Quality assurance in health care based on Big Data

Peter Nordqvist

Forskningsinstitutet Hörselbron
School of Computer Science and Communication
KTH Royal Institute of Technology

Sweden

Long tradition of collecting data in Sweden

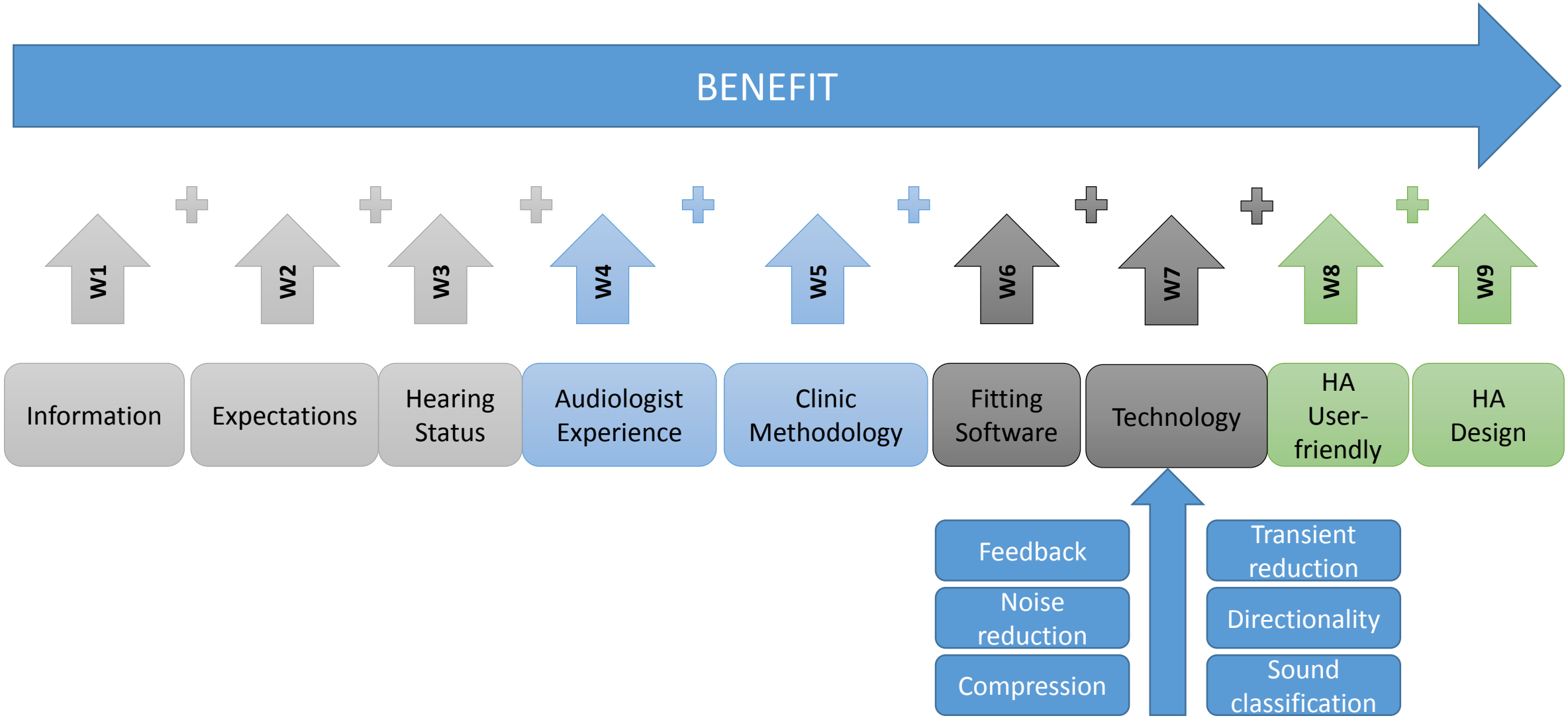
Controlled by Swedish Association of Local Authorities and Regions

National Quality Registries contribute to Sweden´s strong position on health care results, where Sweden has among the best survival rates after heart attack, stroke, breast and colorectal cancer.

96 registers active 2016.

National Quality Register of Hearing Aid Fitting
Since 2011

What factors makes the difference for the end user



Can you afford not to collect data

- All stakeholders benefit from collecting data
- Clients, patients, Clinics, Clinicians, Manufacturers, Researchers
- The quality of the result from the data must be so attractive that everybody wants to participate.

Large amount of data is needed

- 100k
- Data must be collected directly from the clinics
- Across dispenser chains
- Across manufacturer
- Be pragmatic, collect what is possible but do not complicate things
- Do not involve the staff at the clinic
  - May jeopardize a long-term solution
  - Overloaded already
  - May introduce bias

National Quality Register of Hearing Fitting

Collecting about 50000 prescriptions each year

120 units in 14 counties

How to get a hearing aid in Sweden

- **A hearing aid selected and fitted by the county, close to 50%**
- **The user receives a check from the county and selects a private clinic, close to 50%**
- Private clinic

Collecting data

Journal access, IT-solution

- Personal Identification Number, age, gender, address
- County ID
- Unit ID
- Hearing aid model -> (default fitting, features)
- Audiogram
- Audiologist ID
- Socioeconomic status

Collecting data

Postal solution, 3-6 months after the fitting
Response rate, about 55-60 percent

Three indicators

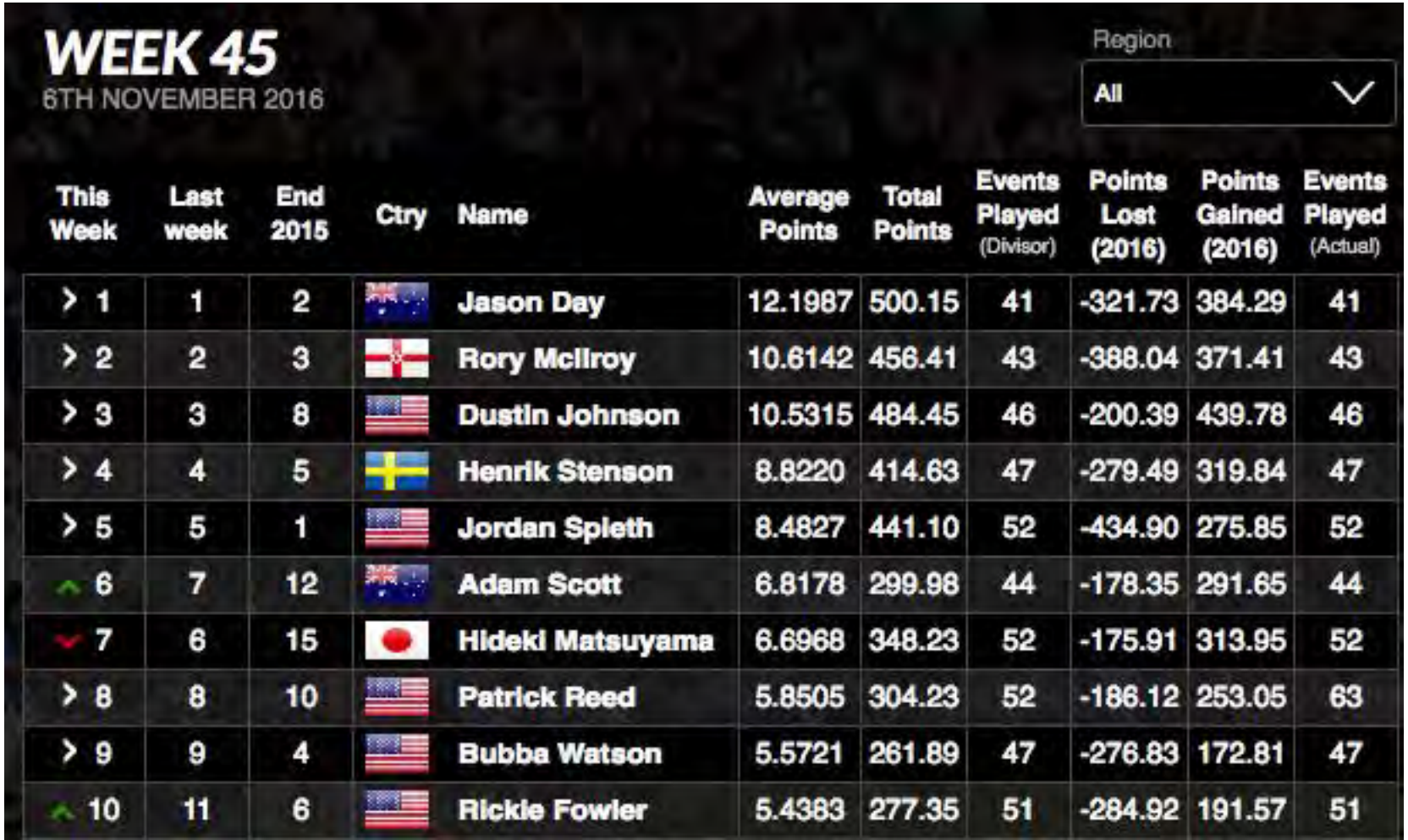
- ***Total Outcome***, Average of IOI-HA, seven questions
- ***Function Outcome*****,** Average of four questions regarding:
  - Uncomfortable loud sounds, Sound Quality, Feedback problems, Communication in noise
- ***Contact/Information Outcome*****,** Average of five questions regarding:
  - Information, Contact, Interaction, Good listener

Choice of questionnaire

- We selected IOI-HA since it is short and fast and well documented
- Should not exceed more than 25 questions in total
- Do not collect too much from the user, It is tempting to have a large number of questions

A fully transparent ranking list with all three indicators is distributed to the clinics every 6 month

Put yourself into context is great for improving



WEEK 45

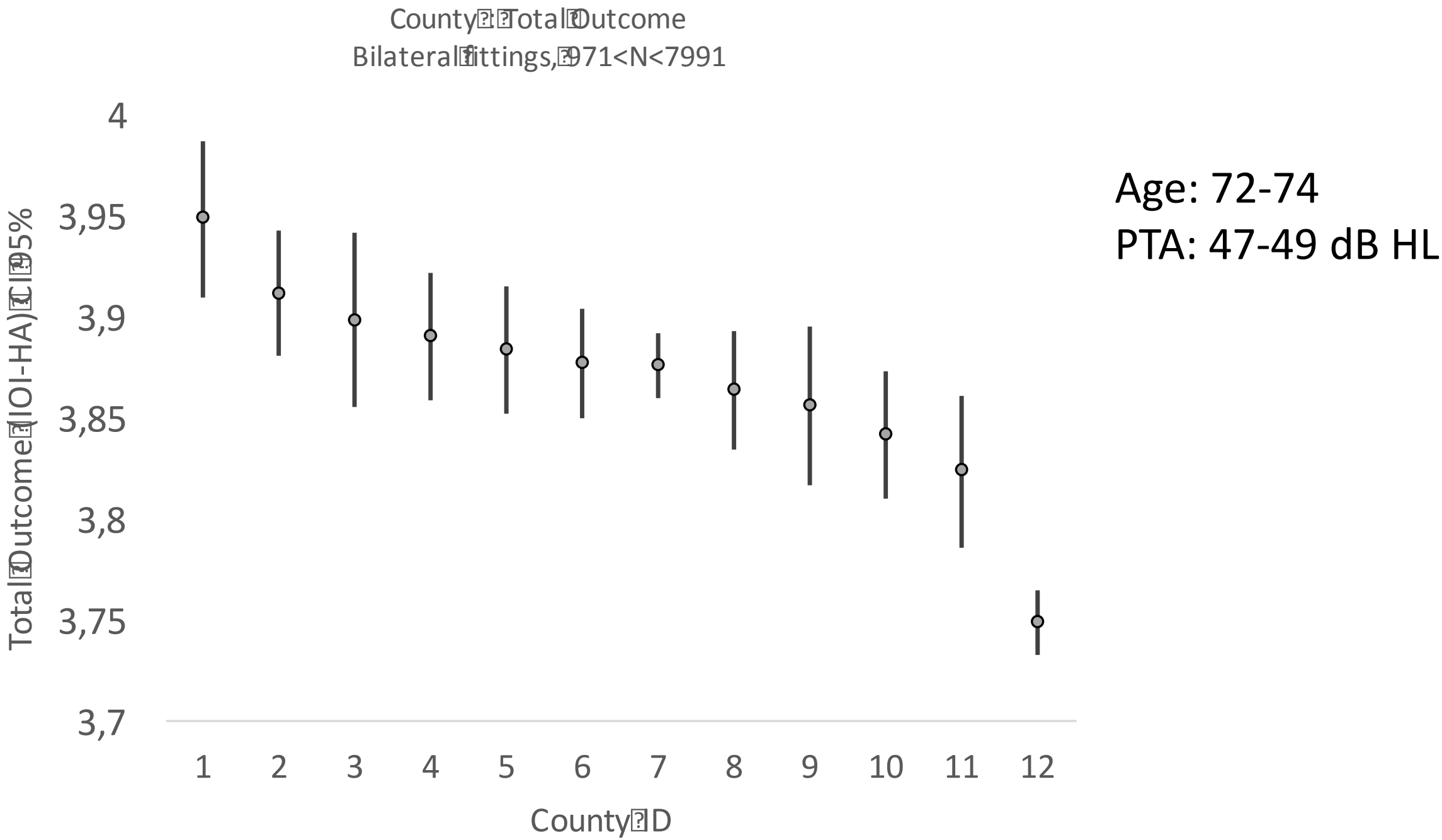
6TH NOVEMBER 2016

Region: All

This Week	Last week	End 2015	Ctry	Name	Average Points	Total Points	Events Played (Divisor)	Points Lost (2016)	Points Gained (2016)	Events Played (Actual)
> 1	1	2		Jason Day	12.1987	500.15	41	-321.73	384.29	41
> 2	2	3		Rory McIlroy	10.6142	456.41	43	-388.04	371.41	43
> 3	3	8		Dustin Johnson	10.5315	484.45	46	-200.39	439.78	46
> 4	4	5		Henrik Stenson	8.8220	414.63	47	-279.49	319.84	47
> 5	5	1		Jordan Spieth	8.4827	441.10	52	-434.90	275.85	52
^ 6	7	12		Adam Scott	6.8178	299.98	44	-178.35	291.65	44
v 7	6	15		Hideki Matsuyama	6.6968	348.23	52	-175.91	313.95	52
> 8	8	10		Patrick Reed	5.8505	304.23	52	-186.12	253.05	63
> 9	9	4		Bubba Watson	5.5721	261.89	47	-276.83	172.81	47
^ 10	11	6		Rickie Fowler	5.4383	277.35	51	-284.92	191.57	51

County level

Total Outcome, Average of IOI-HA, seven questions

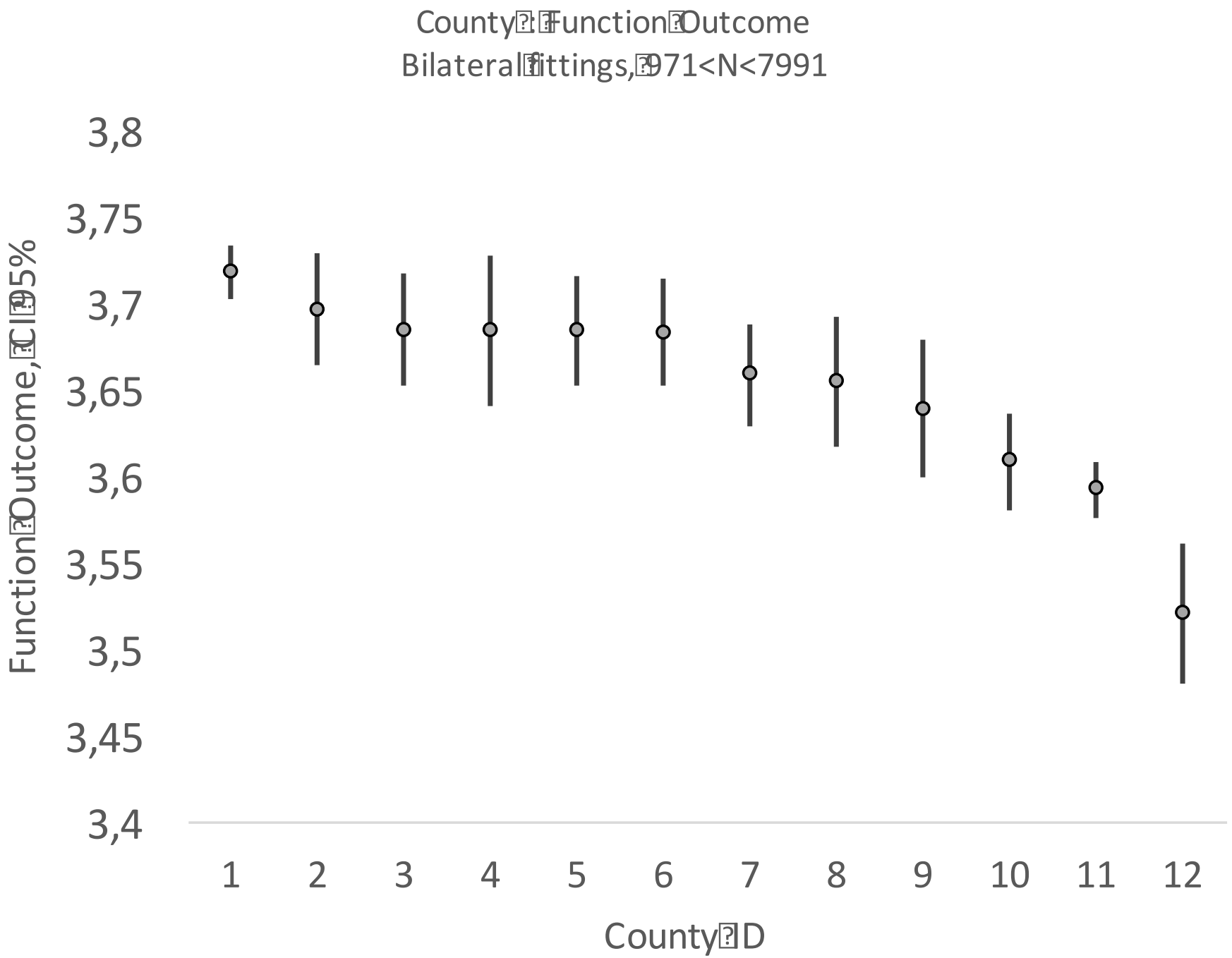


Age: 72-74

PTA: 47-49 dB HL

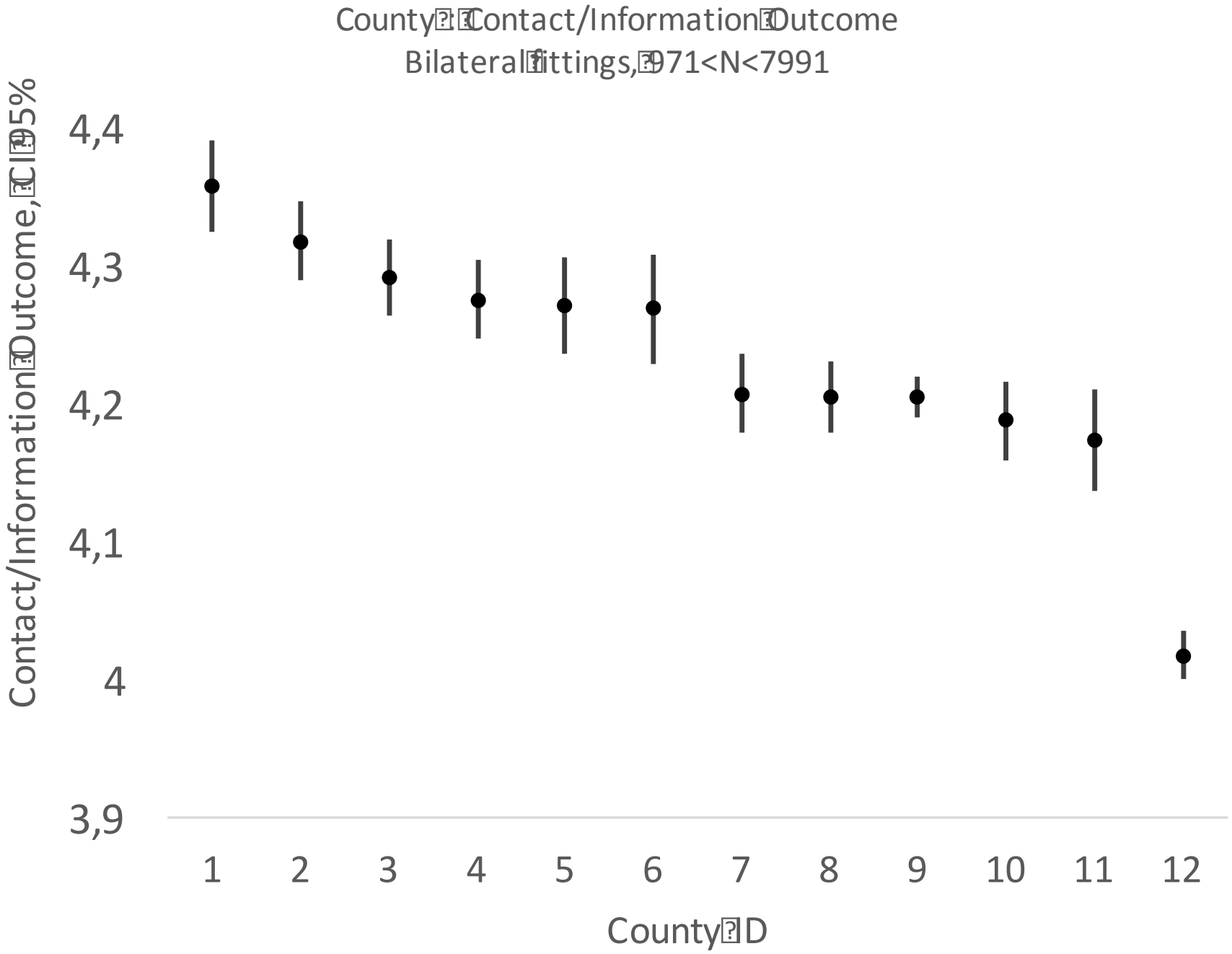
Function Outcome, Average of four questions regarding:

Uncomfortable loud sounds
Sound Quality
Feedback problems
Communication in noise


County Function Outcome
Bilateral fittings, 971<N<7991
3,8
3,75
3,7
3,65
3,6
3,55
3,5
3,45
3,4
Function Outcome, CI 95%
1
2
3
4
5
6
7
8
9
10
11
12
County ID

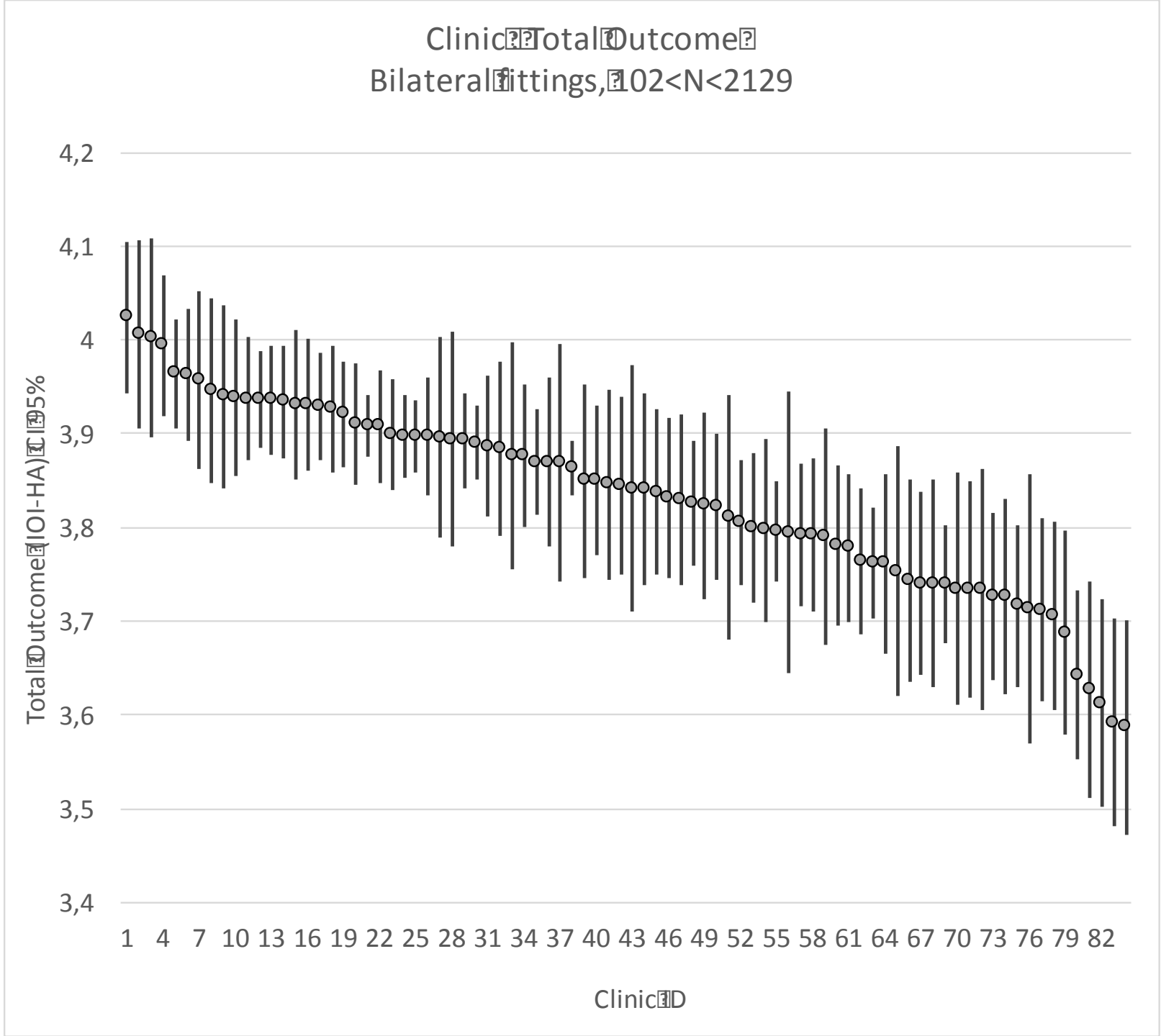
Contact/Information Outcome, Average of five questions regarding:

Information
Contact
Interaction
Good listener


County ID Contact/Information Outcome
Bilateral fittings, 971<N<7991
Contact/Information Outcome, 95% CI
4,4
4,3
4,2
4,1
4
3,9
1
2
3
4
5
6
7
8
9
10
11
12
County ID

Clinic level

Total Outcome, Average of IOI-HA, seven questions

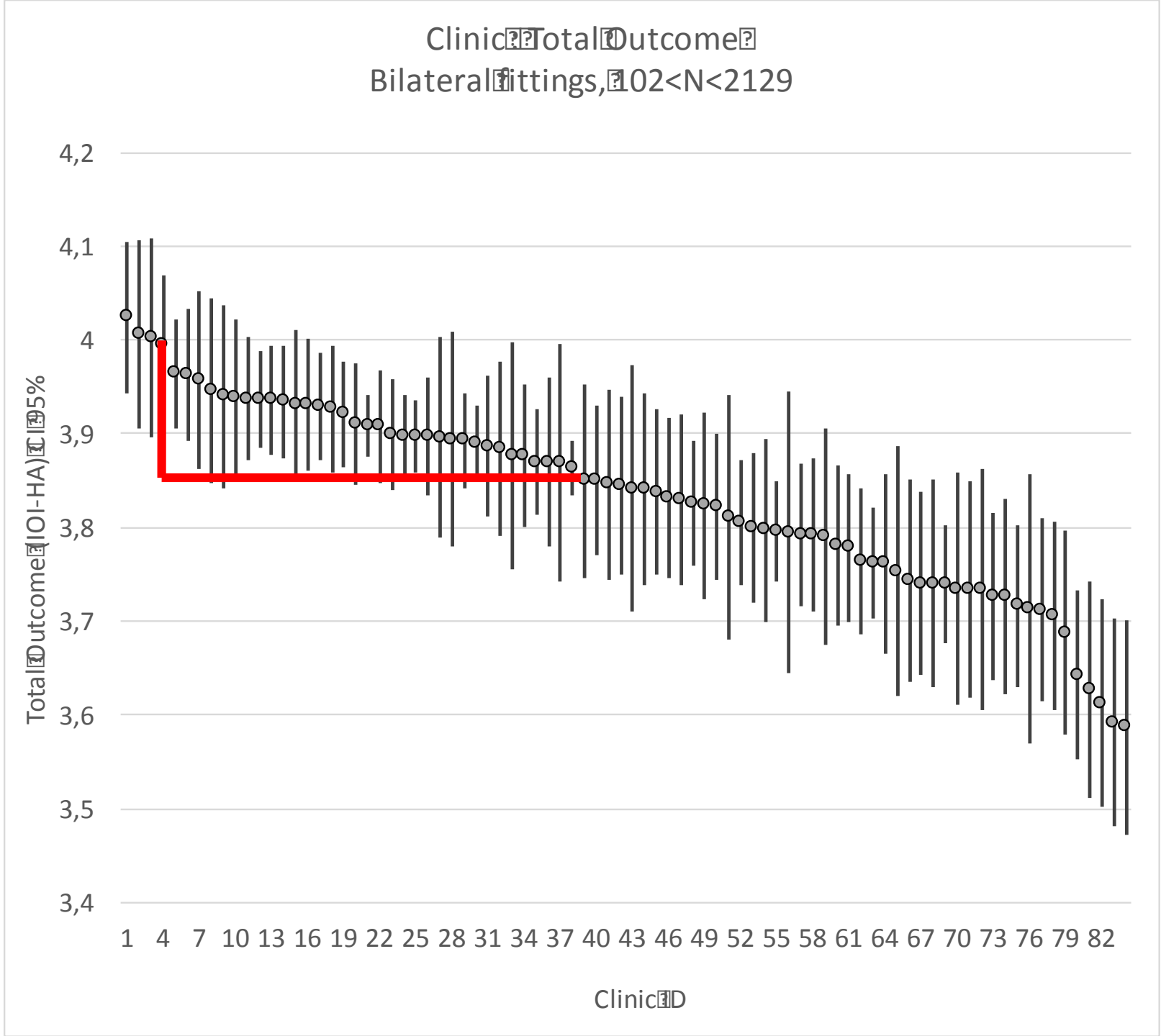

Clinic Total Outcome
Bilateral fittings, 102<N<2129
4,2
4,1
4
3,9
3,8
3,7
3,6
3,5
3,4
Total Outcome (IOI-HA) CI 95%
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82
Clinic ID

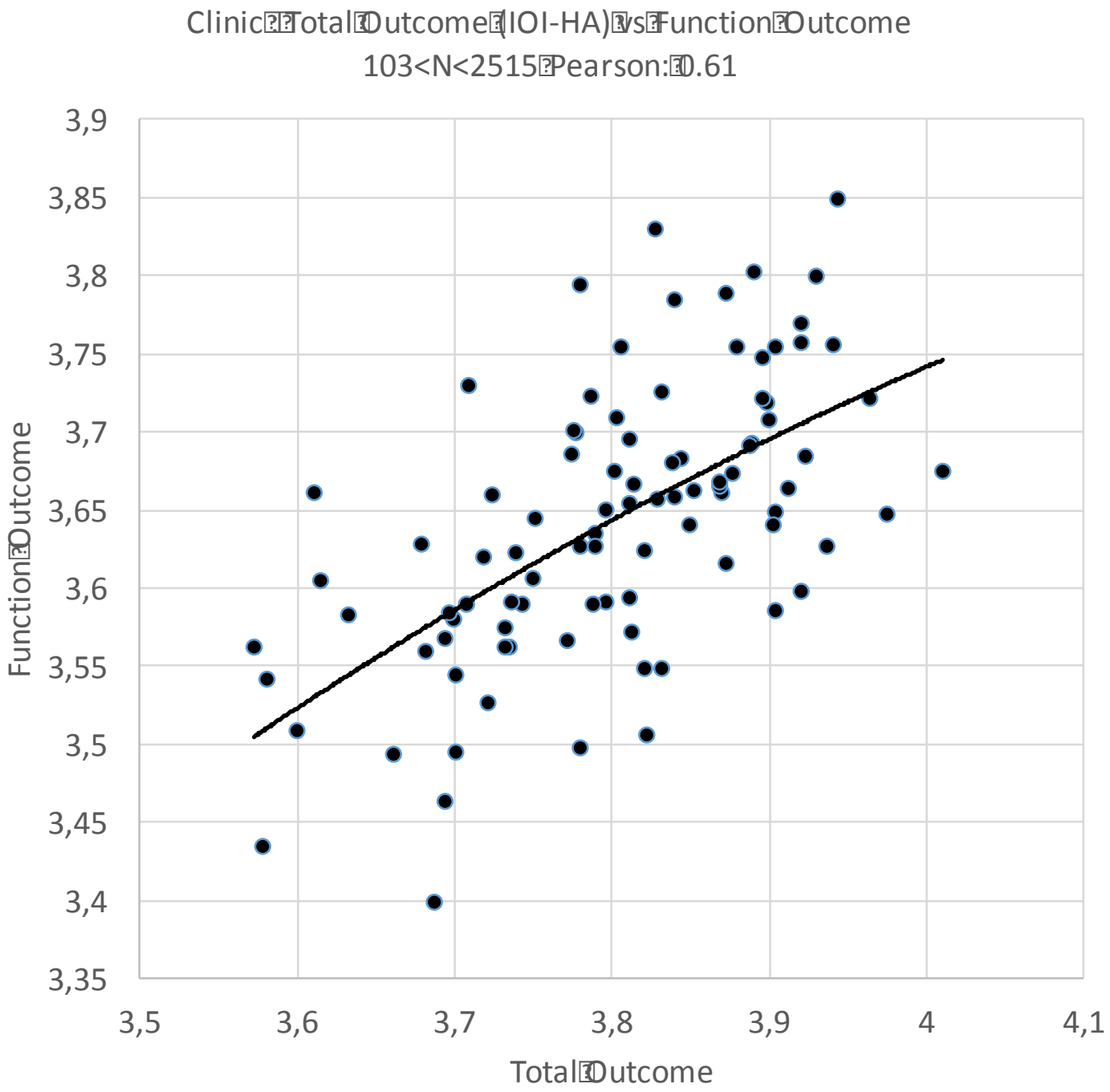
IOI-HA table, N=59477

		Total		Male		Female		Unilateral		Bilateral		Return Client		First Time	
		N	59477	N	32055	N	27422	N	13084	N	46393	N	35680	N	23797
		Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	Total	3.87	1.06	3.84	1.05	3.89	1.07	3.75	1.10	3.90	1.04	3.88	1.07	3.84	1.03
Item 1	Use	4.13	1.02	4.11	1.05	4.16	0.99	4.00	1.09	4.17	1.00	4.38	0.89	3.76	1.10
Item 2	Benefit	3.91	1.00	3.91	0.98	3.92	1.02	3.76	1.05	3.96	0.98	4.00	0.99	3.78	1.00
Item 3	RAL	3.36	1.06	3.34	1.04	3.39	1.08	3.27	1.08	3.39	1.05	3.23	1.07	3.56	1.01
Item 4	Sat	4.13	1.02	4.11	1.02	4.15	1.01	3.97	1.09	4.18	0.99	4.23	0.97	3.98	1.07
Item 5	RPR	4.01	1.02	3.99	1.00	4.03	1.05	3.93	1.07	4.04	1.01	3.88	1.06	4.20	0.93
Item 6	loth	3.74	1.07	3.67	1.06	3.83	1.08	3.66	1.10	3.77	1.06	3.59	1.08	3.97	1.01
Item 7	QoL	3.77	0.99	3.76	0.95	3.78	1.02	3.64	1.01	3.80	0.98	3.85	1.00	3.64	0.96

Total Outcome

Difference between Bilateral and Unilateral: 0.15 units (p-value<10-9)


Clinic Total Outcome
Bilateral fittings, 102<N<2129
4,2
4,1
4
3,9
3,8
3,7
3,6
3,5
3,4
Total Outcome (IOI-HA) CI 95%
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82
Clinic ID

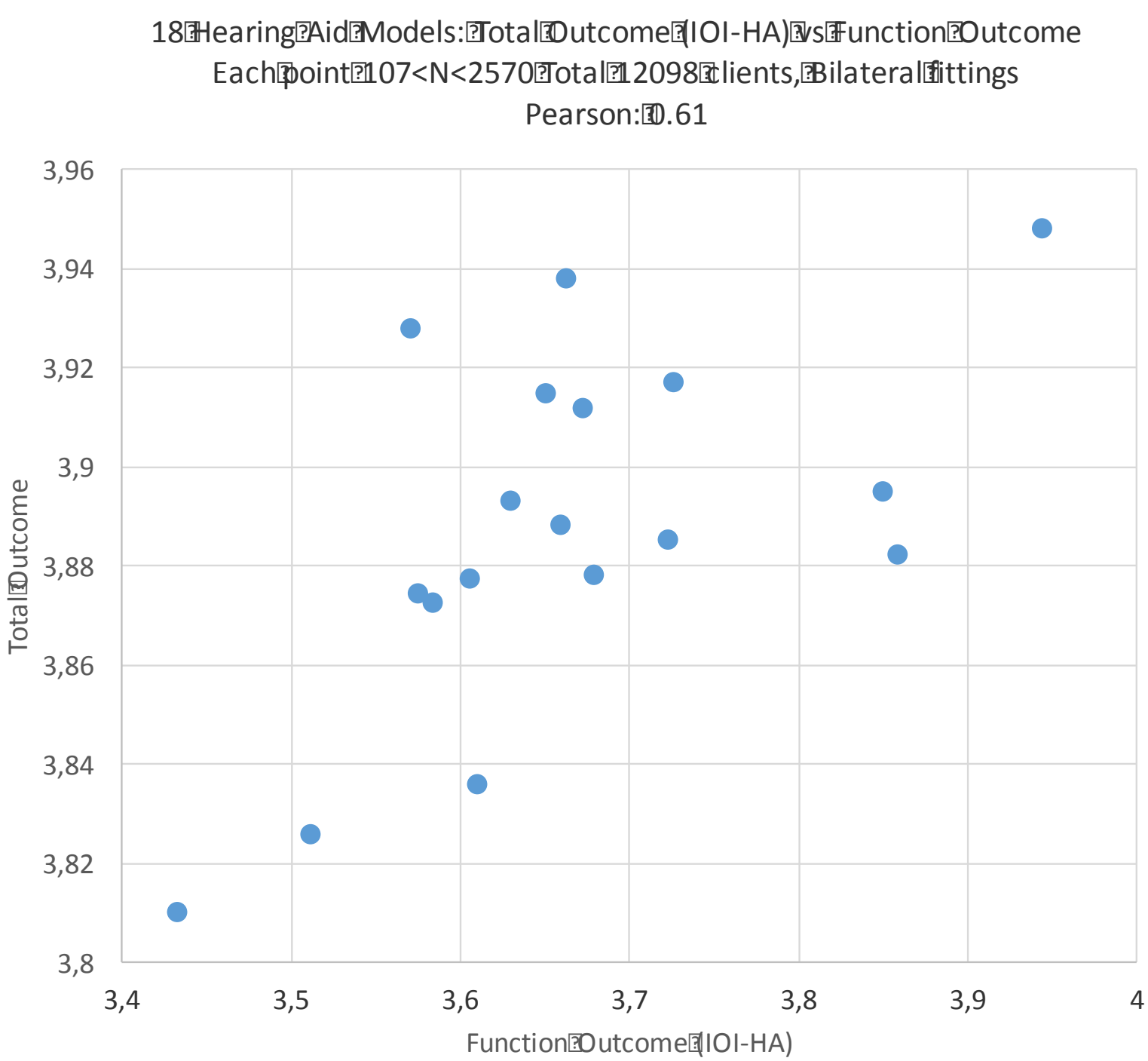

Clinic Total Outcome (IOI-HA) vs Function Outcome
103<N<2515 Pearson: 0.61
3,9
3,85
3,8
3,75
3,7
3,65
3,6
3,55
3,5
3,45
3,4
3,35
Function Outcome
3,5
3,6
3,7
3,8
3,9
4
4,1
Total Outcome

Correlations : Total Outcome and function outcome

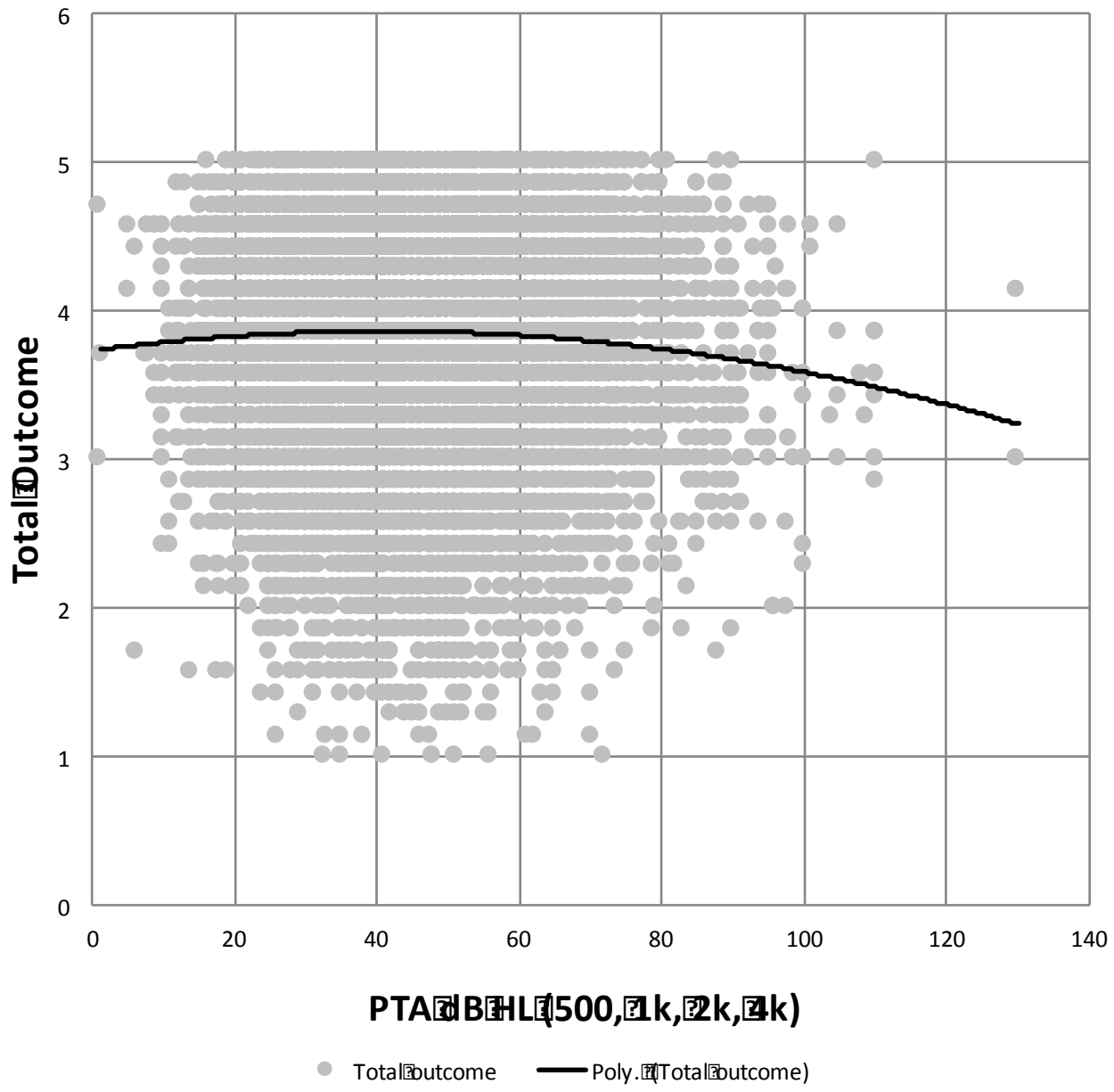
Bilateral fittings	
N=32171	Total Outcome (IOI-HA)
Uncomfortable loud sounds	0.20
Feedback problems	0.16
Sound Quality	0.66
Communication in noise	0.62

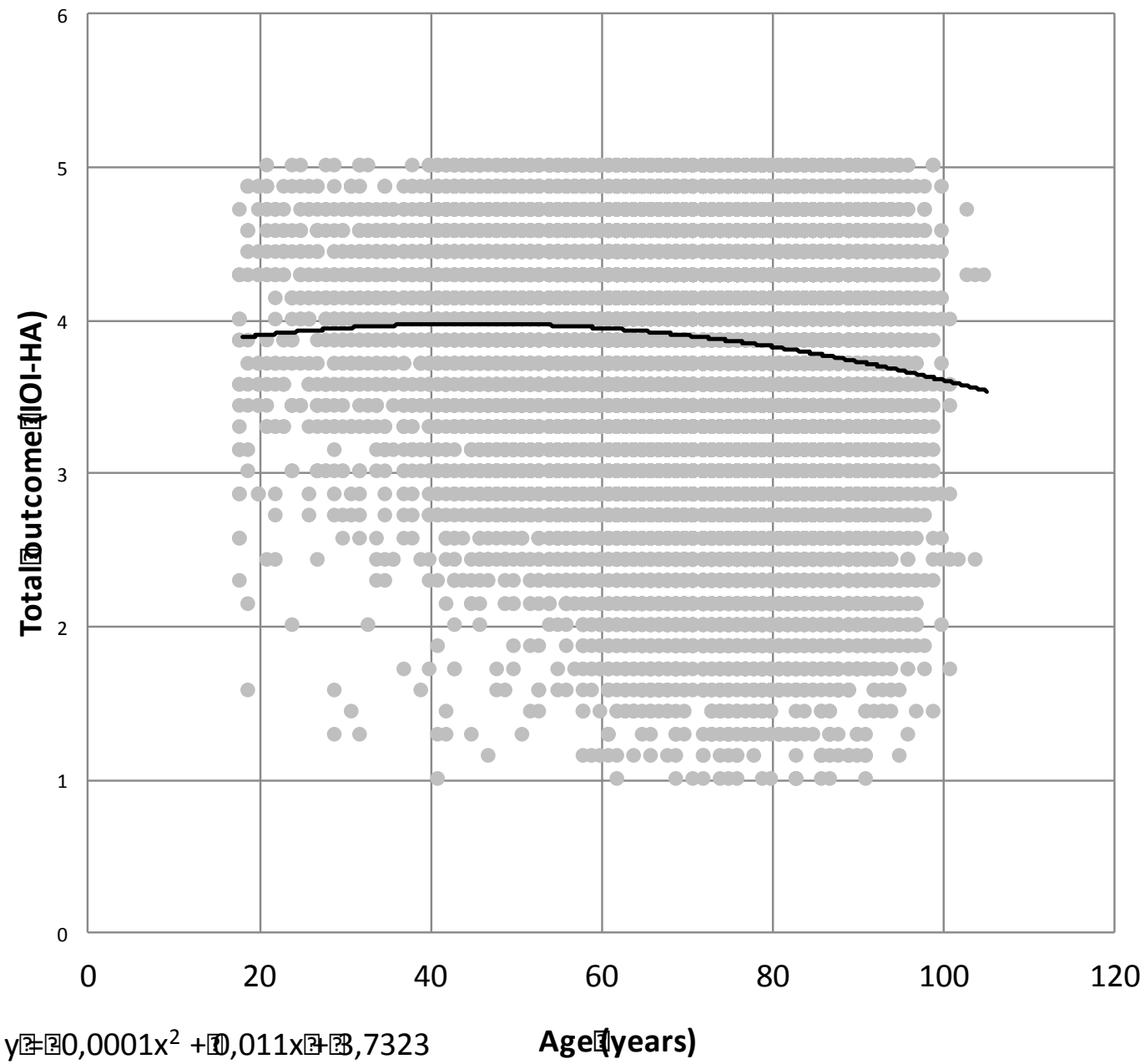
Hearing model level

Total Outcome, Average of IOI-HA, seven questions


18 Hearing Aid Models: Total Outcome (IOI-HA) vs Function Outcome
Each point 107<N<2570 Total 12098 clients, Bilateral fittings
Pearson: 0.61
3,96
3,94
3,92
3,9
3,88
3,86
3,84
3,82
3,8
Total Outcome
3,4
3,5
3,6
3,7
3,8
3,9
4
Function Outcome (IOI-HA)

Client level


Total Outcome (IOI-HA) as function of PTA
N=20697, Bilateral (best ear), Spearman 0.0062
Total Outcome
PTA dB HL (500, 1k, 2k, 4k)
0
1
2
3
4
5
6
0
20
40
60
80
100
120
140
Total outcome
Poly. (Total outcome)


Total outcome (IOI-HA) as function of age
Bilateral, N=56639
Total outcome (IOI-HA)
Age (years)
y = 0,0001x² + 0,011x + 3,7323
0
1
2
3
4
5
6
0
20
40
60
80
100
120

Conclusions

- There are significant differences between counties
- There are significant differences between units
- There are significant differences between hearing aid models
- Correlation between total outcome and function outcome is 0.65
- Correlation between total outcome and contact/information outcome is 0.61
- Correlation between total outcome and PTA is very weak

Thanks!