations but are not required to.

	Script	Treatment
<b>Acute diarrhea w/ dehydration</b>	"I am a mother of a 13 month old boy. His name is Noel. My son has diarrhea."	IV fluid rehydration, nasogastric tube rehydration, ORS rehydration, ORS education, zinc.
<b>Pneumonia</b>	"I am the mother of this 5 year old girl. Her name is Sia. She has a cough."	Amoxicillin (or dosage), a first-line antibiotic, and any anti-pyretic.
<b>Diabetes (Type II)</b>	"My name is Jack. I am worried that something is wrong with me. I feel weak and without energy even though I feel hungry often and eat frequently. I am 48 years old and work as a clerk."	Oral hypoglycemic, insulin when oral hypoglycemic are ineffective, referral to specialized clinic, referral to other clinic.
<b>Tuberculosis</b>	"My name is Bakari. I am 40 years old and I have been suffering from a fever and cough for some time."	Sputum test, chest x-ray, combination therapy (or dosage, drug names, and timing), referral to TB clinic.
<b>Malaria + Anemia</b>	"I am the mother of this 4-year old boy. His name is Saneti. He has had a fever for some time. Now he is worse, so I have come to you for help."	Artemether-lumefantrine (or dosage), artemisinin combination therapy, chloroquine, paracetamol, and iron.
<b>Post-Partum Hemorrhage</b>	"My name is Fatuma. I am 26 years old and I have vaginal bleeding 24 hours after delivery in a health facility."	Any uterotonic, an IV line, foley catheter, bimanual uterine massage.
<b>Neonatal Asphyxia</b>	"A mother gives birth to a baby. The newborn is not crying. The newborn fails to establish regular breathing and appears pale and slightly blue. What do you do?"	Call for help, dry baby, keep baby warm, check to see if baby is breathing, place baby in a natural position, initiate resuscitation with bag/mask, and check heartrate.

# History and Examinations

The “patient” comes in presenting with some symptoms. The doctor can ask history questions and request examinations. For everything they ask, they are given a standardized answer.

Module 3: Case Simulations		
Section G: Case Study Patient 5 <sup>12</sup>		
Case study patient [enumerator reads]		
Good morning (afternoon) doctor. I am the mother of this 4-year-old boy. His name is Sangeti. He has had a fever now for some time. Now he is worse, so I have come to you for help.		
[All other information is provided only if the clinician asks!]		
	Question Asked	Enumerator Response
<b>History Taking</b>		
1.	Duration of fever	One week
2.	Pattern of fever/Presence or history of fever	Some days fine, some days very sick
3.	Shiver or sweat	Yes
4.	Convulsions	No
5.	Vomiting	Yes, sometimes
6.	Appetite	He eats, but not as much as usual, and sometimes he will vomit
7.	Diarrhoea	No
8.	Cough	Yes
9.	Severity of cough	Not severe
10.	Difficulty in breathing	No difficulty in breathing
11.	Type of cough (productive or dry)	The cough is dry
12.	Type of medication given	I started to give him Paracetamol
13.	Amount	One dose two days ago, one yesterday and one this morning
14.	Vaccinations	He has taken all vaccinations.
<b>Physical Examination</b>		
15.	Hands (palmar pallor)	The nail beds are pale
16.	Tongue	The tongue is pale
17.	Eyes, sunken?	The eyes are not sunken
18.	Eyes, pale colour?	The eyes are pale
19.	Responsiveness / general condition	He is awake but lethargic
20.	Skin condition	The skin is normal
21.	Temperature	Temperature is 37.6 degrees (Celsius)
22.	Pulse	Pulse is 95 per minute
23.	Neck stiffness	Neck is not stiff
24.	Puffy face	Face is not puffy
Yes = 1 No = 2	Notes/other questions	

# Diagnostic and treatment knowledge

When the provider is done with examinations, they are then asked for treatment options, including:

1. Diagnosis
2. Treatment
3. Inappropriate Antibiotics
4. Laboratory Tests

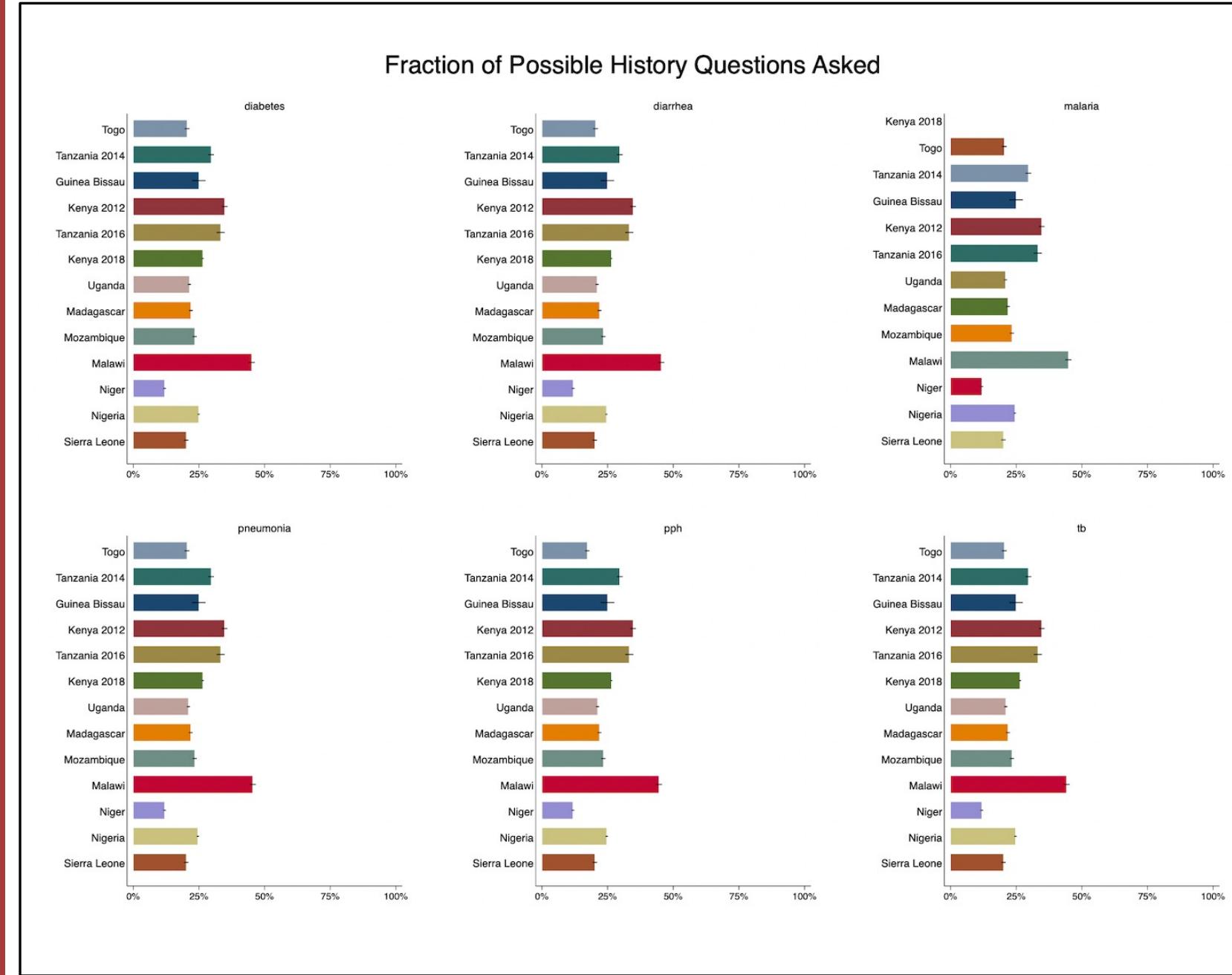
One data improvement here would be to record all meds and tests, unlike in the current vignette structure.

Module 3: Clinical Knowledge Assessment			
Section L: Case Study Patient 2 <sup>2</sup>			
Case study patient [enumerator reads]			
Good morning (afternoon) doctor. I am the mother of this 5 year old girl. Her name is Sia. She has a cough.			
[All other information is provided only if the clinician asks!]			
	Question Asked	Enumerator Response	Yes = 1 No = 2
<b>Tests</b>			
What kind of tests would you administer?			
Q 207.	Chest X-ray	<input type="checkbox"/>	<input type="checkbox"/>
Q 208.	Haemogram	<input type="checkbox"/>	<input type="checkbox"/>
Q 209.	BS for MPS	<input type="checkbox"/>	<input type="checkbox"/>
<b>Diagnosis</b>			
Observer: It will take some time to get the results. Please make a preliminary diagnosis			
Q 210.	Pneumonia	<input type="checkbox"/>	<input type="checkbox"/>
<b>Treatment</b>			
Q 211.	Treat as out-patient.	<input type="checkbox"/>	<input type="checkbox"/>
Q 212a.	Amoxycillin	<input type="checkbox"/>	<input type="checkbox"/>
Q 212b.	Amoxycillin Dosage 250mg three times a day	<input type="checkbox"/>	<input type="checkbox"/>
Q 213a.	Give Antipyretics e.g. paracetamol	<input type="checkbox"/>	<input type="checkbox"/>
Q 213b.	Paracetamol dose 15 mls three times a day	<input type="checkbox"/>	<input type="checkbox"/>
Q 214.	Or ask parent to bring child every day for Benzyl Penicillin G injection	<input type="checkbox"/>	<input type="checkbox"/>
<b>Health Education</b>			
Q 215.	Instruct parent on how to administer antibiotics for 5 days.	<input type="checkbox"/>	<input type="checkbox"/>
Q 216.	Guidance on how to feed.	<input type="checkbox"/>	<input type="checkbox"/>
Q 217.	Increase fluid intake.	<input type="checkbox"/>	<input type="checkbox"/>
Q 218.	Instruct parent to return anytime in case the child worsens (or has any danger signs persisting fever, difficulty in breathing, poor feeding convulsions or new symptoms)	<input type="checkbox"/>	<input type="checkbox"/>
OBSERVER says clinician: Thank you very much! This also went very well. Let us now continue with the third patient case.[Make the clinician relax. If necessary, repeat that everything should be just like normal.]			

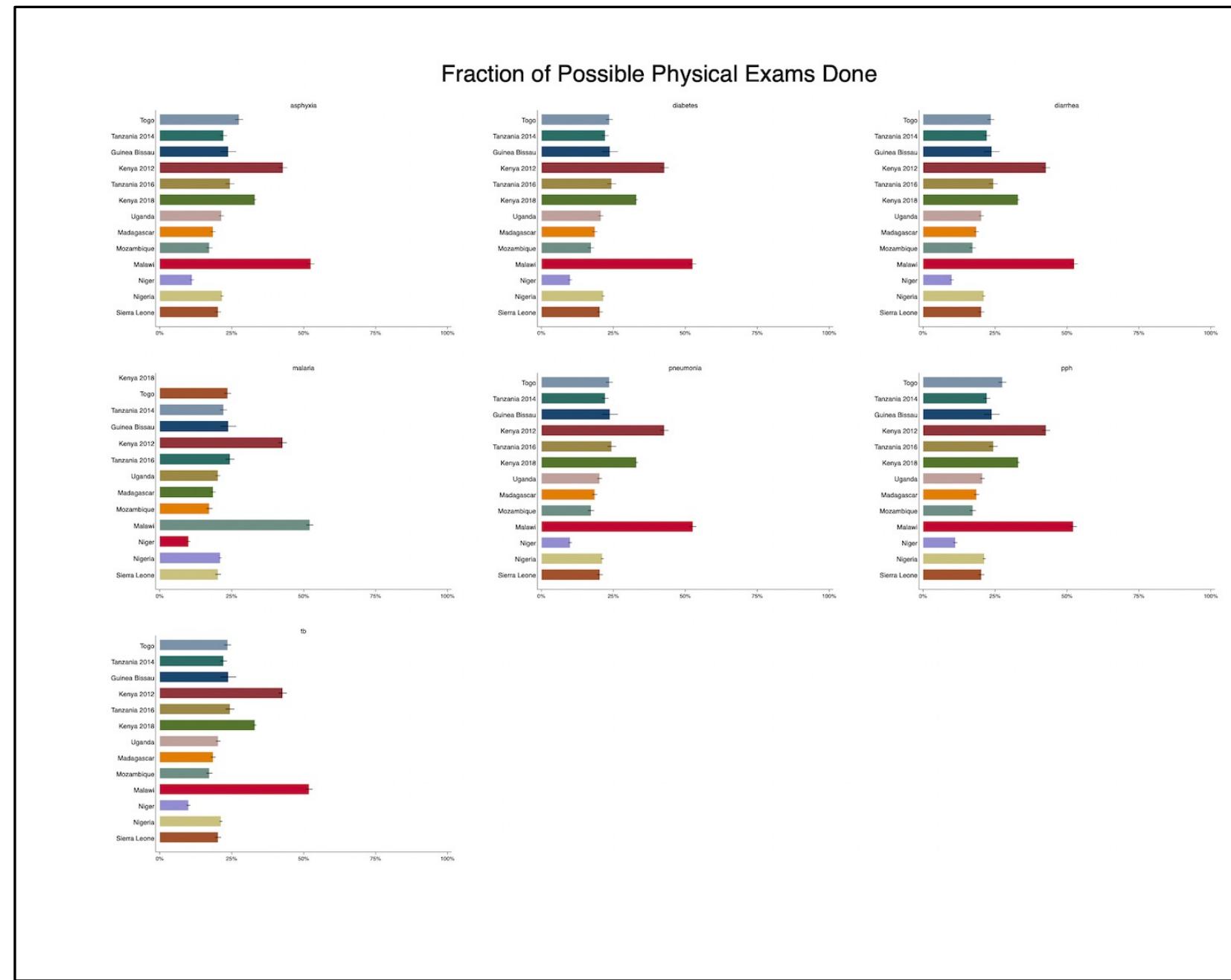
# Comparing Across Vignettes: History Questions

These numbers seem low but remember that they are driven by the denominator. A provider doesn't necessarily have to ask a lot of questions to get the diagnosis right.

We will use a statistical normalization method to put these in more context later in this presentation.



# Comparing Across Vignettes: Physical Exams



# Correct treatment: definitions

There is a fair amount of difference across settings in treatment options.

For this analysis, we graded treatment the same way for all providers using the *less strict* definition of accurate treatment listed here.

The post-partum hemorrhage and neonatal asphyxia vignettes require a management protocol are were not evaluated as “correct”.

	Strict Definition	Less Strict Definition
<b>Diarrhea</b>	Either: <ul style="list-style-type: none"><li>• IV fluid rehydration</li><li>• nasogastric tube rehydration</li><li>• ORS rehydration</li><li>• zinc</li></ul>	Either: <ul style="list-style-type: none"><li>• ORS plus zinc</li></ul>
<b>Pneumonia</b>	Only: <ul style="list-style-type: none"><li>• amoxicillin (or dosage)</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• first-line antibiotic</li><li>• any anti-pyretic</li></ul>
<b>Diabetes</b>	Either: <ul style="list-style-type: none"><li>• oral hypoglycemic</li><li>• insulin when oral hypoglycemic is ineffective</li><li>• referral to specialized clinic</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• referral to another clinician in same facility</li></ul>
<b>Malaria</b>	Either: <ul style="list-style-type: none"><li>• artemether-lumefantrine (or dosage)</li><li>• artemisinin combination therapy</li><li>• chloroquine</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• paracetamol</li><li>• iron</li></ul>
<b>Tuberculosis</b>	Either: <ul style="list-style-type: none"><li>• sputum test</li><li>• chest x-ray</li><li>• combination therapy (or dosage, drug names, and timing)</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• referral to TB clinic</li></ul>
<b>Post-Partum Hemorrhage</b>	Either: <ul style="list-style-type: none"><li>• determine cause</li><li>• any uterotonic</li><li>• an IV line</li><li>• foley catheter</li><li>• bimanual uterine massage</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• oxytocin</li><li>• another uterotonic drug</li><li>• misoprostol</li><li>• ergometrine</li><li>• prostaglandin</li></ul>
<b>Neonatal Asphyxia</b>	Either: <ul style="list-style-type: none"><li>• Cry for help</li><li>• Dry baby</li><li>• Keep baby warm</li><li>• Check if baby is breathing</li><li>• Place baby in natural position</li><li>• Initiate resuscitation with bag/mask</li><li>• Check heartrate</li></ul>	Also allow for: <ul style="list-style-type: none"><li>• At least half of the 7 options in the strict definition</li></ul>

# Coding “Accurate Diagnosis”

In certain survey instruments, there was only a single item listed for diagnosis. However, in other survey instruments, there were multiple items listed. Given these inconsistencies, the following guidelines are used to create a common definition of “correct diagnosis” among the different countries.

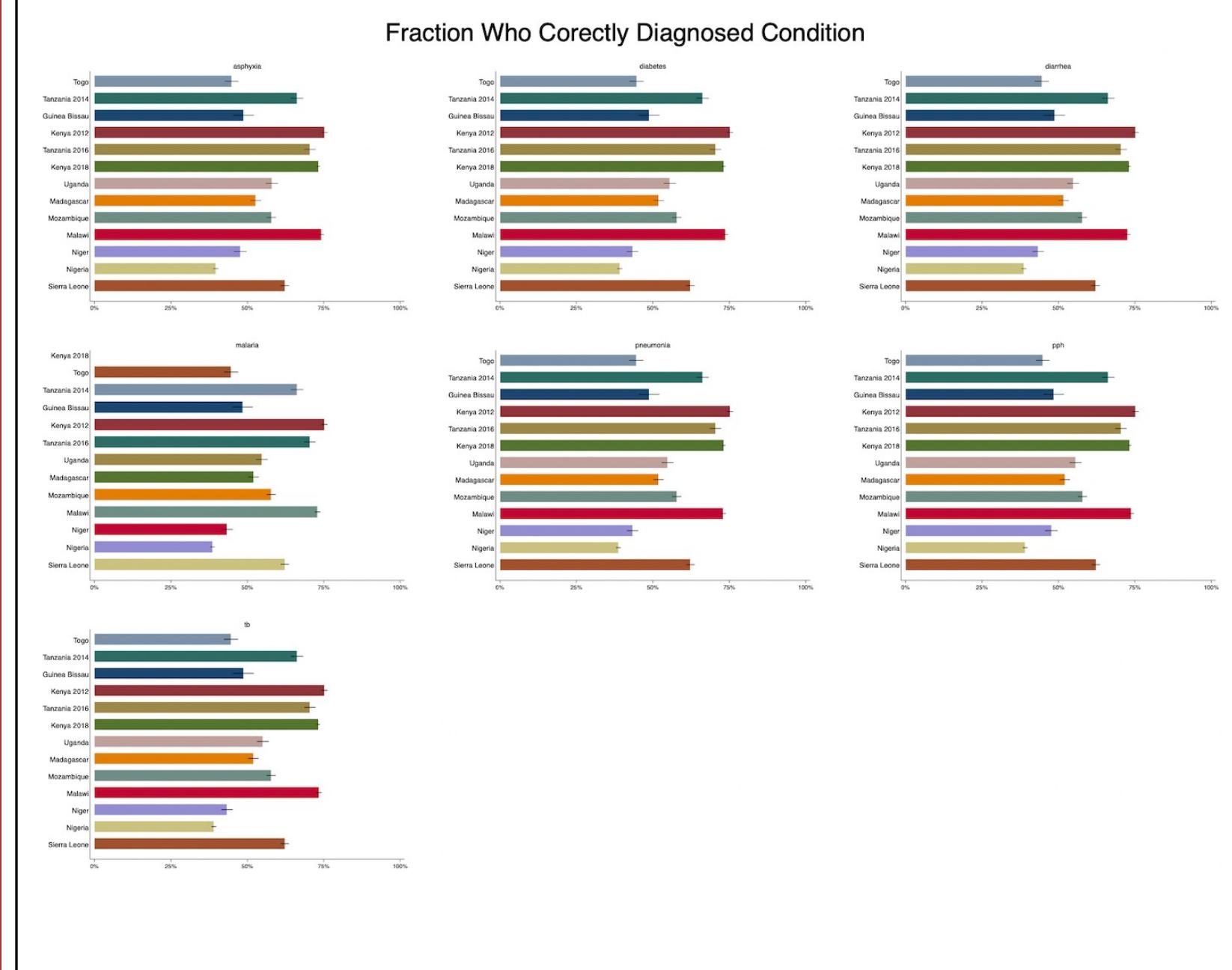
For the analysis, the less strict definition of “correct diagnosis” was used.

	<b>Strict Definition</b>	<b>Less Strict Definition</b>
<b>Diarrhea</b>	Either: <ul style="list-style-type: none"><li>• “acute diarrhea with severe dehydration”</li><li>• “acute diarrhea” and “severe dehydration”</li></ul>	Either: <ul style="list-style-type: none"><li>• “acute diarrhea with severe dehydration”</li><li>• “acute diarrhea”, “moderate dehydration”, and “severe dehydration”</li><li>• “acute diarrhea”</li></ul>
<b>Pneumonia</b>	Only: <ul style="list-style-type: none"><li>• “pneumonia”</li></ul>	n/a
<b>Diabetes</b>	Only: <ul style="list-style-type: none"><li>• “diabetes (type II)”</li></ul>	Either: <ul style="list-style-type: none"><li>• “diabetes (type II)”</li><li>• “diabetes”</li></ul>
<b>Tuberculosis</b>	Only: <ul style="list-style-type: none"><li>• “tuberculosis”</li></ul>	n/a
<b>Malaria</b>	Either: <ul style="list-style-type: none"><li>• “malaria with anemia”</li><li>• “malaria” and “anemia”</li></ul>	Either: <ul style="list-style-type: none"><li>• “malaria with anemia”</li><li>• “malaria” and “anemia”</li><li>• “malaria”</li><li>• “simple malaria”</li></ul>
<b>Post-Partum Hemorrhage</b>	Only: <ul style="list-style-type: none"><li>• “post-partum hemorrhage”</li></ul>	n/a
<b>Neonatal Asphyxia</b>	Only: <ul style="list-style-type: none"><li>• “neonatal asphyxia”</li></ul>	Either: <ul style="list-style-type: none"><li>• “neonatal asphyxia”</li><li>• “respiratory distress”</li></ul>

# Comparing Across Vignettes: Correct Diagnoses

This question measures whether the provider correctly named the condition.

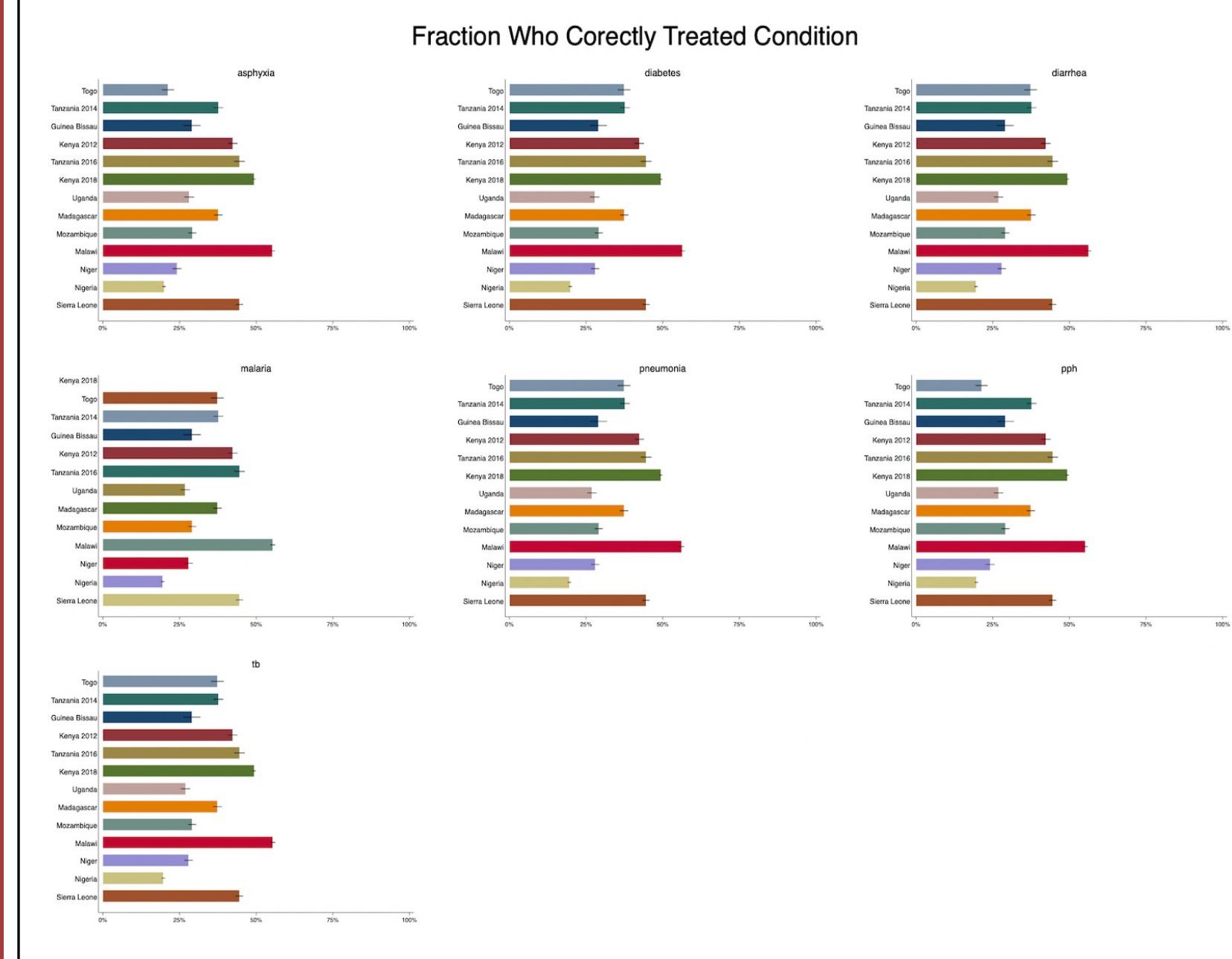
Similarly, there are often cultural differences in whether providers name medical conditions explicitly to patients (or whether they use specific terminology).



# Comparing Across Vignettes: Correct treatment

Providers across the different countries are equally proficient at treating diarrhea, malaria, and tuberculosis.

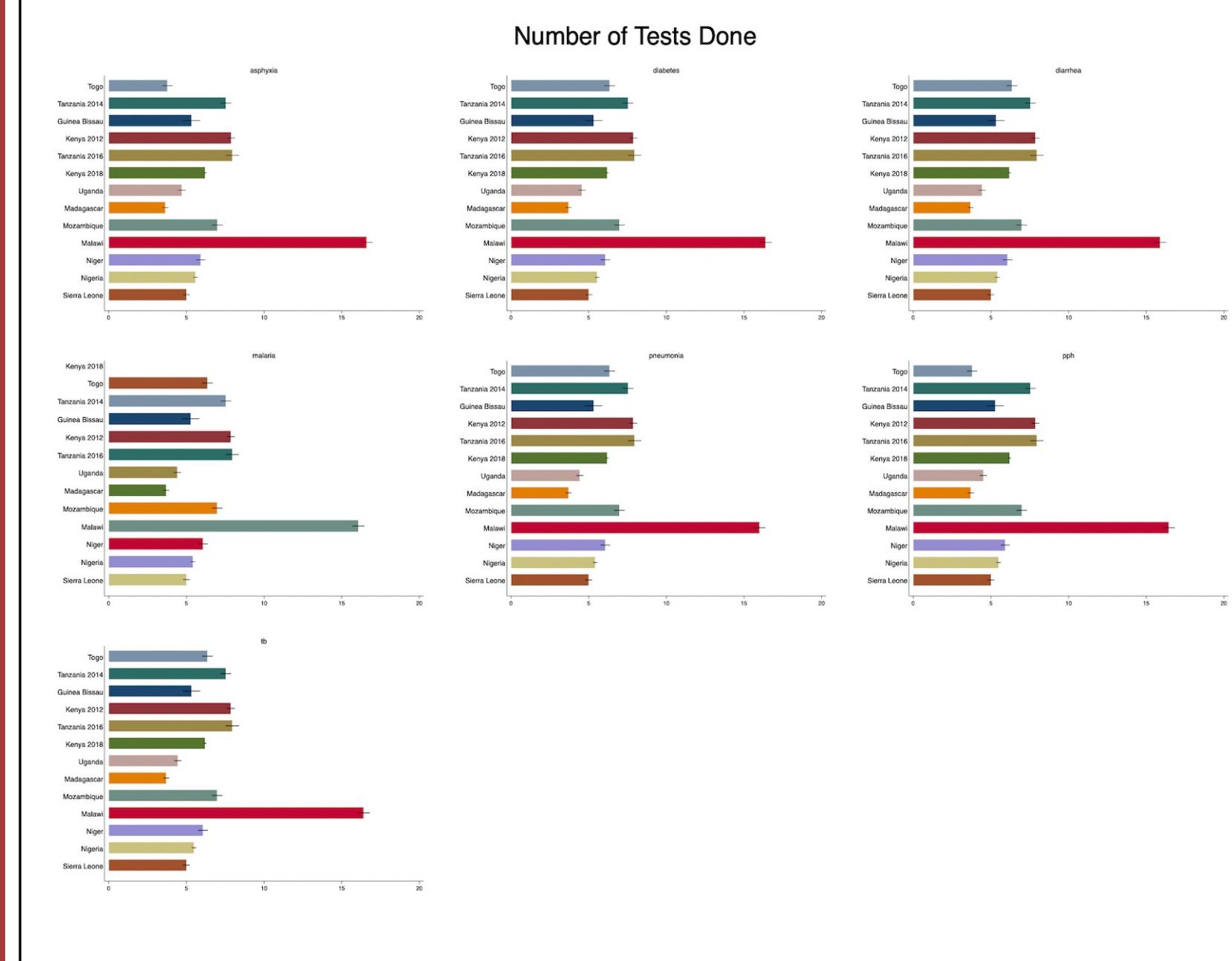
Providers in Nigeria were slightly worse, *on average*, with regard to prescribing the appropriate treatment for most of the vignettes.



# Comparing Across Vignettes: Tests

In general, most tests are ordered for diabetes, malaria, and tuberculosis; but again this is partly due to the data sheet structure. (And testing is appropriate in these cases.)

While varying in the number of tests prescribed for each vignette, providers in Malawi.



# Using psychometrics to “score” vignettes and assess treatment variations

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1. Create a diagnostic score for every provider based on history questions and exams. This score only relates providers to each other, and doesn’t say anything about “absolute” knowledge.
2. Assess management outcomes directly: we look at diagnosis, treatment, testing, and medicine separately *as they relate to the abstract score*.
3. If those relationships are statistically strong, then we can use variations in the diagnostic score to think about policy-relevant differences between countries, professional cadres, care levels, etc.

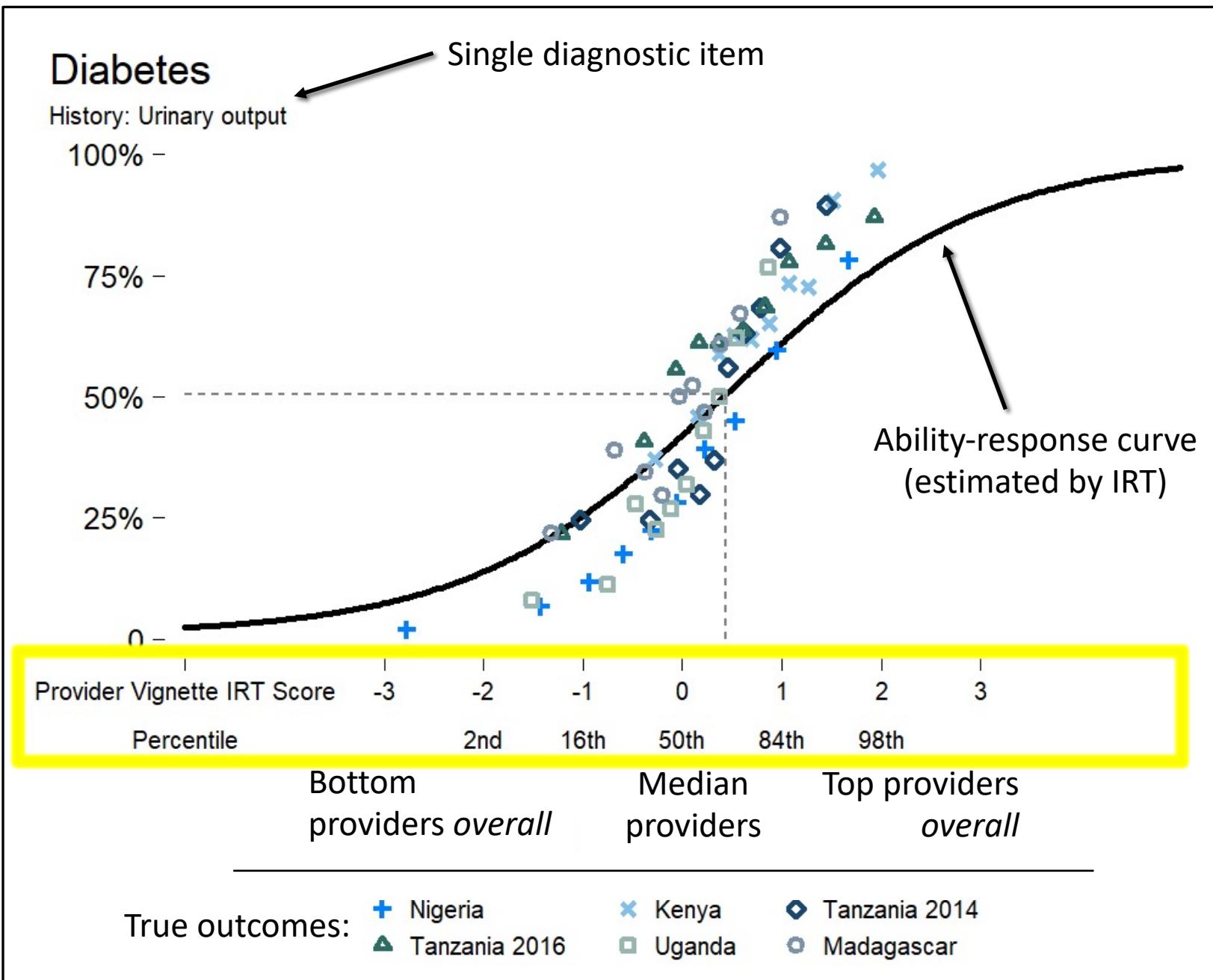
# How do we read an IRT score?

This is an example *item response curve* from the SDI data. Each provider is given a single overall score (X-axis).

For every item, that score predicts how likely that provider was to complete that item (response curve). The distribution is approximately standard normal, so:

Average provider score = 0

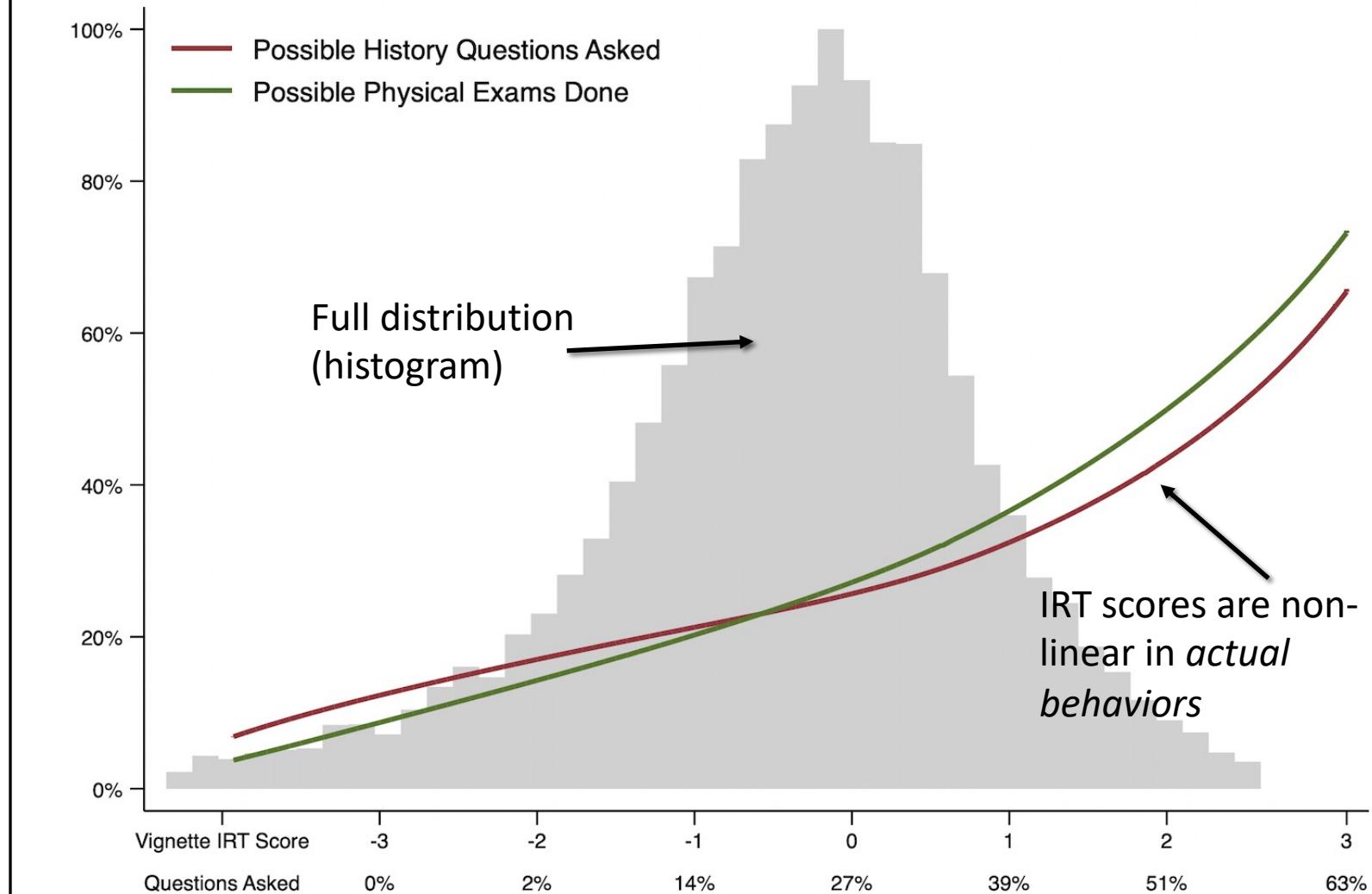
IQR is -0.68 to +0.68



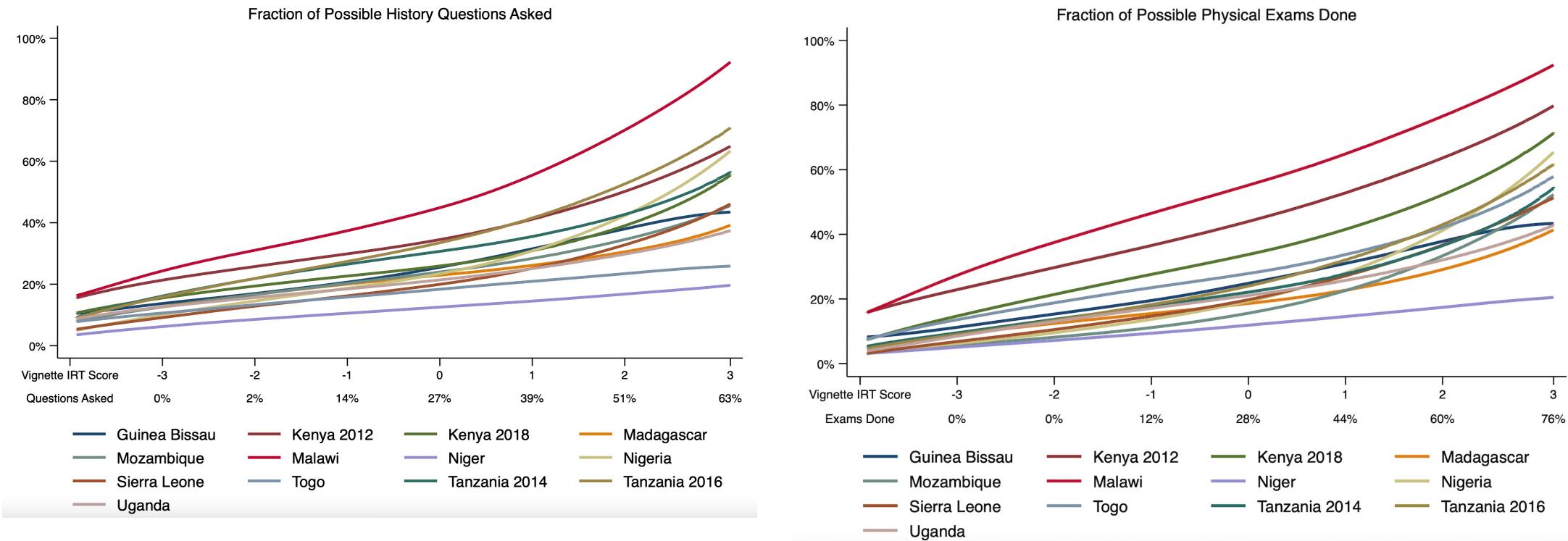
# What does the score distribution look like?

For the rest of the presentation, we will reference overall scores instead of individual items. This chart summarizes how performance measures varied across the score distribution in all SDI data when analyzed by IRT.

The box plot shows the 5<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 95<sup>th</sup> percentiles for reference. As you can see, this is again a dataset with a “long tail” at the bottom of the distribution.



# Benchmarking IRT vignettes scores



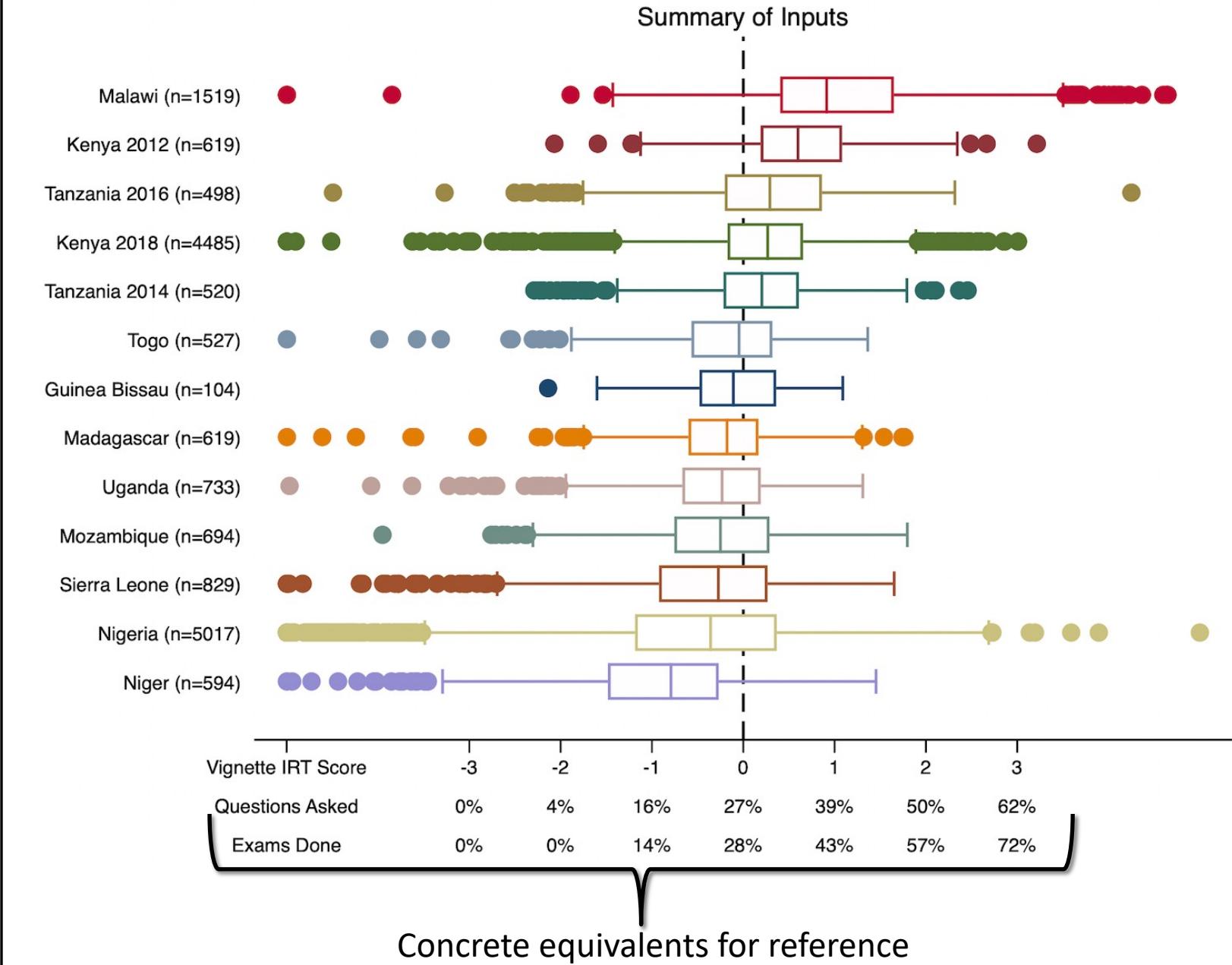
The key point to note is that this *strongly validates* the use of IRT as a summary index for SDI. All countries fall on about the same curve relating IRT score to the actual proportion of history questions and physical exams they completed.

# Cross-country Ability Score Distributions

Providers at the 50<sup>th</sup> percentile of the overall distribution only ask and do about 25% of the history questions and physical exams. Those at the 95<sup>th</sup> percentile ask and do 50% of the possible history questions and physical exams.

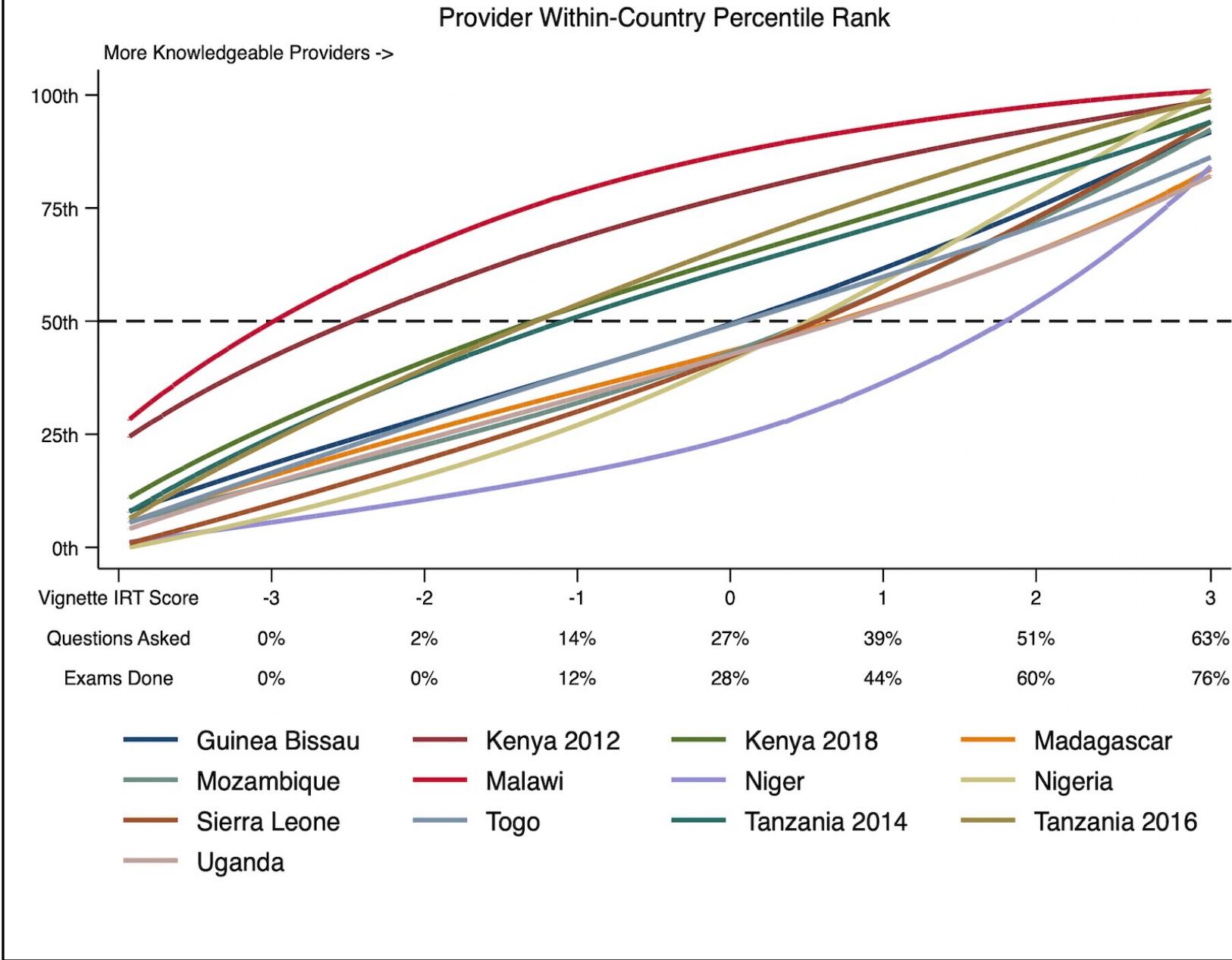
Key distributional questions:

1. Is a country with many low-knowledge providers “bad”, if it also has many high-knowledge providers? (see Nigeria)
2. How informative is “average” in that case?



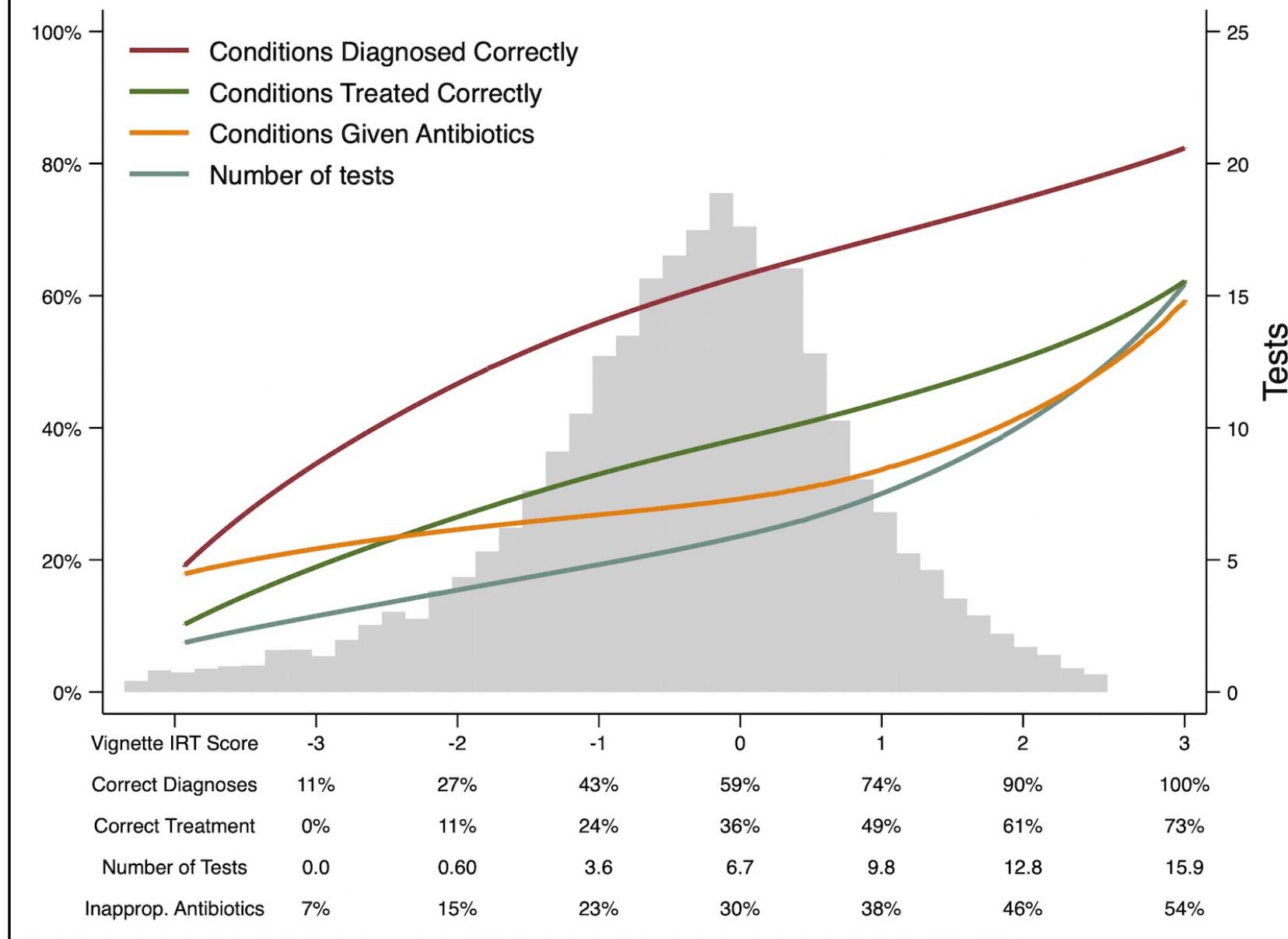
# Within-country Ability Score Distributions

This graph answers the question: How knowledgeable is the 50<sup>th</sup>-percentile provider in each country? The 95<sup>th</sup>?



# IRT Scores predict correct management – *and unnecessary management.*

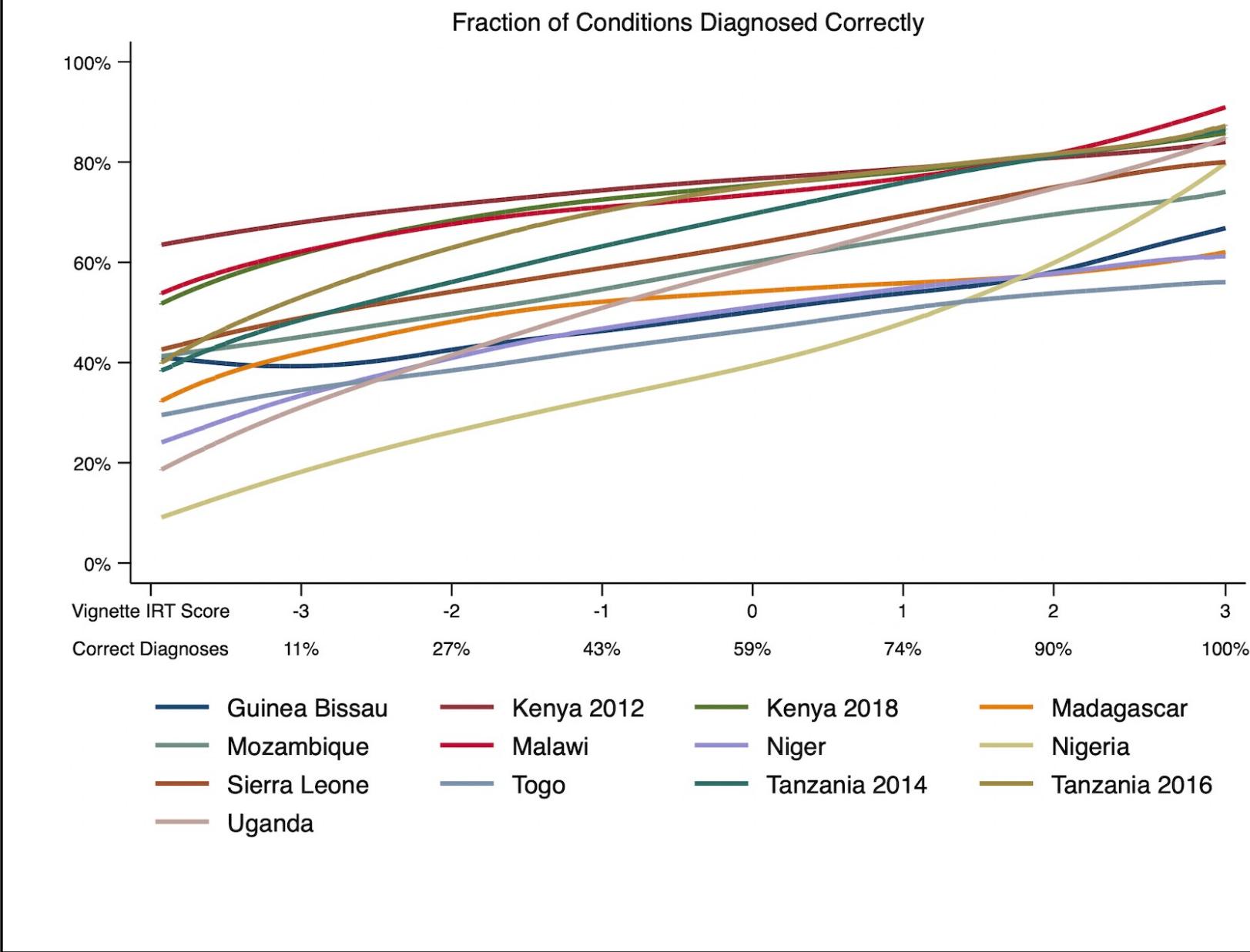
The IRT score is a good predictor of diagnostic and treatment accuracy. It is also a good predictor of the number of tests ordered by a provider, and the number of unnecessary antibiotics provided across the vignettes.



# IRT is a predictor of *diagnosis* across countries.

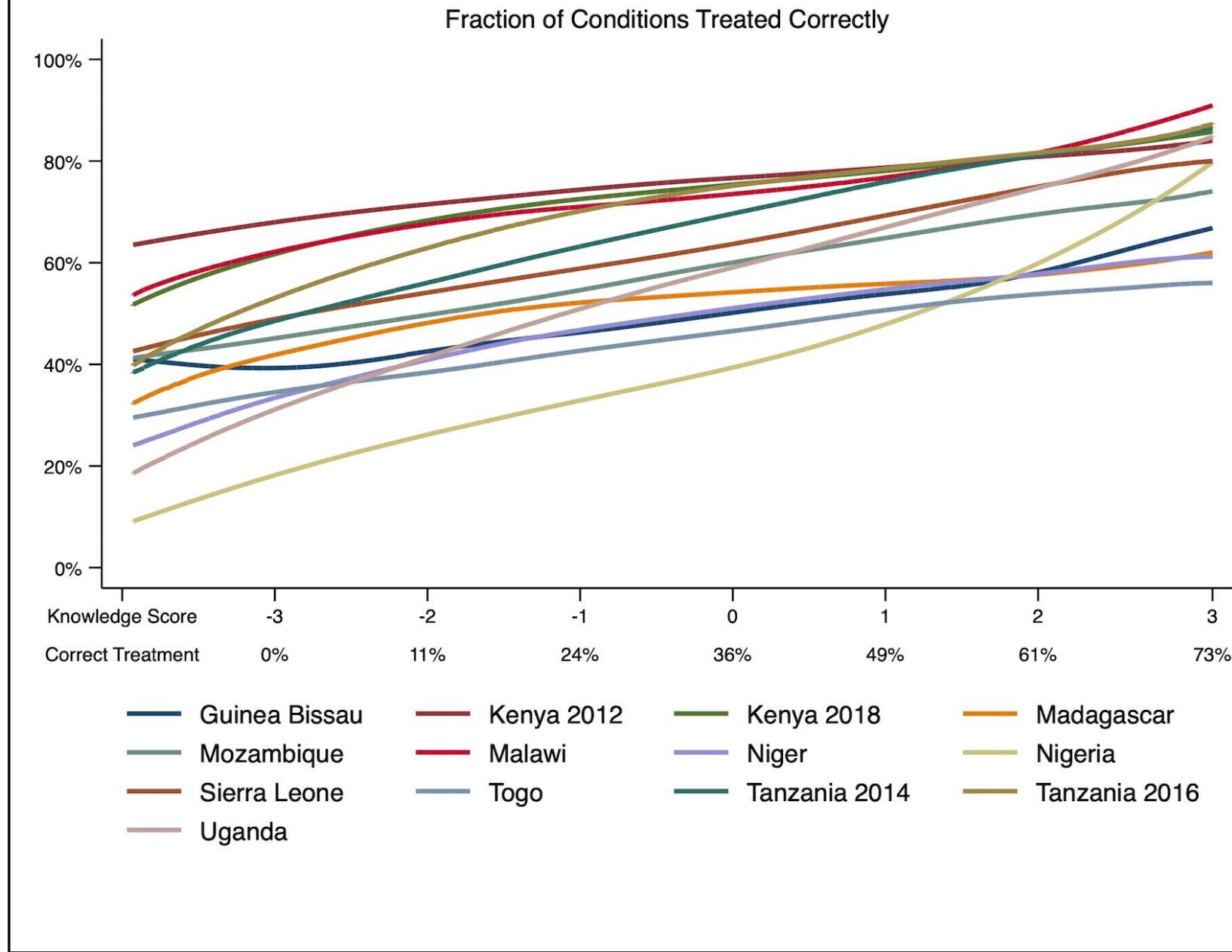
In Kenya 2012, all providers can accurately diagnose at least 60% of the conditions.

In the other countries, the worst providers range from being able to diagnose 10% of the conditions in Nigeria to 50% of the conditions in Tanzania and Malawi.



# IRT is a predictor of *treatment* across countries.

Providers in Uganda and Nigeria, fair the worst when it comes to correctly treating the given diagnostic.

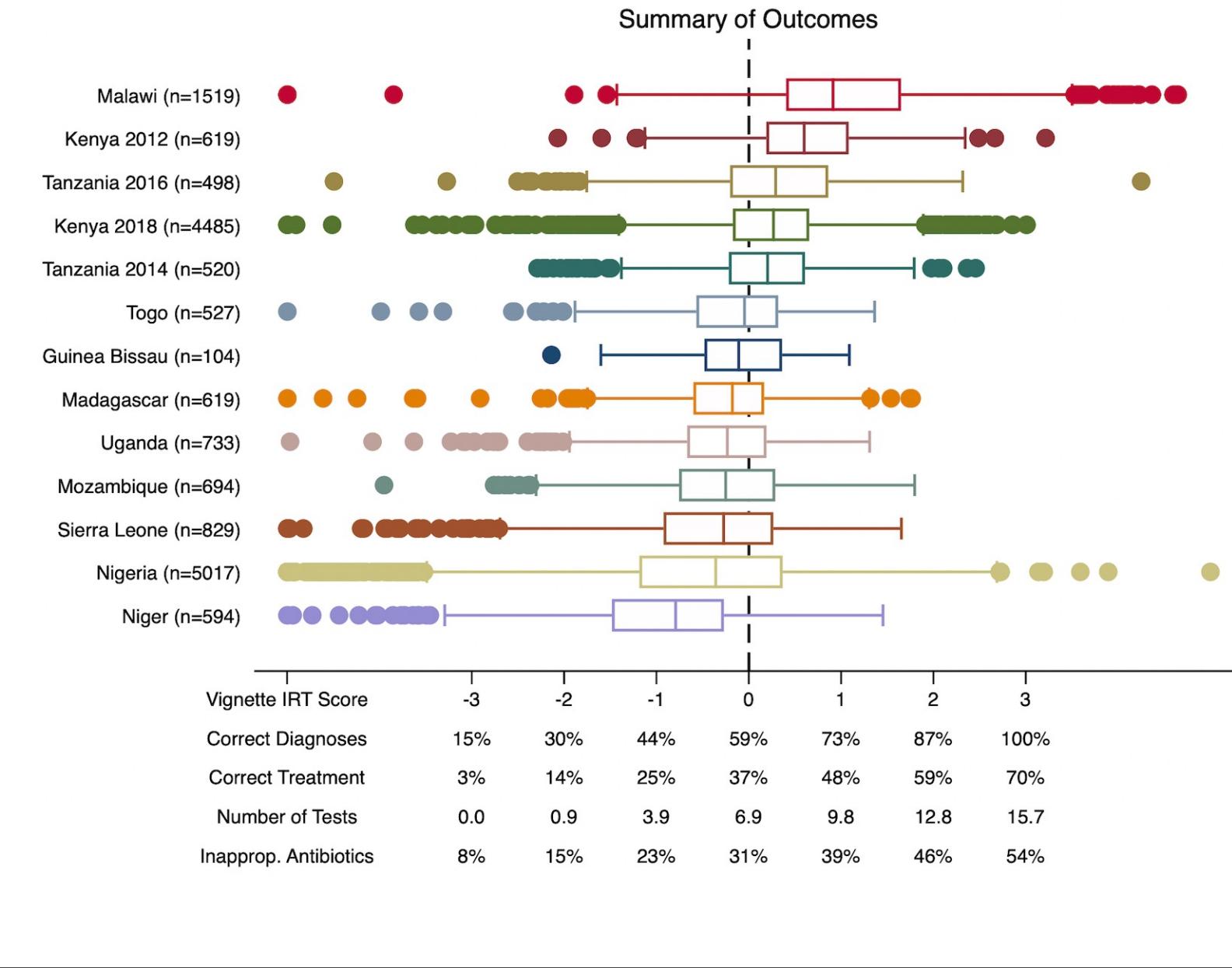


# Summary: Variation Across Countries

An increase in one standard deviation of vignette IRT score (the difference between the worst and best performing countries, on average) leads to:

- 14% more conditions diagnosed correctly
- 11% more conditions treated correctly
- Over 3 more tests ordered
- 8% more of the conditions given inappropriate antibiotics.

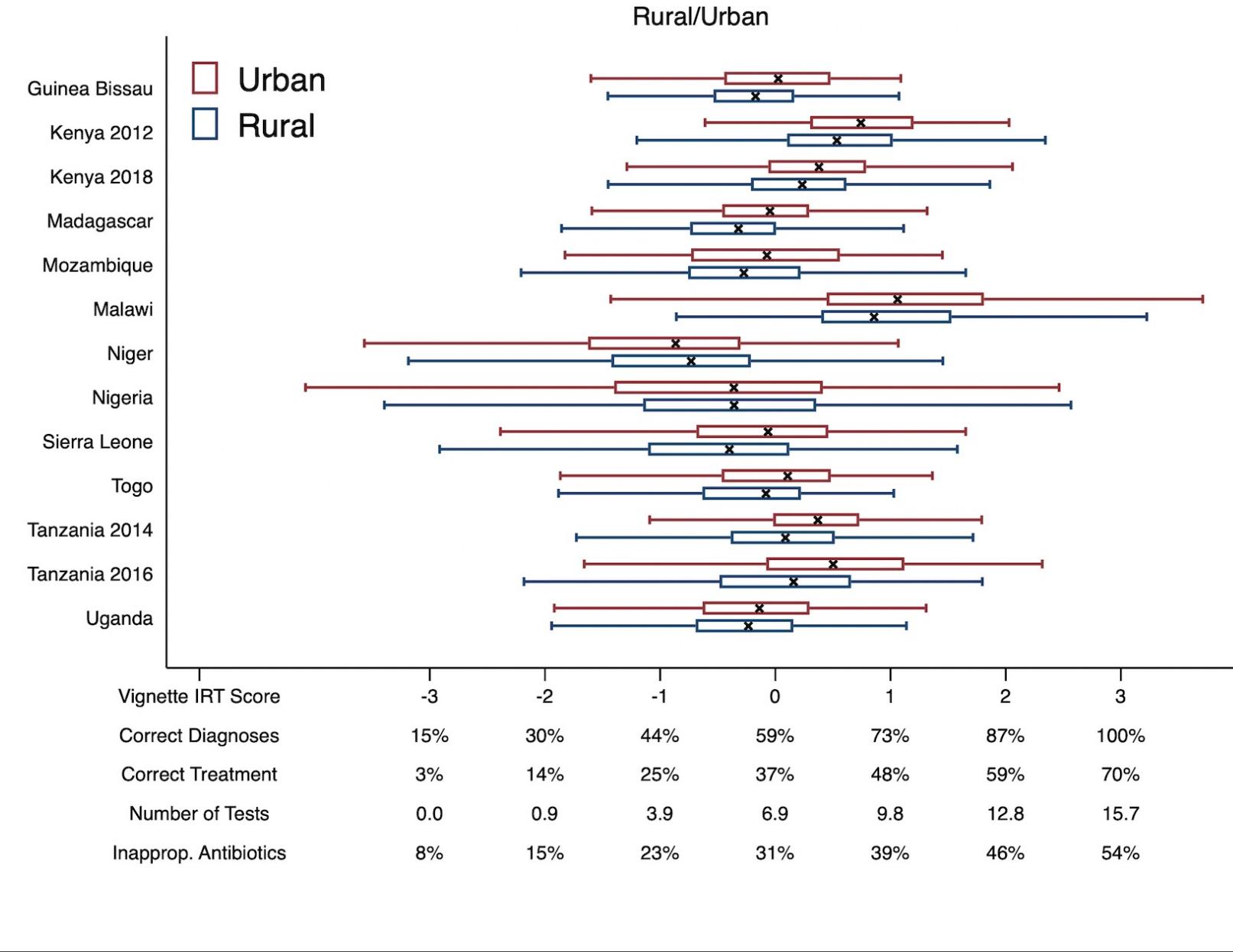
On average across the countries, more knowledgeable providers do prescribe inappropriate antibiotics at a greater rate.



# Rural-Urban Variation

Urban providers are more knowledgeable *on average* than rural providers in all countries except Niger.

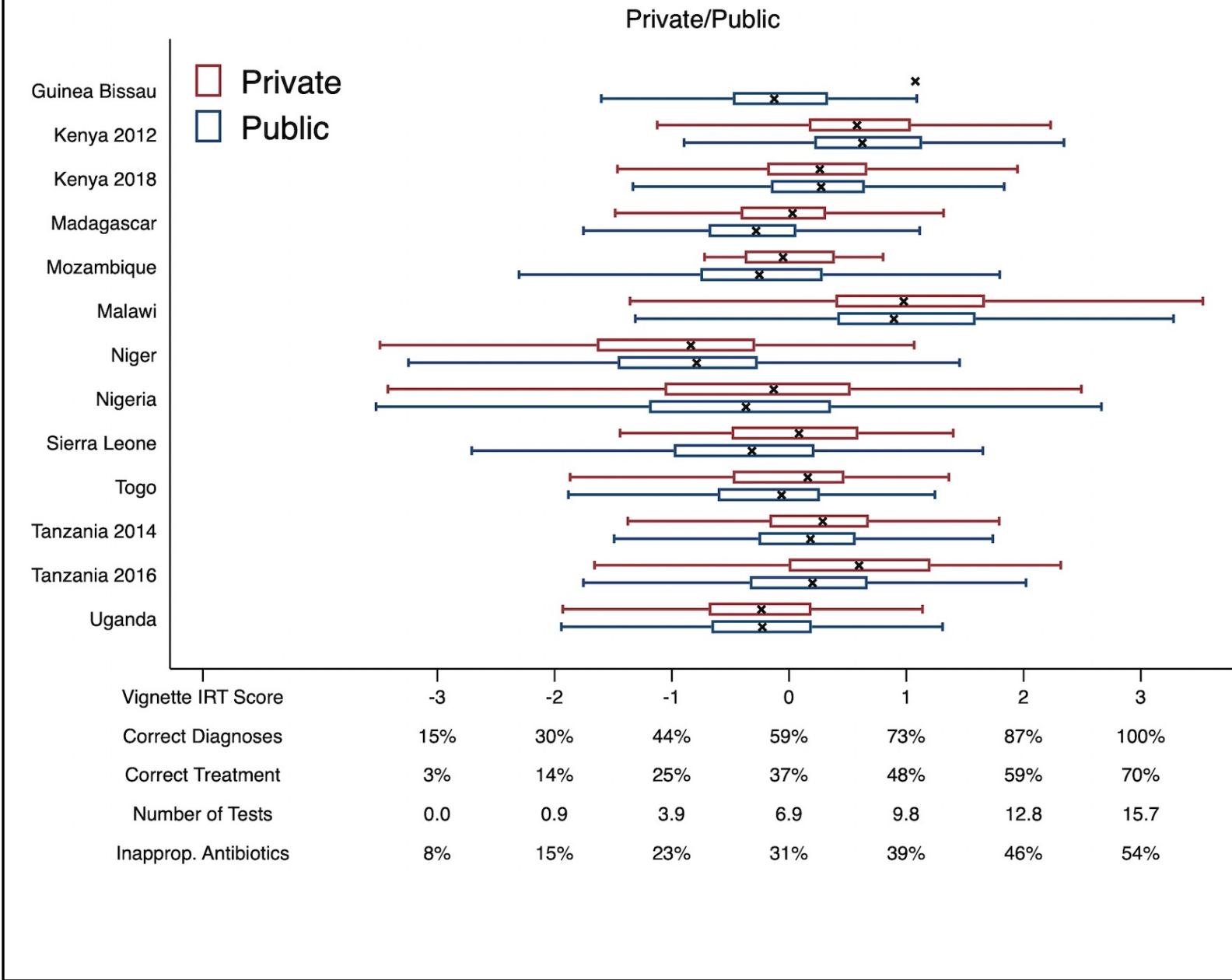
The largest difference between rural and urban providers occurs in Tanzania, where they are nearly half a standard deviation apart, and the gap at the top of the distribution has grown between rounds.



# Public-Private Variation

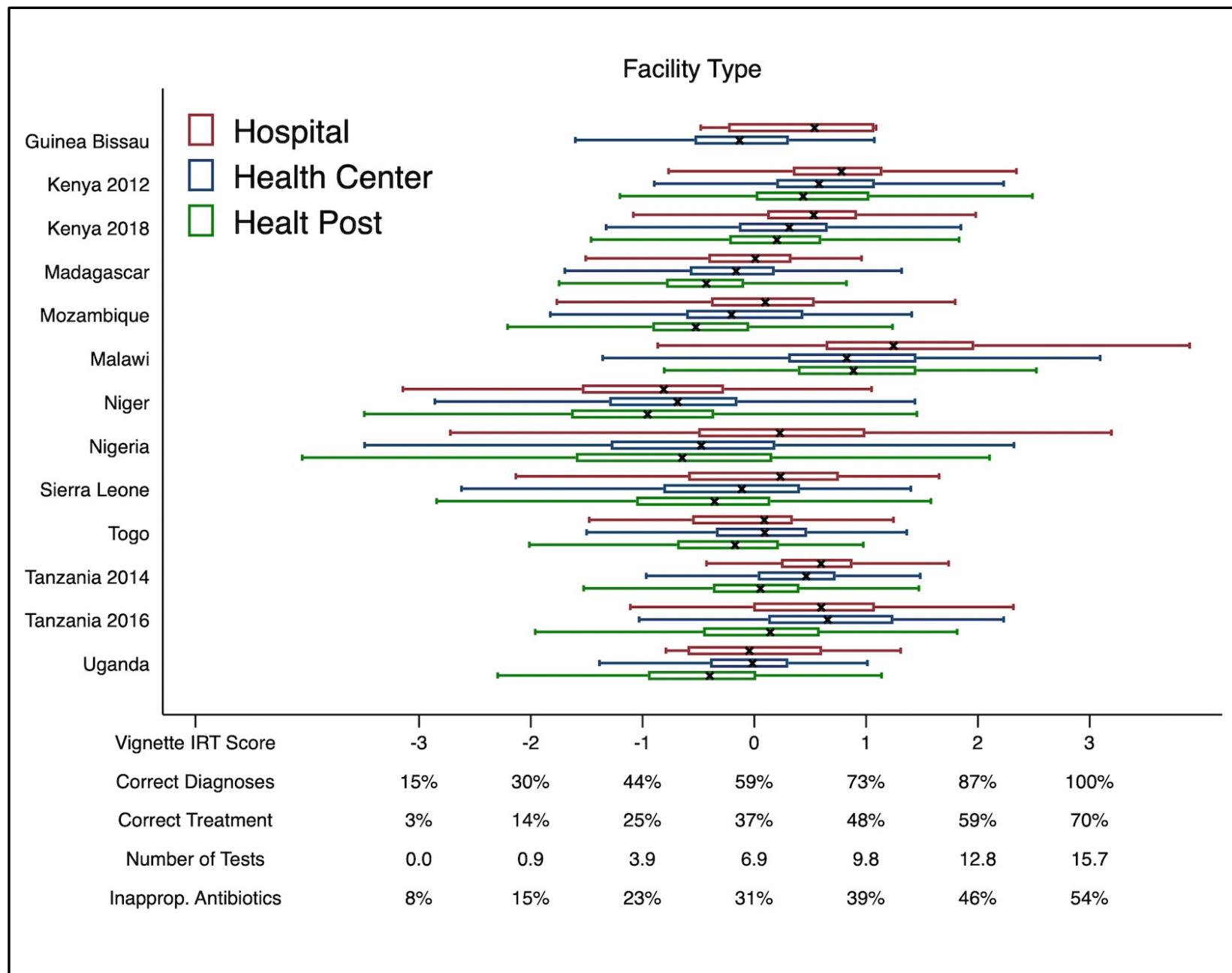
Private providers are more knowledgeable than public providers in most countries, while in others they are equivalent.

The largest difference between public and private providers occurs again in Tanzania, where they are nearly half a standard deviation apart.



# Facility Level Variation

In general, provider knowledge increases with the level of the health facility, but there is very wide variation in every group.



# Provider Identity Summary

Providers in Kenya 2012 and Uganda were not asked survey questions related to their medical education.

A common set of categories for medical education and profession were applied across all contexts to allow for better comparison.

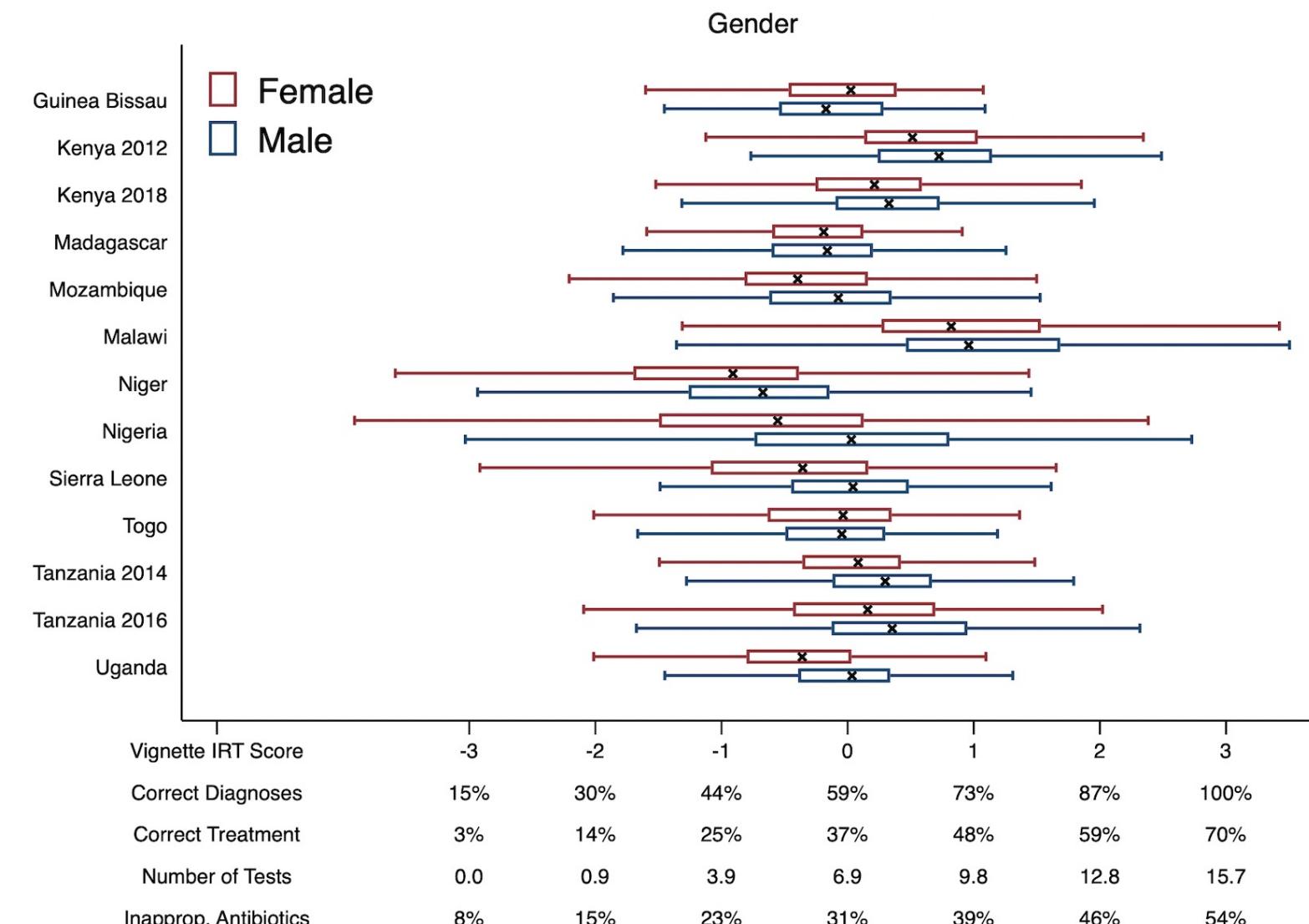
	Medical Education				Profession			Gender		Total Providers
	None	Certificate	Diploma	Masters+	Doctor	Nurse	Para-Professional	Female	Male	
Guinea Bissau	0(0%)	101(78%)	27(21%)	2(2%)	16(12%)	99(76%)	15(12%)	61(47%)	69(53%)	130
Kenya 2012	n/a	n/a	n/a	n/a	615(20%)	1671(53%)	849(27%)	1922(61%)	1209(39%)	3138
Kenya 2018	657(3%)	3414(14%)	17575(72%)	2737(11%)	4408(18%)	11134(46%)	8861(36%)	13697(56%)	10706(44%)	24404
Madagascar	148(7%)	155(7%)	1125(53%)	705(33%)	683(31%)	1084(49%)	433(20%)	1332(61%)	868(39%)	2200
Mozambique	7(0%)	96(4%)	2192(87%)	233(9%)	1023(34%)	1242(42%)	707(24%)	1405(47%)	1567(53%)	2972
Malawi	11(1%)	684(46%)	784(52%)	24(2%)	1228(10%)	4327(33%)	7369(57%)	5956(46%)	6933(54%)	13275
Niger	6(0%)	159(12%)	248(19%)	904(69%)	94(7%)	821(62%)	416(31%)	921(69%)	406(31%)	1331
Nigeria	3263(18%)	8264(45%)	1557(8%)	5455(29%)	960(5%)	4790(23%)	15445(73%)	14042(66%)	7151(34%)	21318
Sierra Leone	1434(29%)	2993(60%)	491(10%)	96(2%)	62(1%)	1553(31%)	3440(68%)	3019(60%)	2036(40%)	5055
Togo	481(36%)	130(10%)	353(26%)	376(28%)	142(10%)	483(35%)	739(54%)	695(51%)	669(49%)	1364
Tanzania 2014	175(4%)	2528(57%)	1577(35%)	176(4%)	1140(26%)	1310(29%)	2009(45%)	2881(65%)	1578(35%)	4459
Tanzania 2016	128(2%)	2919(57%)	1855(36%)	231(5%)	1181(23%)	1874(36%)	2090(41%)	3402(66%)	1734(34%)	5160
Uganda	n/a	n/a	n/a	n/a	381(16%)	1067(46%)	893(38%)	1483(63%)	859(37%)	2347

Certain providers contained missing data for the above categories

# Male-Female Variation

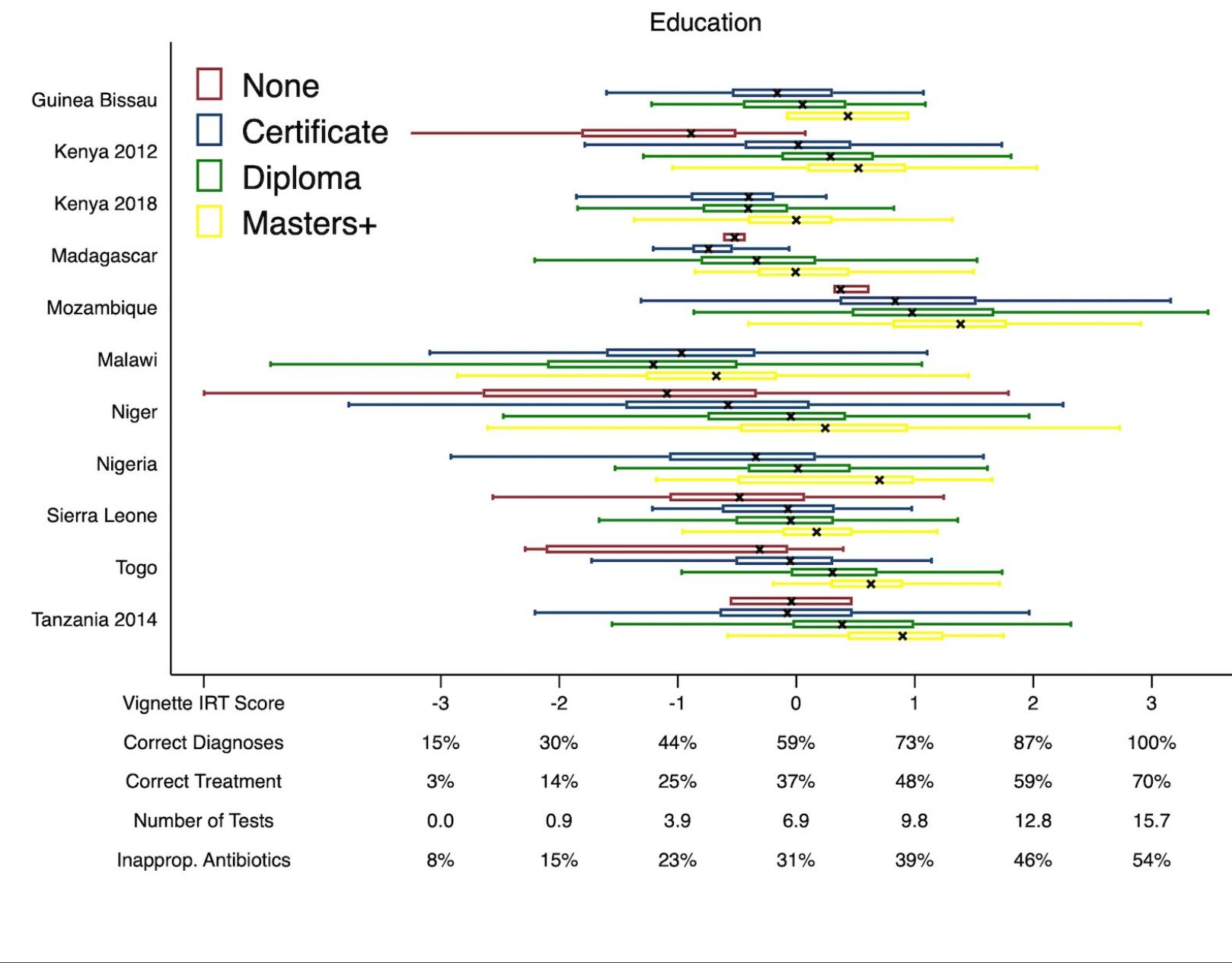
Male providers are more knowledgeable than female providers in all countries except Togo, Guinea Bissau, and Madagascar.

Similarly, the best providers in most countries tend to be male.



# Educational Variation

Diagnostic knowledge also increases generally with educational level, although there remains very wide variation within the groups in every setting.



# Professional Variation

Similarly, higher cadre providers tend to be more knowledgeable.

