ANTIBIOTIC STEWARDSHIP
NEWPORT HOSPITAL

AN ARGUMENT FOR POOLING REGIONAL DATA WHEN CONSTRUCTING A CUMULATIVE ANTIBIOGRAM

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Pooling of Antibiogram Data Rationale

- A more statistically powerful data set (narrow 95% confidence interval) by increasing sample size
- More reliable detection of emerging resistant organisms
- Allows for inclusion of a greater number of organisms above the 30 isolate threshold

Cumulative Antibiogram

- Offers a guide to empiric antibiotic therapy at an institution (*"Use local data; know your antibiogram"*)
- Can offer clues towards early detection of emerging drug resistant organism
- Can reliably inform infection control mechanisms

Cumulative Antibiogram
CLSI Recommendations

- Analyze and present data at least annually
- Include only species in which there are at least 30 isolates
- Diagnostic, not surveillance cultures
- Include the results for all antimicrobials tested
- Include only the first isolate for the patient tested

Newport Hospital

- Our current antibiogram report is a spreadsheet with the sensitivity data on 43 organisms
- Only four organisms meet the criteria for inclusion (at least 30 isolates reported)
- E coli, Enterococcus faecalis, Klebsiella pneumonia, Staph aureus

Just because the sample size is 30 and approximates a "normal distribution", does this necessarily imply that we can derive statistically meaningful conclusions from the data?

NEWPORT HOSPITAL ANTIBIOGRAM

Organism	N	Sensitivity Levofloxacin
Pseudomonas aeruginosa	30*	80%

2018 data

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Is the 80% sensitivity of Pseudomonas aeruginosa to Levofloxacin a meaningful number?

- Problem: Confidence interval testing tells us with 95% probability that the sensitivity could be represented anywhere between 61% and 92%

Sample Size	Susceptible or Resistant Rate																	
	10%		20%		30%		40%		50%		60%		70%		80%		90%	
10	0	45	3	56	7	65	12	74	19	81	26	88	35	93	44	97	55	100
20	1	32	6	44	12	54	19	64	27	73	36	81	46	88	56	94	68	99
30	2	27	8	39	15	49	23	59	31	69	41	77	51	85	61	92	73	98
40	3	24	9	36	17	47	25	57	34	66	43	75	53	83	64	91	76	97
50	3	22	10	34	18	45	26	55	36	64	45	74	55	82	66	90	78	97
60	4	21	11	32	19	43	28	53	37	63	47	72	57	81	68	89	79	96
70	4	20	11	31	20	42	28	52	38	62	48	72	58	80	69	89	80	96
80	4	19	12	30	20	41	29	52	39	61	48	71	59	80	70	88	81	96
90	5	18	12	30	21	41	30	51	39	61	49	70	59	79	70	88	82	95
100	5	18	13	29	21	40	30	50	40	60	50	70	60	79	71	87	82	95
200	6	15	15	26	24	37	33	47	43	57	53	67	63	76	74	85	85	94
400	7	13	16	24	26	35	35	45	45	55	55	65	65	74	76	84	87	93
600	8	13	17	23	26	34	36	44	46	54	56	64	66	74	77	83	87	92
1000	8	12	18	23	27	33	37	43	47	53	57	63	67	73	77	82	88	92

Confidence intervals were calculated using the Clopper-Pearson method.

$$\sum_{k=0}^{k} \binom{n}{k} {p_{UB}}^{k} (1 - p_{UB})^{n-k} = \frac{\alpha}{2}$$

$$\sum_{k=x}^{n} \binom{n}{k} {p_{LB}}^{k} (1 - p_{LB})^{n-k} = \frac{\alpha}{2}$$

Clopper Pearson method of calculating confidence interval

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- If the sample size were N=200, the confidence interval narrows significantly and the 80% sensitivity could be represented anywhere between 74% and 85%.
- *More statistically meaningful data?*

Sample Size	Susceptible or Resistant Rate																	
	10%		20%		30%		40%		50%		60%		70%		80%		90%	
10	0	45	3	56	7	65	12	74	19	81	26	88	35	93	44	97	55	100
20	1	32	6	44	12	54	19	64	27	73	36	81	46	88	56	94	68	99
30	2	27	8	39	15	49	23	59	31	69	41	77	51	85	61	92	73	98
40	3	24	9	36	17	47	25	57	34	66	43	75	53	83	64	91	76	97
50	3	22	10	34	18	45	26	55	36	64	45	74	55	82	66	90	78	97
60	4	21	11	32	19	43	28	53	37	63	47	72	57	81	68	89	79	96
70	4	20	11	31	20	42	28	52	38	62	48	72	58	80	69	89	80	96
80	4	19	12	30	20	41	29	52	39	61	48	71	59	80	70	88	81	96
90	5	18	12	30	21	41	30	51	39	61	49	70	59	79	70	88	82	95
100	5	18	13	29	21	40	30	50	40	60	50	70	60	79	71	87	82	95
200	6	15	15	26	24	37	33	47	43	57	53	67	63	74	74	85	85	94
400	7	13	16	24	26	35	35	45	45	55	55	65	65	74	76	84	87	93
600	8	13	17	23	26	34	36	44	46	54	56	64	66	74	77	83	87	92
1000	8	12	18	23	27	33	37	43	47	53	57	63	67	73	77	82	88	92

Confidence intervals were calculated using the Clopper-Pearson method.

CONSENSUS STATEMENT: CLSI

- *Combining data from several facilities located in the same geographic area is another way to circumvent the concern about having a small number of isolates available for analysis.*

Analysis and Presentation of Cumulative Antibiograms: A New Consensus Guideline from the Clinical and Laboratory Standards Institute

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NHHS

- It is likely that with pooling of our antibiogram data with other regional facilities, we could add three other organisms to our data set
- Proteus mirabilis (N=18), Pseudomonas aeruginosa (N=24), Staph epidermidis (N=23)

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SURVEILLANCE FOR EMERGING ANTIBIOTIC RESISTANCE

EMERGING ANTIBIOTIC RESISTANCE

Organism	N	Sensitivity Ciprofloxacin
Enterococcus faecalis	50*	90%

2018 data

EMERGING ANTIBIOTIC RESISTANCE

- Hypothetical: *What If the following year the sensitivity of Enterococcus faecalis to Ciprofloxacin drops from 90% to 80%? Would this be an indication of emerging resistance?*

DETERMINING EMERGING ANTIBIOTIC RESISTANCE

- Hypothesis testing shows that the sensitivity of Enterococcus faecalis to Ciprofloxacin can vary from 90% to 73% by chance alone when the sample N=50. ($p<.05$)
- If the sample size were 200, a drop in the sensitivity from 90% to 82% would be statistically significant

Table H2. Table to Use if % Susceptible Decreases

	Sample Size							
Initial %S	10	20	50	100	200	400	600	1000
98	-	-	84	90	93	95	95	96
95	-	65	78	85	89	91	92	92
90	30	55	72	78	82	85	86	87
80	20	45	60	66	71	73	75	76
70	10	30	48	55	60	63	64	65
60	0	20	38	45	49	52	54	55
50	0	15	28	35	39	42	44	45
40	NS	5	20	25	30	33	34	35
30	NS	0	12	17	20	23	24	25
20	NS	NS	4	9	12	14	15	16
10	NS	NS	NS	2	4	5	6	7

NS - not significant

Regional Pooling of Antibiogram Data

- For a smaller hospital to produce a useful antibiogram with sufficient statistical power for validation, one option is to increase the sample size by pooling data from regional facilities
- CLSI supports this concept