Data Interpretation in the AKT

If you have found yourself wondering how data interpretation is being tested in the AKT, then we trust that this publication is of practical help to you. GPs are not statisticians, but we do spend a good proportion of time reviewing data and considering how this relates to our patients. We are often ruling conditions in and out of our differential diagnosis list based on probability from symptoms that patients present with. We explain to patients how their lifestyle and choices may increase or reduce their risk of developing conditions and how likely they are to benefit from treatments, or get side-effects. Often we are asked about claims made in the media about different drugs and need to try to explain what has been demonstrated. When the clinical workload allows there is plenty of data about how the practice is performing with regard to targets, such as antibiotic prescribing, referral rates etc. We need to be able to review and analyse our performance in a rigorous and recognised way. Without the skills to understand data that is relevant to general practice we cannot work safely, nor be a trusted and reliable source of advice for our patients.

These are some of the reasons why we test on data interpretation in the AKT.

This document is not a statistics textbook but we hope will help you to understand some of the themes that will be tested in the AKT. We provide example questions which you can work through on your own, or with peers, or perhaps in a tutorial.

Data is interesting but interpreting it can sometimes be challenging for us all. Work on the areas you identify as more difficult.

Here are the links to two videos on data interpretation on the AKT site which will be referred to again later. With the help of Professor Michael Harris, some GP registrars discuss data interpretation and concepts that we hope will help.

Interpreting risk

How to interpret the results of a randomised control trial

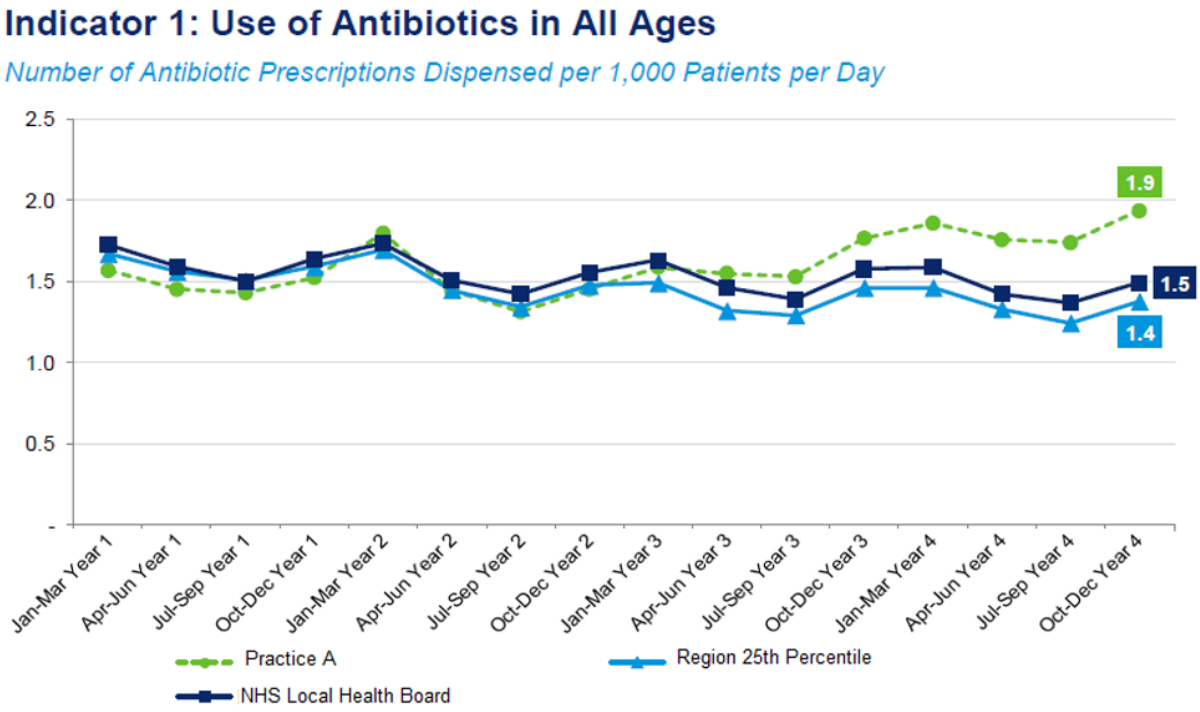
https://www.rcgp.org.uk/mrcgp-exams/applied-knowledge-test/akt-preparing

Interpreting graphs

Prescribing data is commonly available, in a range of formats. Below are two examples of this with example questions.

Antibiotic prescribing

This chart depicts antibiotic prescribing data sent to local practices.



Example question

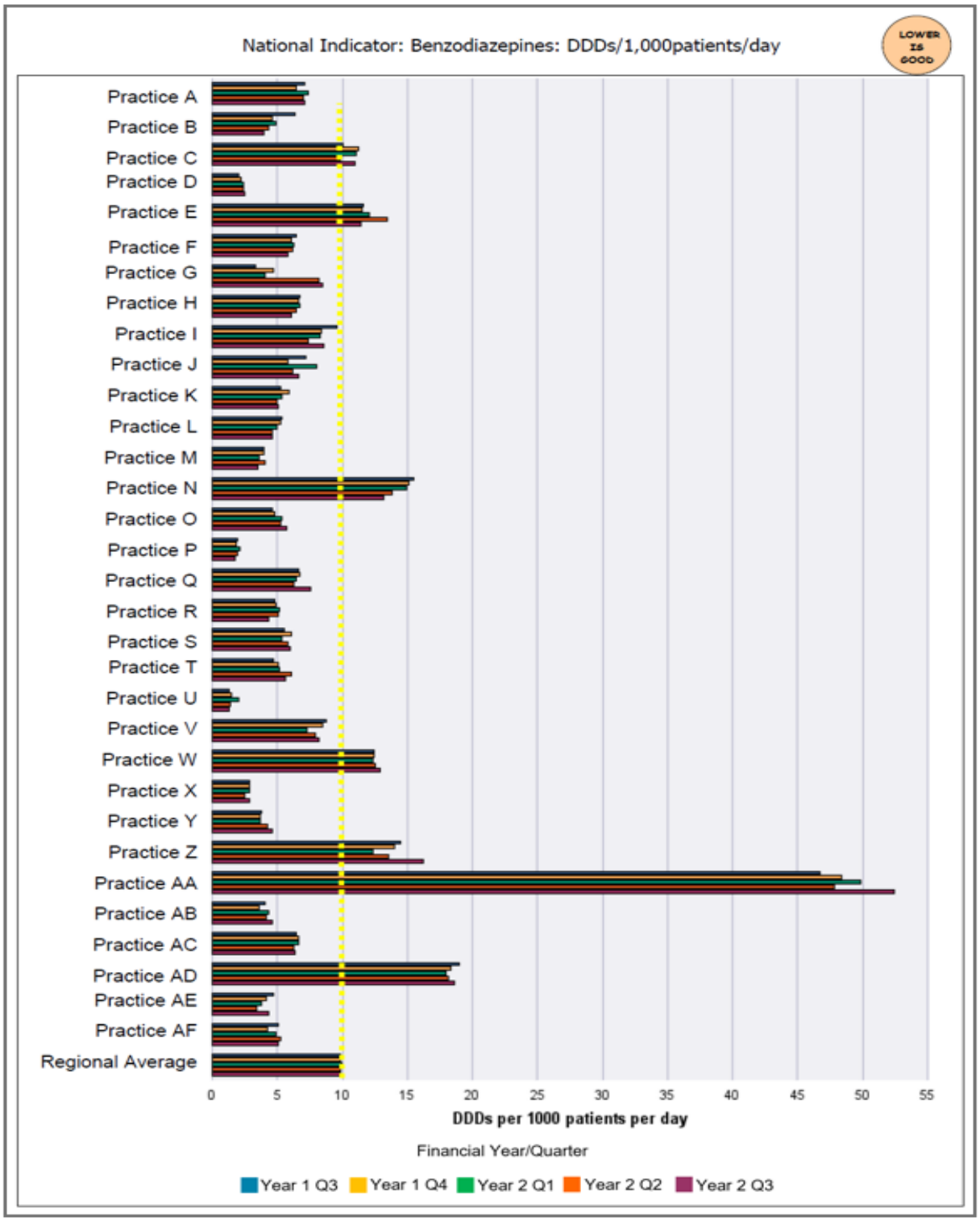
Which is the **single best** interpretation of the data shown? Select **one** option only.

A. Antibiotic prescribing by Practice A is higher in October Year 4 than April Year 1
B. Antibiotic prescribing by the NHS local health board closely follows the pattern of prescribing of Practice A
C. Antibiotic prescribing by the NHS local health board increased between January and June in Year 1
D. The number of antibiotic prescriptions dispensed by Practice A was 1.5 per 1000 patients per day between October and December Year 4
E. The number of antibiotic prescriptions dispensed by the NHS local health board was 1.9 per 1000 patients per day between October and December Year 4

Answer: A. Antibiotic prescribing by Practice A is higher in October Year 4 than April Year 1

Benzodiazepine prescribing

This chart depicts benzodiazepine prescribing data sent to local practices.



TIP

Read the title and axes of graphs carefully so you are clear what you are looking at. For example, are the values given absolute numbers or proportions?

Example questions

Using the information given, from quarter 4 of Year 1, which practice has the **highest** levels of benzodiazepine prescribing?

Give your answer in the box below.

Practice

Answer: AA

Using the information given, from quarter 3 of Year 2, which practice has the **lowest** levels of benzodiazepine prescribing?

Give your answer in the box below.

Practice

Answer: U

Population level data can be presented in a range of ways.

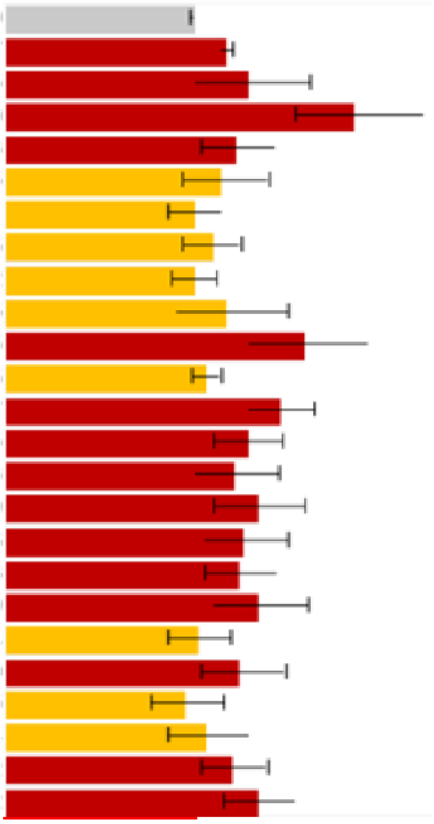
The graph below introduces the important concept of 95% confidence intervals (CIs). An AKT question would show less of the data to help with exam time management.

CIs that do not overlap indicate a statistically significant difference between two groups. Where they do overlap, it is unclear whether there is a significant difference.

https://phw.nhs.wales/services-and-teams/observatory/data-and-analysis/public-health-outcomes-framework-2022/phof-tech-guide/interpretation-guide/)

4.01 - Alcohol related mortality 2016

Area	Recent trend	Count	Value	95% Lower CI	95% Upper CI
England	-	23,839	46.0	45.5	46.6
North West region	-	3,732	54.7	52.9	56.5
A	-	71	59.5	46.2	75.3
B	-	120	86.0	71.2	102.9
C	-	145	56.8	47.9	67.0
D	-	95	53.5	43.3	65.5
E	-	188	46.1	39.7	53.3
F	-	176	50.5	43.3	58.6
G	-	253	46.2	40.6	52.3
H	-	64	54.5	41.8	69.8
I	-	102	73.5	59.7	89.4
J	-	588	49.5	45.6	53.7
K	-	269	67.7	59.7	76.4
L	-	197	59.5	51.1	68.8
M	-	112	56.3	46.3	67.8
N	-	118	61.9	51.1	74.2
O	-	120	58.6	48.4	70.2
P	-	170	57.3	48.9	66.7
Q	-	109	62.0	50.9	74.9
R	-	138	47.4	39.8	56.0
S	-	119	58.0	48.0	69.5
T	-	97	44.5	36.0	54.3
U	-	98	49.4	40.1	60.3
V	-	174	56.2	48.1	65.3
W	-	208	62.2	54.0	71.3



Source: calculated by Public Health England: Risk Factors Intelligence (RFI) team from the Office for National Statistics (ONS) Annual Death Extract Public Health Mortality File and ONS Mid Year Population Estimates

Example question

Based on the bar chart given, which **single one** of the following areas has the **highest** alcohol-related mortality? Select **one** option only.

1. Area E
2. Area G
3. Area K
4. Area R
5. Area T

Answer 3. Area K

Positive predictive value (PPV)

In symptomatic disease, the PPV is the probability that the person has the disease if a particular symptom/risk marker is present.

PPV can also be used when describing screening results, where patients are asymptomatic. In this case it is the percentage or proportion of patients with a positive test who actually have the disease.

This chart depicts the PPV of individual risk markers and pairs of risk markers in the diagnosis of pancreatic cancer in patients aged over 60.

The top figure in each cell is the PPV when both features are present.

The two smaller figures represent the 95% confidence intervals for the PPV.

The jaundice/jaundice intersect is the positive predictive value for pancreatic cancer when a patient has attended at least twice with jaundice. The same is true for abdominal pain and back pain.

Back pain	New onset diabetes	Diarrhoea	Constipation	Malaise	Nausea or vomiting	Abdominal pain	Loss of weight	Jaundice	
0.1 (0.1, 0.1)	0.2 (0.2, 0.2)	0.2 (0.2, 0.2)	0.2 (0.2, 0.2)	0.2 (0.2, 0.3)	0.3 (0.3, 0.4)	0.3 (0.3, 0.4)	0.8 (0.7, 1.0)	21.6 (14.52)	PPV as a single symptom
0.2 (0.1, 0.2)	0.3 (0.2, 0.4)	0.2 (0.1, 0.3)	0.3 (0.2, 0.4)	0.3 (0.2, 0.6)	0.3 (0.2, 0.5)	0.4 (0.3, 0.5)	2.0 (1.0, 4.3)	8.9 –	Back pain
		0.4 (0.3, 0.5)	0.4 (0.3, 0.6)	0.5 (0.3, 0.9)	0.7 (0.5, 1.0)	0.9 (0.7, 1.1)	1.6 (1.0, 2.9)	22.3 –	New onset diabetes
			0.2 (0.1, 0.3)	0.3 (0.1, 0.5)	0.2 (0.2, 0.3)	0.4 (0.3, 0.5)	2.7 –	>10 –	Diarrhoea
				0.3 (0.2, 0.5)	0.6 (0.4, 0.8)	0.5 (0.4, 0.7)	1.5 (0.8, 3.0)	>10 –	Constipation
					0.5 (0.3, 0.8)	0.6 (0.4, 0.8)	0.9 (0.4, 2.1)	>10 –	Malaise
						0.9 (0.7, 1.2)	2.2 (1.1, 4.6)	14.6 –	Nausea or vomiting
						1.0 (0.8, 1.2)	2.5 (1.5, 4.4)	15.0 –	Abdominal pain
								>10 –	Loss of weight
								31.6 –	Jaundice

Example question

Using the information given, what is the PPV of having pancreatic cancer for a patient that has both diarrhoea and a new onset of diabetes?

Give your **numerical** answer as a percentage in the box below.

%

Answer 0.4

Understanding absolute and relative risk

Medicines & Healthcare products Regulatory Agency

MHRA

Table 2: Detailed summary of relative and absolute risks and benefits during current use from age of menopause and up to age 69, per 1000 women with 5 years or 10 years use of HRT

Risks associated with **combined estrogen–progestogen HRT**					
	Duration of HRT use (years)	Total cases per 1000 women with no HRT use* (RR= 1)	Total cases (range) per 1000 women using HRT†	**Extra cases per 1000 women using HRT**	Risk ratio (RR) (95% CI)‡
Cancer risks					
Breast cancer					
Overall combined HRT					
Current use from age 50	5	13	21	**+8**	1.62
	10	27	47	**+20**	1.74
Total risk from age 50 to 69 (HRT use + past use)	5	63	80	**+17**	1.27
	10	63	97	**+34**	1.54
Sequential HRT					
Current use from age 50	5	13	20	**+7**	1.54
	10	27	44	**+17**	1.63
Total risk from age 50 to 69 (HRT use + past use)	5	63	77	**+14**	1.22
	10	63	92	**+29**	1.46
Continuous combined HRT					
Current use from age 50	5	13	23	**+10**	1.77
	10	27	52	**+25**	1.93
Total risk to from age 50 to 69 (HRT use + past use)	5	63	83	**+20**	1.32
	10	63	103	**+40**	1.63
Endometrial Cancer					
age 50–59	5	2	2 (2–3)	NS	1·0 (0·8–1·2)[4]
	10	4	4 (4–5)	NS	1·1 (0·9–1·2)
age 60–69	5	3	3 (2–4)	NS	1·0 (0·8–1·2)[4]
	10	6	7 (5–7)	NS	1·1 (0·9–1·2)
Ovarian Cancer					
age 50–59	5	2	2 (2–3)	**+ <1**	1.1 (1.0–1.3)
	10	4	5 (4–6)	**+1**	1·3 (1·1–1·5)
age 60–69	5	3	3 (3–4)	**+ <1**	1.1 (1.0–1.3)
	10	6	8 (7–9)	**+2**	1·3 (1·1–1·5)
Cardiovascular risks					
Venous thromboembolism (VTE)§					
age 50–59	5	5	12 (10–15)	**+7**	2·3 (1·8–3·0)
age 60–69	5	8	18 (15–24)	**+10**	
Stroke					
age 50–59	5	4	5 (5–6)	**+1**	1.3 (1.1–1.4)
age 60–69	5	9	12 (10–13)	**+3**	
Coronary heart disease (CHD)					
age 50–59	5	9	12 (7–19)	NS	1·3 (0·8–2·1)
age 60–69	5	18	18 (13–25)	NS	1·0 (0·7–1·4)
age 70–79	5	29	44 (29–61)	**+15**	1·5 (1·0–2·1)
Benefits?					
Fracture of femur					
age 50–59	5	1.5	1 (0.8–1.5)	NS	0·7 (0·5–1.0)
age 60-69	5	5.5	4 (3-5.5)	NS	

This information from the MHRA details relative and absolute risks and benefits of HRT. Use this to answer the following example questions.

Example questions

1. A 55-year-old woman started combined HRT for menopause symptoms five years ago.

   Using the table above, what is her **absolute risk** of ovarian cancer?

   Type your numerical answer in the box below.

   [ ] %

2. Using the information in the table above, for women aged 50-59-years-old who have been using combined HRT for five years, how many **extra** cases of venous thromboembolism will be expected as a result of using combined HRT?

   Type your numerical answer in the box below.

   [ ] per 1000 women

3. A 65-year-old woman started combined HRT five years ago for menopause symptoms.

   Using the table above, what is the **risk ratio (relative risk)** of her developing a stroke?

   Type your numerical answer in the box below.

   [ ]

Please see the following pages for worked out answers.

You may find the video resources from Professor Harris helpful for understanding some of the terms used. They are available here from the RCGP https://www.rcgp.org.uk/mrcgp-exams/applied-knowledge-test/akt-preparing

Worked example of Question 1

Medicines & Healthcare products Regulatory Agency

MHRA

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Cancer risks					
Breast cancer					
Overall combined HRT					
Current use from age 50	5	13	21	**+8**	1.62
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Sequential HRT					
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Total risk to from age 50 to 69 (HRT use + past use)	5	63	83	**+20**	1.32
	10	63	103	**+40**	1.63
Endometrial Cancer					
age 50–59	5	2	2 (2–3)	NS	1·0 (0·8–1·2)[4]
	10	4	4 (4–5)	NS	1·1 (0·9–1·2)
age 60–69	5	3	3 (2–4)	NS	1·0 (0·8–1·2)[4]
	10	6	7 (5–7)	NS	1·1 (0·9–1·2)
Ovarian Cancer					
age 50–59	5	2	2 (2–3)	+ <1	1.1 (1.0–1.3)
	10	4	5 (4–6)	+1	1·3 (1·1–1·5)
age 60–69	5	3	3 (3–4)	+ <1	1.1 (1.0–1.3)
	10	6	8 (7–9)	+2	1·3 (1·1–1·5)
Cardiovascular risks					
Venous thromboembolism (VTE)§					
age 50–59	5	5	12 (10–15)	+7	2·3 (1·8–3·0)
age 60–69	5	8	18 (15–24)	+10	
Stroke					
age 50–59	5	4	5 (5–6)	+1	1.3 (1.1–1.4)
age 60–69	5	9	12 (10–13)	+3	
Coronary heart disease (CHD)					
age 50–59	5	9	12 (7–19)	NS	1·3 (0·8–2·1)
age 60–69	5	18	18 (13–25)	NS	1·0 (0·7–1·4)
age 70–79	5	29	44 (29–61)	+15	1·5 (1·0–2·1)
Benefits?					
Fracture of femur					
age 50–59	5	1.5	1 (0.8–1.5)	NS	0·7 (0·5–1.0)
age 60-69	5	5.5	4 (3-5.5)	NS	

The column indicates the absolute risk of each adverse event in women taking combined HRT.

Absolute risk = number of events/total number of people.

Worked example question 1

A 55-year-old woman started combined HRT for menopause symptoms five years ago.

Using the table above, what is her **absolute risk** of ovarian cancer ?

Answer: 2/1000 = 0.002 = 0.2%

Worked example of Question 2

Medicines & Healthcare products Regulatory Agency

MHRA

Table 2: Detailed summary of relative and absolute risks and benefits during current use from age of menopause and up to age 69, per 1000 women with 5 years or 10 years use of HRT

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Cancer risks					
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Overall combined HRT					
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Total risk from age 50 to 69 (HRT use + past use)	5	63	80	**+17**	1.27
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Sequential HRT					
Current use from age 50	5	13	20	**+7**	1.54
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	10	63	92	**+29**	1.46
Continuous combined HRT					
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Total risk to from age 50 to 69 (HRT use + past use)	5	63	83	**+20**	1.32
	10	63	103	**+40**	1.63
Endometrial Cancer					
age 50–59	5	2	2 (2–3)	NS	1·0 (0·8–1·2)[4]
	10	4	4 (4–5)	NS	1·1 (0·9–1·2)
age 60–69	5	3	3 (2–4)	NS	1·0 (0·8–1·2)[4]
	10	6	7 (5–7)	NS	1·1 (0·9–1·2)
Ovarian Cancer					
age 50–59	5	2	2 (2–3)	+ <1	1.1 (1.0–1.3)
	10	4	5 (4–6)	+1	1·3 (1·1–1·5)
age 60–69	5	3	3 (3–4)	+ <1	1.1 (1.0–1.3)
	10	6	8 (7–9)	+2	1·3 (1·1–1·5)
Cardiovascular risks					
Venous thromboembolism (VTE)§					
age 50–59	5	5	12 (10–15)	+7	2·3 (1·8–3·0)
age 60–69	5	8	18 (15–24)	+10	
Stroke					
age 50–59	5	4	5 (5–6)	+1	1.3 (1.1–1.4)
age 60–69	5	9	12 (10–13)	+3	
Coronary heart disease (CHD)					
age 50–59	5	9	12 (7–19)	NS	1·3 (0·8–2·1)
age 60–69	5	18	18 (13–25)	NS	1·0 (0·7–1·4)
age 70–79	5	29	44 (29–61)	+15	1·5 (1·0–2·1)
Benefits?					
Fracture of femur					
age 50–59	5	1.5	1 (0.8–1.5)	NS	0·7 (0·5–1.0)
age 60-69	5	5.5	4 (3-5.5)	NS	

This column indicates the additional cases per 1000 women taking combined HRT. This could also be expressed as the absolute risk increase.

Absolute risk increase (or decrease) = difference in absolute risk between each group and is expressed as a percentage or as a number between 0 and 1.

=12/1000 – 5/1000 = 7/1000

= 0.7% or 0.007

Worked example question 2

Using the information in the table above, for women aged 50-59-years-old who have been using combined HRT for five years, how many **extra** cases of venous thromboembolism will be expected as a result of using combined HRT?

Answer: **7 per 1000 women**

To express this as an absolute risk increase, the answer would be 7/1000 = 0.007 or 0.7% but the question asks only for the number of extra cases.

Worked example of Question 3

Medicines & Healthcare products Regulatory Agency

MHRA

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Breast cancer					
Overall combined HRT					
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Continuous combined HRT					
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Total risk to from age 50 to 69 (HRT use + past use)	5	63	83	**+20**	1.32
	10	63	103	**+40**	1.63
Endometrial Cancer					
age 50–59	5	2	2 (2–3)	NS	1·0 (0·8–1·2)[4]
	10	4	4 (4–5)	NS	1·1 (0·9–1·2)
age 60–69	5	3	3 (2–4)	NS	1·0 (0·8–1·2)[4]
	10	6	7 (5–7)	NS	1·1 (0·9–1·2)
Ovarian Cancer					
age 50–59	5	2	2 (2–3)	+ <1	1.1 (1.0–1.3)
	10	4	5 (4–6)	+1	1·3 (1·1–1·5)
age 60–69	5	3	3 (3–4)	+ <1	1.1 (1.0–1.3)
	10	6	8 (7–9)	+2	1·3 (1·1–1·5)
Cardiovascular risks					
Venous thromboembolism (VTE)§					
age 50–59	5	5	12 (10–15)	+7	2·3 (1·8–3·0)
age 60–69	5	8	18 (15–24)	+10	
Stroke					
age 50–59	5	4	5 (5–6)	+1	1.3 (1.1–1.4)
age 60–69	5	9	12 (10–13)	+3	
Coronary heart disease (CHD)					
age 50–59	5	9	12 (7–19)	NS	1·3 (0·8–2·1)
age 60–69	5	18	18 (13–25)	NS	1·0 (0·7–1·4)
age 70–79	5	29	44 (29–61)	+15	1·5 (1·0–2·1)
Benefits?					
Fracture of femur					
age 50–59	5	1.5	1 (0.8–1.5)	NS	0·7 (0·5–1.0)
age 60-69	5	5.5	4 (3-5.5)	NS	

This column indicates the risk ratio (or relative risk) for women taking combined HRT.

Risk ratio (relative risk) = Absolute risk in treatment group/Absolute risk in control group

From the table, the absolute risk of a 65-year-woman not on combined HRT having a stroke is 9/1000 = 0.009. The absolute risk of a 65-year-old woman on combined HRT having a stroke is 12/1000 = 0.012.

Risk ratio (relative risk) = 0.012/0.009 = 1.3

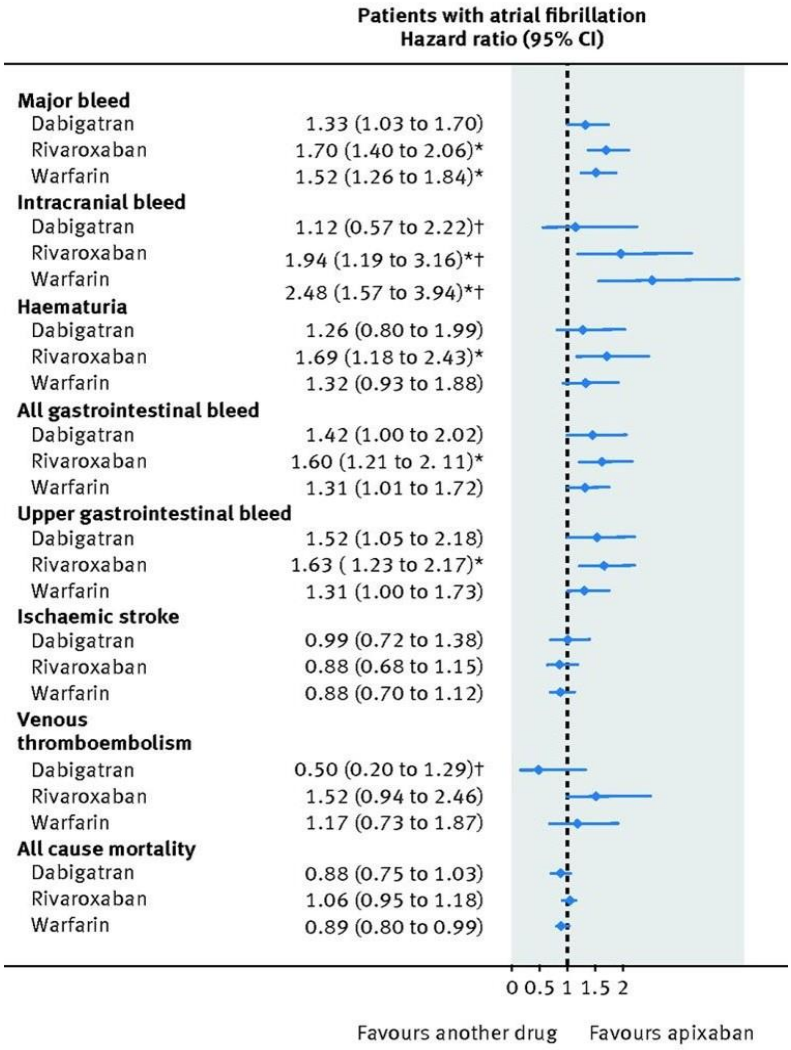
Worked example question 3

A 65-year-old woman started combined HRT five years ago for menopause symptoms.

Using the table above, what is the **risk ratio (relative risk)** of her developing a stroke as a result of taking combined HRT?

Answer: **1.3**

Journal graphics- forest plots



Risks and benefits of direct oral anticoagulants versus warfarin in a real world setting: cohort study in primary care
Source: *BMJ* 2018;362:k2505

TIP

Remember in a forest plot, if the 95% confidence interval includes the line of no effect (the central vertical line) then this illustrates a result which is not statistically significant with regard to the relevant comparison. *(Chris to check this)*

Example question

This forest plot compares the risk of adverse events in patients with atrial fibrillation (AF) taking dabigatran, rivaroxaban or warfarin with the risk in patients taking apixaban.

Based on the forest plot given, which is the **single best** conclusion that can be drawn about the risk of events in patients with AF? Select **one** option only.

A. The risk of all-cause mortality is significantly higher with dabigatran than apixaban
B. The risk of intracranial bleed is significantly higher with warfarin than apixaban
C. The risk of ischaemic stroke is significantly lower with dabigatran than apixaban
D. The risk of major bleed is significantly higher with apixaban than warfarin
E. The risk of upper gastrointestinal bleed is higher with rivaroxaban than apixaban, but it is statistically insignificant

Answer B. The risk of intracranial bleed is significantly higher with warfarin than apixaban

Make sure you know what the lines and symbols on a forest plot signify.

For an explanation of hazard ratio see the video

Explaining risks to patients-infographics

This is an infographic way of displaying risks associated with HRT, intended as a decision aid for patients.

Consider how you would have a conversation with a patient, informed by this infographic, about the risk of breast cancer when taking HRT, in comparison with the risk associated with various lifestyle factors.

For example, what could you tell a patient about the extra risk of breast cancer in;

Women who are current smokers

Women who are overweight/obese

Women who undertake at least 2.5 hours moderate exercise weekly

Tip

Think about changes in both absolute and relative risks and how you would explain these to a patient.

Numbers needed to treat/harm

The **number needed to treat (NNT)** is the number of patients that would need to be treated for a defined period in order to prevent one unwanted outcome (e.g. death). The NNT is calculated as the reciprocal of the absolute risk reduction (1 divided by ARR).

(See video)

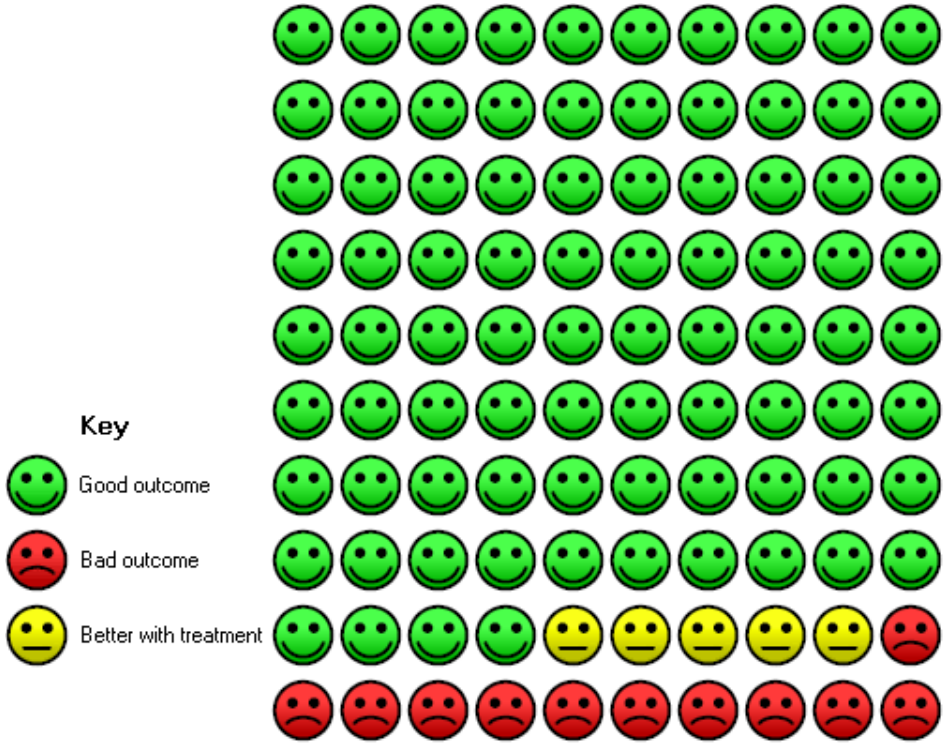
The NNT can give an indication of the effectiveness of a treatment – something that gives a large reduction in a bad/unwanted outcome will have a small NNT (i.e. fewer patients need to be treated to demonstrate benefit).

A **number needed to harm (NNH)** is the number of patients who must be treated before one has a bad/unwanted outcome. It can be calculated in the same way as a number needed to treat (i.e. 1 divided by the absolute risk increase (ARI). This gives information on the likelihood of unwanted effects.

Ideally, a treatment would have a small NNT (a benefit is expected frequently) and a large NNH (i.e. many patients would need to take the treatment before one was harmed by it, such that harm is expected infrequently).

Antibiotic prescribing and NNT

This is a Cates plot of pain at 2-3 days in children given antibiotics versus placebo for acute otitis media.



The 84 green faces are children who would have been free from pain at 2 to 3 days even if they had not received an antibiotic.

The 11 red faces are children who are still in pain even with antibiotics.

The 5 yellow faces are the children who show a benefit; they would have been in pain without the antibiotic but are not when they receive one.

In this example, for every 100 children given the antibiotic, 5 will benefit who would not have improved without an antibiotic.

Example question

In the Cates plot given, what is the **number needed to treat** to prevent one bad outcome?

Enter your **numerical** answer in the box below.

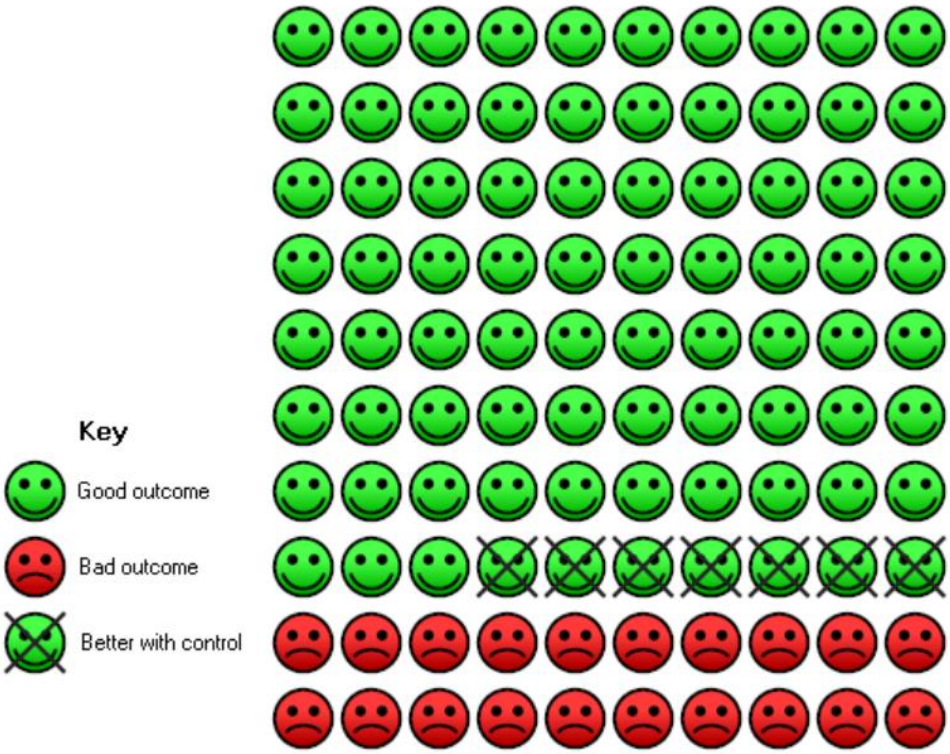
Answer:20

Absolute risk reduction (ARR) = 5/100 = 0.05 or 5%

Number needed to treat (NNT) = 1/ARR = 1/0.05 = 20

Antibiotic-related adverse effects (NNH)

This is a Cates plot of diarrhoea, vomiting or rash in a study of children given antibiotics versus control (placebo) for acute otitis media.



For every 100 children treated with antibiotics, 27 would develop a bad outcome - diarrhoea, vomiting or rash.

For every 100 children treated with placebo (control), or not receiving antibiotics, 20 would develop a bad outcome - diarrhoea, vomiting or rash.

Example Question

In the Cates plot given, what is the number needed to cause a harmful outcome in one child (**number needed to harm**)?

Give your **numerical** answer in the box below.

Answer:14

Absolute risk increase (ARI) = 7/100 = 0.07 or 7%

NNH = 1/ARI = 1/0.07 = 14

So the number needed to cause a harmful outcome in one child is 14.